REPUBLIKA E SHQIPËRISË
MINISTRIA E TURIZMIT DHE MJEDISIT

DRAFT

National Inventory Document (NID) 2024 of Albania

submission under the United Nations Framework Convention on Climate Change (UNFCCC) and Paris Agreement

DRAFT

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1.1 Background information on greenhouse gas (GHG) inventory and climate change

1.1.1 Global Warming

According to the Fifth assessment report of the IPCC (AR5) and stated in the IPCC special report *Global Warming of 1.5 °C* (SR1.5)[1] human activities are estimated to have caused approximately 1.0°C of global warming above pre-industrial levels, with a likely range of 0.8°C to 1.2°C. Global warming is likely to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate.

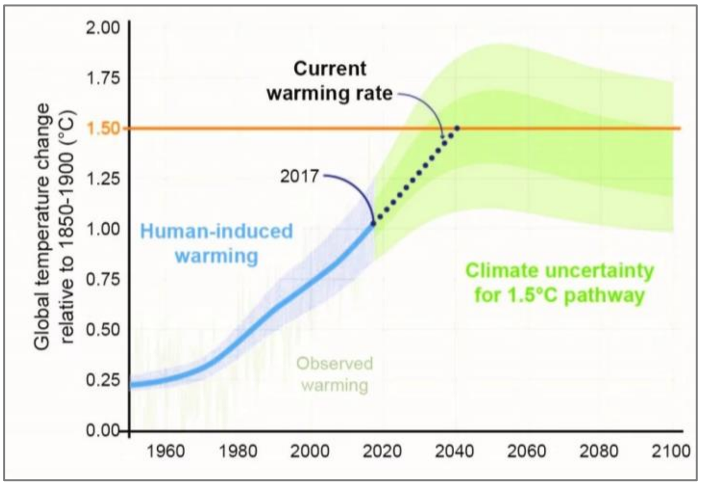


Figure 1-1 Human-induced warming reached approximately 1°C above pre-industrial levels in 2018.

Source: IPCC (2018): IPCC special report *Global Warming of 1.5 °C* (SR1.5).

As summarized in IPCC special report *Global Warming of 1.5 °C* (SR1.5) the increase of the average surface temperature of the earth will lead to

- differences in regional climate characteristics with
  - changes in climate and weather extremes, temperature extremes on land,
  - risks from droughts and precipitation deficits,
  - global mean sea level rise;
- impacts on biodiversity and ecosystems including species loss and extinction;
- increase in ocean temperature with associated increase in ocean acidity and decreases in ocean oxygen levels;
- climate-related risks to health, livelihoods, food security, water supply, human security, and economic growth;
- needs for adaptation which also includes limited adaptive capacity for some human and natural systems.

[1] Available (25 May 2019) on https://www.ipcc.ch/sr15/

According to Sixth assessment report of the IPCC (AR6) global warming, reaching 1.5°C in the near-term (2021–2040), would cause unavoidable increases in multiple climate hazards and present multiple risks to ecosystems and humans (very high confidence). The level of risk will depend on concurrent nearterm trends in vulnerability, exposure, level of socioeconomic development and adaptation (high confidence). Near-term actions that limit global warming to close to 1.5°C would substantially reduce projected losses and damages related to climate change in human systems and ecosystems, compared to higher warming levels, but cannot eliminate them all (very high confidence)

Albania is particularly exposed and vulnerable to climate hazards, such as droughts, floods, forest fires, and heatwaves. Climate projections show that these climate extremes will increase in frequency and magnitude in the future:

- The **water sector** shows a reduction in the water balance in all river basins in Albania. The decrease in rainfall and snowfall will drastically affect surface water availability.
- The **forestry sector** is affected by climate change not only in the current developmental processes and growth, but often results in cumulative effects that can last for the lifetime of the tree. The greatest risk is to forests located in the coastal and central regions, where high air temperatures during the summer period and the typical vegetation create the necessary preconditions for forest fires to start.
- The **agricultural sector** is highly vulnerable to climate change due to its dependence on specific temperature conditions and water availability, and it is also exposed to climate hazards such as droughts or floods. A large part of the agricultural areas in Albania are located in lowlands, which makes them particularly prone to regular floods.
- The **fishing sector** is highly affected by an increase in the temperature of sea water which favours the distribution, spread, abundance, and impact of invasive species.
- Good **public health** depends on safe drinking water, sufficient food, secure shelter, and good social conditions, which may all be affected by a changing climate – and are particularly important in the context of economies in transition, such as Albania’s. It is important to consider that climate change could affect the capacity of health services to deal with emergencies.

1.1.2 Convention, Kyoto Protocol and Paris Agreement

Albania became a Party to the UN Framework Convention on Climate Change (UNFCCC) as Non-Annex I Party in October 1994, accede the Kyoto Protocol also on 1 April 2005 and ratified the Paris Agreement on 21 Sepember 2016. In the following paragraphs the key massages of the convention and Kyoto Protocol and Paris agreement are presented as on the website of UNFCCC.

- The **UN Framework Convention on Climate Change** (UNFCCC) is a "Rio Convention", one of three adopted at the "Rio Earth Summit" in 1992. Its sister Rio Conventions are the UN Convention on Biological Diversity and the Convention to Combat Desertification. Preventing "dangerous" human interference with the climate system is the ultimate aim of the UNFCCC.
- The **Kyoto Protocol** (KP) is an international agreement linked to the United Nations Framework Convention on Climate Change, which commits its Parties by setting internationally binding emission reduction targets. Recognizing that developed countries are principally responsible for the current high levels of GHG emissions in the atmosphere as a result of more than 150 years of industrial activity, the Protocol places a heavier burden on developed nations under the principle of "common but differentiated responsibilities.[2]
- The **Paris Agreement** (PA) builds upon the Convention and for the first time brings all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects, with enhanced support to assist developing countries to do so. As such, it charts a new course in the global climate effort:[3]
    - The Paris Agreement is a legally binding international treaty on climate change.
    - Its goal is to limit global warming to well below 2, preferably to 1.5 degrees Celsius, compared to pre-industrial levels.
    - To achieve this long-term temperature goal, countries aim to reach global peaking of greenhouse gas emissions as soon as possible to achieve a climate neutral world by mid-century.

  Article 13 is related to transparency.

In the following tables are presented the Convention, Kyoto Protocol and Paris Agreement with the dates of entry into force and the current status as well as the Albanian submissions – reports and data sets –.

Table 1-1 Status of signature and ratification by Albania of the UNFCCC, Kyoto Protocol and Paris Agreement

	Entry into force	Status (07/2024)	Albania	
			Signature	Ratification
United Nations Framework Convention on Climate Change (UNFCCC) [4]	21 March 1994	198 Parties		3 Oct 1994 a
Kyoto Protocol *to the UNFCCC*[5] (First commitment period 2008-2012)	16 February 2005	192 Parties		1 Apr 2005 a
Doha Amendment[6] *to the Kyoto Protocol* (Second commitment period 2013-2020)		130 Parties		31 Mar 2017 A
Copenhagen Accord[7]			agreeing to the Accord[8]	
Paris Agreement *to the UNFCCC*[9]	4 November 2016	195 Parties	22 Apr 2016	21 Sep 2016

Remark: Ratification, Acceptance(A), Accession(a), Approval(AA), Succession(d)

[2] Link to and Text of the Kyoto Protocol; available (19 July 2024) on https://unfccc.int/process/the-kyoto-protocol/status-of-ratification

[3] Link to and Text of the Paris Agreement; available (19 July 2024) on https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement.

[4] Link to and Text of the United Nations Framework Convention on Climate Change; available (19 July 2024) on https://unfccc.int/process/the-convention/what-is-the-convention/status-of-ratification-of-the-convention

[5] Link to and Text of the Kyoto Protocol; available (19 July 2024) on https://unfccc.int/process/the-kyoto-protocol/status-of-ratification

[6] Link and Text of the Doha amendment; available (19 July 2024) on https://unfccc.int/files/kyoto_protocol/application/pdf/kp_doha_amendment_english.pdf

[7] Link to and text of the Copenhagen Accord: FCCC/CP/2009/11/Add.1, 2/CP.15; available (19 July 2024) on https://unfccc.int/resource/docs/2009/cop15/eng/11a01.pdf

[8] https://unfccc.int/process/conferences/pastconferences/copenhagen-climate-change-conference-december-2009/statements-and-resources/information-provided-by-parties-to-the-convention-relating-to-the-copenhagen-accord

[9] Link to and Text of the Paris Agreement; available (19 July 2024) on https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement. https://unfccc.int/process/the-paris-agreement/status-of-ratification

Table 1-2 Status of Albania's submission of the National Communication (NC), Biennial Update Report (BUR) and Nationally Determined Contribution (NDC)

UNFCCC Reporting obligation	National Communication (NC)	Biennial Update Report (BUR)	Biennial transparency report (BTR)	National Inventory Report (NID) / National Inventory Document (NID)	GHG inventory as part of NC and BUR/BTR *Time series based on*		
					1996 revised IPCC GL & IPCC GPG	2006 IPCC Guidelines	2019 Refinements to the 2006 IPCC GL
NC1 = INC	13 Sep 2002[10]				1990-1994		
NC2	23 Nov 2009[11]				1990–2000		
NC3	13 Oct 2016[12]				2000 - 2009		
NC4	3 Nov 2022[13]					2009-2019	
1st BUR		12 Oct 2021[14]		12 Oct 2021[15]		2009-2016	
1st BTR			Planned for 2025	31 Dec 2024[16] (draft)		1990-2022	

UNFCCC Reporting obligation	Intended Nationally Determined Contribution (INDC) / Nationally Determined Contribution (NDC)
INDC	September 2015[17]
NDC	Entered into force 2016
Updated NDC	12 Oct 2021[18]

The Convention divides countries into three main groups according to differing commitments:

Annex I Parties — The industrialized countries that were members of the OECD (Organization for Economic Co-operation and Development) in 1992 and listed in Annex I to the Convention. They include the 24 original OECD members, the European Union, and 14 countries with economies in transition (EIT).

Annex II Parties — Consist of the OECD members of Annex I, but not the EIT Parties.

Non-Annex I Parties — Refers to countries that have ratified or acceded to the United Nations Framework Convention on Climate Change that are not included in Annex I of the Convention.

1.2 A description of national circumstances and institutional arrangements

As a Party to the Convention and according to the Guidelines for the preparation of national communications from Parties not included in Annex I to the Convention, section III[19], non-Annex I Parties

Para 6. shall, in accordance with Article 4, paragraph 1 (a), and Article 12, paragraph 1(a) of the Convention, communicate to the Conference of the Parties a national inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases (GHGs) not controlled by the Montreal Protocol, to the extent its capacities permit, following the provisions in these guidelines.

Para 7. shall estimate national GHG inventories for the year 1994 for the initial national communication (INC) or

[10] available (19 July 2024) on https://unfccc.int/documents/17704
[11] available (19 July 2024) on https://unfccc.int/documents/67378
[12] available (19 July 2024) on https://unfccc.int/documents/67380
[13] available (19 July 2024) on https://unfccc.int/documents/620929
[14] available (19 July 2024) on https://unfccc.int/documents/307387
[15] available (19 July 2024) on https://unfccc.int/documents/307388
[16] available (19 July 2024) on https://unfccc.int/first-biennial-transparency-reports
[17] available (19 July 2024) on https://unfccc.int/sites/default/files/NDC/2022-06/Albania%20First.pdf
[18] available (19 July 2024) on https://unfccc.int/sites/default/files/2022-08/Albania%20Revised%20NDC.pdf
[19] available (19 July 2024) on FCCC/CP/2002/7/Add.2, section III., paragraph 6.

alternatively may provide data for the year 1990. For the second national communication (SNC), non-Annex I Parties shall estimate national GHG inventories for the year 2000. The least developed country Parties could estimate their national GHG inventories for years at their discretion.

Therefore, Albania is required to produce regularly a National Greenhouse Gas Inventory; see here table above.

A National Inventory Document (NID) containing detailed and complete information on the inventory, in order to ensure the transparency of the inventory, the two relevant Guidelines provide the following guidance:

- 'Modalities, procedures and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement'[20]
- Guidance for operationalizing the modalities, procedures and guidelines for the enhanced transparency framework referred to in Article 13 of the Paris Agreement[21]
- which is in place from 2024 onwards:
    - Application of 2006 IPCC Guidelines for National Greenhouse Gas Inventories and 2019 Refinement to the 2006 IPCC Guidelines.

1.2.1 National entity or national focal point

In the following figure the MRV framework for the GHG inventory of Albania is illustrated. In the following (sub-)chapters below a description of the various roles and responsibilities is provided.

According to the ### the ### is the Single National Entity (SNE) responsible for the preparation of emission inventories. EPA has the overall responsibility and submits the inventory report to

- the United Nations Framework Convention on Climate Change (UNFCCC), and
- the UNECE[22] Convention on Long-range Transboundary Air Pollution (CLRTAP).

The institutional arrangements for the inventory system currently used in Albania are presented in following figure.

Figure 1-2 National Inventory system of Albania

Within the NEPA, experts from different departments are contributing, whereby experts from the Sector for nature protection, monitoring, analysis and reporting are compiling and reporting the inventory. Data needed for the preparation of the inventory are provided by either

- Industrial operators,
- Statistical office (INSTAT),
- NEPA ####.

[20] Decision 18/CMA.1, FCCC/PA/CMA/2018/3/Add.2. Available (8 January 2020) on https://unfccc.int/sites/default/files/resource/CMA2018_03a02E.pdf

[21] Decision 5/CMA.3 FCCC/PA/CMA/2021/10/Add.2. Available (20 September 2022) on https://unfccc.int/documents/460951

[22] United Nations, Economic Commission for Europe (UNECE)

The other ministries/institutions mentioned above are delivering the data on voluntary basis and upon requirements. The plant operators are reporting the data due to their obligation under European Pollutant Release and Transfer Register (PRTR) and national sub legislation under the Law on air protection.

In the following figure the *draft* MRV framework for the GHG and Air pollution emission inventory of Albania is illustrated. In the following (sub-)chapters below a description of the various roles and responsibilities are provided.

Figure 1-3 National system - detailed

Emissions shall be estimated by *sector experts* for

(a) all sectors of the Air pollutants inventory according to the 2006 IPCC guidelines and the EMEP/EEA Air pollutant Emission Inventory Guidebook 2023

- IPCC/NFR sector 1 Energy
- IPCC/NFR sector 2 Industrial Processes and Product Use (IPPU)
- IPCC/NFR sector 3 Agriculture
- CRT sector 4 Land Use, Land use Change and Forestry (LULUCF)
- IPCC/NFR sector 5 Waste
- IPCC/NFR sector 6 Other

The CRT sector AFOLU – Agriculture, Forestry and Other Land Use - is divided into two 'sectors' but with close linkage.

(b) all seven gases of the GHG inventory according to the 2006 IPCC guidelines

- carbon dioxide (CO_2)
- methane (CH_4),
- nitrous oxide (N_2O),
- hydrofluorocarbons (HFCs),
- perfluorocarbons (PFCs),
- sulphur hexafluoride (SF_6), and
- nitrogen trifluoride (NF_3).

(c) Emissions carbon monoxide (CO), nitrogen oxides (NOx), non-methane volatile organic compounds (NMVOCs), and sulphur oxides (SOx) are estimated in the air pollutants inventory according to the EMEP/EEA Air pollutant Emission Inventory Guidebook 2023 and are submitted under UNECE Convention on Long-range Transboundary Air Pollution (CLRTAP).

Table 1-3 Overview on reporting obligation

Greenhouse gases (GHG) and Air pollutants emission inventory	GHG							Air pollutants																					
								Main pollutants					Particulate matter (PM)				Persistent organic pollutants (POPs)				Heavy Metals (HMs)								
				F-gases				Precursors													Priority HMs			Additional HMs					
	CO_2	N_2O	CH_4	SF_6	HFC	PFC	NF_3	SO_x	NOx	NMVOC	CO	NH_3	TSP	PM_{10}	$PM_{2.5}$	BC	PCDD/ PCDF	HCB	PAH	PCB	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
IPCC / NFR Sectors																													
1. Energy																													
2. Industrial processes and product use (IPPU)																													
AFOLU 3. Agriculture																													
4. LULUCF																													
5. Waste																													
6. Other																													
Reporting obligtion																													
UNFCCC - Greenhouse gas (GHG) inventory under the Convention, the Kyoto protocol and under the Paris Agreement																													
Data – CRF/CRT or Non-Annex I Tables																													
National Inventory report (NID)/document (NID)																													
EU Greenhouse gas Monitoring Mechanism Regulation (MMR) and EU Governance Regulation of the Energy Union and Climate Action*																													
Data – CRF/CRT																													
National Inventory report (NID)/document (NID)																													
UNECE / LRTAP - Air pollution emissions inventory																													
Data - NFR tables																													
Informative Inventory Report (IIR)																													
EU National Emission Ceilings Directive*																													
Data - NFR tables																													
Informative Inventory Report (IIR)																													
POPs under the Stockholm Convention																													
National reports																													
Voluntary obligation																													
Climate and Clean Air Coalition**																													
Short-lived climate pollutants (SLCPs)***																													
Batumi Action for Cleaner Air (BACA) */****																													
Batumi Action for Cleaner Air (BACA)																													

Remark: polycyclic aromatic hydrocarbons (PAHs) reported as {benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene,Total 1-4}

* currently not relevant to Albania

** https://www.ccacoalition.org/en

*** https://www.ccacoalition.org/en/partners/herceg-novi-Albania

**** https://unece.org/baca

Remark

- According to Decision 17/CP.8 - Guidelines for the preparation of national communications from Parties not included in Annex I to the Convention Non-Annex I Parties are encouraged to provide information relating to HFCs, PFCs, SF6.
- According to Modalities, procedures and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement: para 48. Each Party shall report seven gases (CO_2, CH_4, N_2O, HFCs, PFCs, SF6 and NF3); those developing country Parties that need flexibility in the light of their capacities with respect to this provision have the flexibility to instead report at least three gases (CO_2, CH_4 and N_2O) as well as any of the additional four gases (HFCs, PFCs, SF6 and NF3) that are included in the Party's NDC under Article 4 of the Paris Agreement, are covered by an activity under Article 6 of the Paris Agreement, or have been previously reported. (https://unfccc.int/sites/default/files/resource/cp24_auv_transparency.pdf)

1.2.2 Inventory preparation process

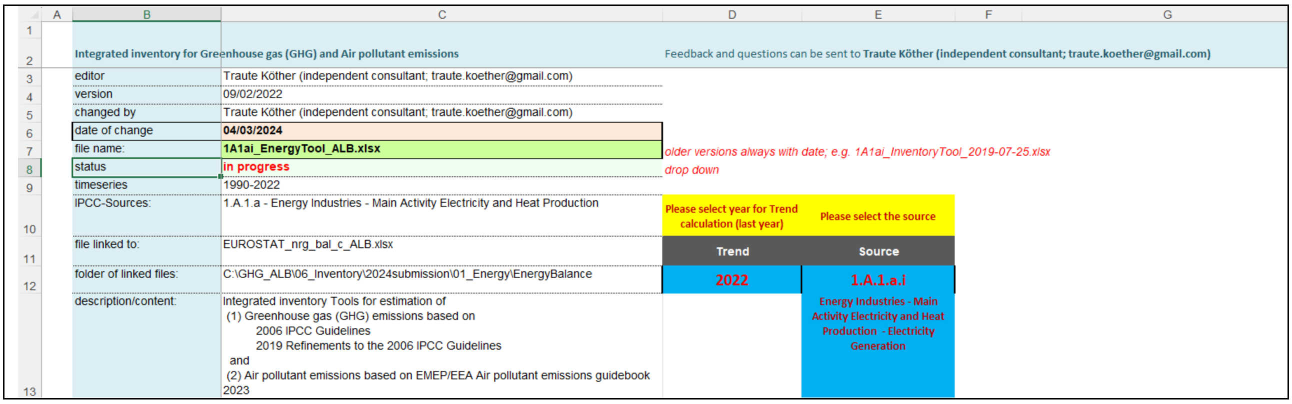
The current National GHG Inventory and National Inventory Report (NID) of Albania for the period 1990 – 2022 was compiled according to the recommendations for inventories set out in the 'Modalities, procedures and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement'[23] which is in place from 2024 onwards:

- Application of 2006 IPCC Guidelines for National Greenhouse Gas Inventories;
- Preparation of the NID according to the principles listed in section B. Guiding principles para 3:
  - (a) Building on and enhancing the transparency arrangements under the Convention, recognizing the special circumstances of the least developed countries (LDCs) and small island developing States (SIDS), and implementing the transparency framework in a facilitative, non-intrusive, non-punitive manner, respecting national sovereignty and avoiding placing undue burden on Parties;
  - (b) The importance of facilitating improved reporting and transparency over time;
  - (c) Providing flexibility to those developing country Parties that need it in the light of their capacities;
  - (d) Promoting transparency, accuracy, completeness, consistency and comparability;
  - (e) Avoiding duplication of work and undue burden on Parties and the secretariat;
  - (f) Ensuring that Parties maintain at least the frequency and quality of reporting in accordance with their respective obligations under the Convention;
  - (g) Ensuring that double counting is avoided;
  - (h) Ensuring environmental integrity.

1.2.3 Archiving of information

1.2.3.1 Documentation

For each category the documentation of the methodology and actual emission calculation is provided in the calculation tool (e.g. 1A1a_ElectricityTool_ALB.xlsx).



[23] Available (8 January 2020) on FCCC/PA/CMA/2018/3/Add.2 (18/CMA.1) https://unfccc.int/sites/default/files/resource/CMA2018_03a02E.pdf

	Sheet name	Content	Content description	Susanne2018	IPCC	Other remarks
13	Sheet name	Content	Content description	Susanne2018	IPCC	Other remarks
14				Password		
15	ChangeLog	Information regarding updating / modification / changes	*Information*	*unprotected worksheet*		
16	1A1ai_IncentoryCylce	ToDo list linked to InventoryCycle.xlsx	*Information*	*unprotected worksheet*	1.A.1.a.i	
17	1A1ai_QC Checklist	QC TIER 1 & 2 CHECKLIST according to IPCC 2006 Guidelines, Chapter 6 linked to QC_TIER-1-2_Checklist.xlsx	*Information*	*unprotected worksheet*	1.A.1.a.i	
18	1A1ai_ChoiceMethology	Choice of Methology	*Information*	*unprotected worksheet*	1.A.1.a.i	
19	1A1ai_Completness & KeyCategory	Completness evaluation & KeyCategory linked to CompletnessEvaluation_KeyCategory.xlsx	*Information*	*unprotected worksheet*	1.A.1.a.i	
20	1A1ai_PlannedImprovements	Information related to Planned Improvements for transfer to NIR sectoral chapter for transfer to NIR chapter Recalculation & Planned improvements for transfer to IIR sectoral chapter for transfer to IIR chapter Recalculation & Planned improvements linked to PlannedImprovements.xlsx	*Information*	*unprotected worksheet*	1.A.1.a.i	
21	1A1ai_Recalculation	Information related to Recalculation for transfer to NIR sectoral chapter for transfer to NIR chapter Recalculation & Planned improvements for transfer to IIR sectoral chapter for transfer to IIR chapter Recalculation & Planned improvements linked to Reclaculation.xlsx	Recalculation	*unprotected worksheet*	1.A.1.a.i	
22	1A1ai_Uncertainty	Information related to Uncertainty for transfer to NIR sectoral chapter for transfer to NIR chapter Uncertainty for transfer to IIR sectoral chapter for transfer to IIR chapter Uncertainty linked to Uncertainty.xlsx	*Information*	*unprotected worksheet*	1.A.1.a.i	
23	1A1ai_NIR_tables_&_gr	Tables & graphs für NIR	*result*	*unprotected worksheet but occasional*	1.A.1.a.i	
24	1A1ai_IIR_tables_&_gra	Tables & graphs für IIR	*result*	*unprotected worksheet but occasional*	1.A.1.a.i	
25	1A1ai_CRT	**GHG** emissions (automatised) for CRT reporting for transfer to **CRT - Common ReportingTables**	*(intermediate)* ***result***	*protected worksheet*	1.A.1.a.i	CRT - Common Reporting Tables
26	1A1ai_NFR	**Air Pollutants** emissions (automatised) for NFR for transfer to **NFR - Tables**	*(intermediate)* ***result***	*protected worksheet*	1.A.1.a.i	Nomenclature Format for Reporting (NFR) table
27	**1A1ai_AD_Liquid**	**Calculation of emissions by liquid fuel and GHG / Pollutants**	***Input data***	*unprotected worksheet but occasional protected cells*	1.A.1.a.i	
28	**1A1ai_AD_Solid**	**Calculation of emissions by solid fuel and GHG / Pollutants**	***Input data***	*unprotected worksheet but occasional protected cells*	1.A.1.a.i	
29	**1A1ai_AD_Gas**	**Calculation of emissions by gaseous fuel and GHG / Pollutants**	***Input data***	*unprotected worksheet but occasional protected cells*	1.A.1.a.i	
30	**1A1ai_AD_Other-Fossil**	**Calculation of emissions by other fossil fuel and GHG / Pollutants**	***Input data***	*unprotected worksheet but occasional protected cells*	1.A.1.a.i	
31	**1A1ai_AD_Peat**	**Calculation of emissions by peat (fuel) and GHG / Pollutants**	***Input data***	*unprotected worksheet but occasional protected cells*	1.A.1.a.i	
32	**1A1ai_AD_Biomass**	**Calculation of emissions by biomass (fuel) and GHG / Pollutants**	***Input data***	*unprotected worksheet but occasional protected cells*	1.A.1.a.i	
33	EF IPCC	Emission factors of 2006 IPCC GL for sector 1 A	*Emission factors*	*protected worksheet*	1.A	
34	EF EMEP-EEA 1A1	Emission factors of 2019 EMEP/EEA GB for sector 1.A.1	*Emission factors*	*protected worksheet*	1.A.1	
35	NCV_Default_2006_IPCC	TABLE 1.2 DEFAULT NET CALORIFIC VALUES (NCVs) AND LOWER AND UPPER LIMITS OF THE 95% CONFIDENCE INTERVALS	*Parameter*	*protected worksheet*	1.A	
36	Metric GWP	Global warming potential	*Information*	*unprotected worksheet*		
37	ExcelSuport	Excel support regarding used formulars	*Information*	*unprotected worksheet*		
38	Matrix_EBxCRF	Correspondance of activities of Energy Balance (IEA/EUROSTAT Questionnaire) and CRF sub categories	*Information*	*unprotected worksheet*		
39	DropDown&Definition	List for DropDown and Definitions of sectors and fuels	*Information*	*protected worksheet*		

Figure 1-4 Documentation of the methodology and actual emission calculation

1.2.3.2 Expert judgements

The documentation of expert judgements in line with the IPCC 2006 Guidelines should include:

- Name of the expert and institution/department,
- Date,
- Basis of judgement (references to relevant studies etc.),
- Underlying assumptions

1.2.3.3 Archiving

Archiving should take place on a central server within the folder ‘GHG inventory’ and relevant subfolders. The proposed structure of the ‘GHG inventory’ is provided in the next Figure. Relevant literature has to be archived and references to be stated in the internal documentation as well as in the NID.

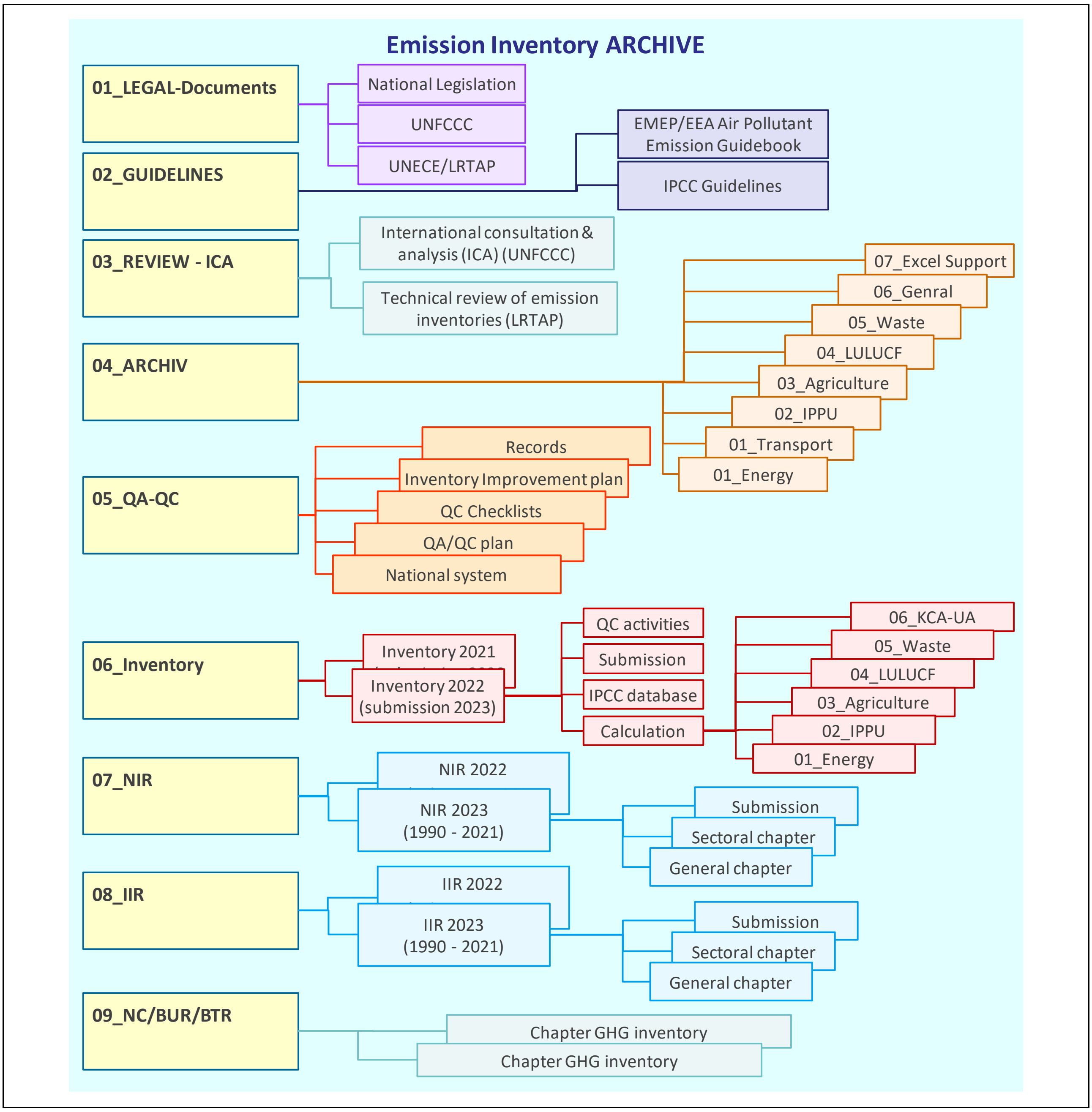


Figure 1-5 Emission Inventory Archive

1.2.4 Processes for official consideration and approval of inventory

Figure 1-6 National MRV system

Source: ####

1.3 Brief general description of methodologies and data sources used

The main sources for activity data are national statistics from INSTAT and international statistics like Eurostat, UNSD and FAO. In order to fill gaps expert judgement based on discussion with relevant national experts is applied.

The main sources for emission factors of GHG are the 2006 IPCC Guidelines and 2019 Refinements to the

2006 IPCC Guidelines. For the emission factors of air pollutants, the EMEP/EEA air pollutant emission inventory guidebook 2023 is used.

For key categories, the most accurate methods for the preparation of the greenhouse gas inventory should be used. Due to lack of data and resources, it was not possible to estimate for all emissions according to the sectoral decision trees. Where the methodological choice is not in line with the sectoral decision tree, actions are defined and listed in the inventory improvement plan.

The following table briefly presents the activity data (AD) sources, the types of emission factors (EF) used, and the methods applied for estimating GHG emissions reported in this NID. Detailed information on applied methodology, used activity data (AD) and emission factors (EF) are presented in the relevant sectoral chapters.

The preparation of the inventory starts always with identification of the key categories of the previous inventory followed by the selection of the appropriate identify the appropriate method for estimation for each category according to the **decision tree** of each source presented in Volume 2 – 5 of the 2006 IPCC guidelines. In the following Figure the general Decision Tree to choose a **Good Practice method** is presented.

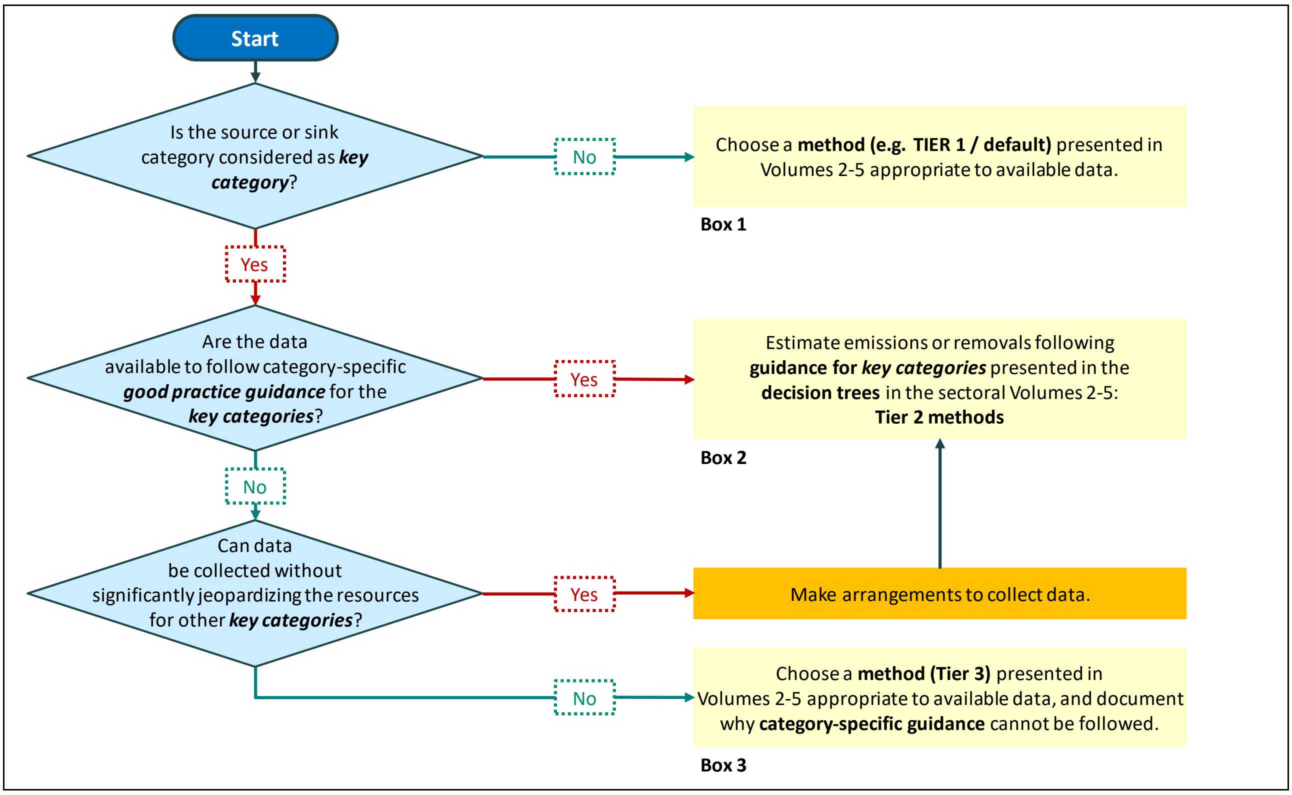


Figure 1-7 Decision Tree to choose a Good Practice method

Source: 2006 IPCC guidelines, Vol. 1: General Guidance and Reporting, Chap. 1: Introduction to the 2006 Guidelines, sub-chap. 4.1.2 Purpose of the key category analysis, Figure 4.1, p. 4.6.

In the following table, an overview is provided for

- Notation keys (in general)
- Notation keys to specify the method applied
- Notation keys to specify the emission factor used
- Notation keys to specify the activity data used

Table 1-4 Notation keys used to specify the method applied, emission factor used report and activity data used

Notation keys to specify completness		Notation keys to specify the method applied			
NA	Not applicable	**D**	IPCC default	**CS**	Country Specific
NO	Not occurring	**T1**	IPCC Tier 1	**CR**	CORINAIR
NE	Not estimated	**T1a, T1b, T1c**	IPCC Tier 1a, Tier 1b and Tier 1c, respectively	**RA**	Reference Approach
IE	Included elsewhere	**T2**	IPCC Tier 2	**OTH**	Other
C	Confidential	**T3**	IPCC Tier 3	**M**	Model

Notation keys to specify the emission factor used		Notation keys to specify the activity data used			
D	IPCC default	**Q**	Specific Questionnaire	**PS**	Plant specific
CS	Country specific	**INSTAT**	Statistical Office of Albania	**EJ**	Expert Judgement
PS	Plant specific	**UNSD**	United Nations Statistics Division (UNSD)		
OTH	Other	**FAO**	FAO Statistics Division (FAOSTAT)		
M	Model				

Table 1-5 Summary report for methods and emission factors used and source of activity data in CRT sector 1 Energy

CRT sector	CO2			CH4			N2O		
1 Energy	Method aplied	Emission factor (EF)	Activity data	Method aplied	Emission factor (EF)	Activity data	Method aplied	Emission factor (EF)	Activity data
1.A Fuel combustion									
1.A.1 Energy industries									
1.A.1.a Public electricity and heat production	T1/T2	D/CS	INSTAT	T1	D	INSTAT	T1	D	MEM/UNSD
1.A.1.b Petroleum refining	NA	NA	NO	NA	NA	NO	NA	NA	NO
1.A.1.c Manufacture solid fuels Other energy industries	NA	NA	NA	NA	NA	NE	NA	NA	NA
1.A.2 Manufacturing industries Construction									
1.A.2.a Iron and steel	T1	D	INSTAT	T1	D	INSTAT	T1	D	INSTAT
1.A.2.b Non-ferrous metals	T1	D	INSTAT	T1	D	INSTAT	T1	D	INSTAT
1.A.2.c Chemicals	T1	D	INSTAT	T1	D	INSTAT	T1	D	INSTAT
1.A.2.d Pulp paper and print	T1	D	INSTAT	T1	D	INSTAT	T1	D	INSTAT
1.A.2.e Food processing beverages and tobacco	T1	D	INSTAT	T1	D	INSTAT	T1	D	INSTAT
1.A.2.f Non-metallic minerals	T1	D	INSTAT	T1	D	INSTAT	T1	D	INSTAT
1.A.2.g Manufacturing machinery	NA	NA	NO	NA	NA	NO	NA	NA	NO
1.A.2.h Manufacturing transport equipment	NA	NA	NO	NA	NA	NO	NA	NA	NO
1.A.2.i Mining excluding fuels and quarrying	T1	D	INSTAT	T1	D	INSTAT	T1	D	INSTAT
1.A.2.j Wood and wood products	T1	D	INSTAT	T1	D	INSTAT	T1	D	INSTAT
1.A.2.k Construction	T1	D	INSTAT	T1	D	INSTAT	T1	D	INSTAT
1.A.2.l Textile and leather	T1	D	INSTAT	T1	D	INSTAT	T1	D	INSTAT

CRT sector	CO2			CH4			N2O		
1 Energy	Method aplied	Emission factor (EF)	Activity data	Method aplied	Emission factor (EF)	Activity data	Method aplied	Emission factor (EF)	Activity data
1.A.2.g.vii Off-road vehicles Other machinery	T1	D	INSTAT	T1	D	INSTAT	T1	D	INSTAT
1.A.2.m Other	T1	D	INSTAT	T1	D	INSTAT	T1	D	INSTAT
1.A.3 Transport									
1.A.3.a Domestic aviation	T1	D	INSTAT	T1	D	INSTAT	T1	D	INSTAT
1.A.3.b Road transportation	T1	D	INSTAT	T1	D	INSTAT	T1	D	INSTAT
1.A.3.c Railways	T1	D	INSTAT	T1	D	INSTAT	T1	D	INSTAT
1.A.3.d Domestic Navigation	T1	D	INSTAT	T1	D	INSTAT	T1	D	INSTAT
1.A.3.e Other transportation	NA	NA	NO	NA	NA	NO	NA	NA	NO
1.A.4 Other sectors									
1.A.4.a Commercial institutional	T1	D	INSTAT	T1	D	INSTAT	T1	D	INSTAT
1.A.4.b Residential	T1	D	INSTAT	T1	D	INSTAT	T1	D	INSTAT
1.A.4.c Agriculture forestry fishing	T1	D	INSTAT	T1	D	INSTAT	T1	D	INSTAT
1.A.5 Other	NE	NA	NE	NE	NA	NA	NE	NA	NE
1.B Fugitive emissions from fuels									
1.B.1 Solid Fuels									
1.B.1.a Coal mining and handling	T1	D	INSTAT	T1	D	INSTAT	NA	NA	NA
1.B.1.b Fuel transformation									
1.B.1.b.i Charcoal and biochar production	NE	NA	NA	NE	NA	NA	NE	NA	NA
1.B.1.c Other	NA	NA	NO	NA	NA	NO	NA	NA	NO
1.B.2 Oil and gas									
1.B.2.a Oil									
1.B.2.a.i Exploration	NA	NA	NO	NA	NA	NO	NA	NA	NO
1.B.2.a.ii Production and upgrading	NA	NA	NO	NA	NA	NO	NA	NA	NO
1.B.2.a.iii Transport	NA	NA	NO	NA	NA	NO	NA	NA	NO
1.B.2.a.iv Refining storage	NA	NA	NO	NA	NA	NO	NA	NA	NO
1.B.2.a.v Distribution of oil products	T1	D	INSTAT	T1	D	INSTAT	NA	NA	NO
1.B.2.a.vi Other	NA	NA	NO	NA	NA	NO	NA	NA	NO
Natural gas									
1.B.2.b Natural gas	NA	NA	NO	NA	NA	NO	NA	NA	NO
1.C CO2 Transport and storage									
1.D Memo items									
1.D.1 International bunkers - Aviation	T1	D	INSTAT	T1	D	INSTAT	T1	D	INSTAT
1.D.1 International bunkers - Navigation	T1	D	INSTAT	T1	D	INSTAT	T1	D	INSTAT
1.D.2 Multilateral operations	NA	NA	NO	NA	NA	NO	NA	NA	NO
1.D.3 CO2 emissions from biomass	T1	D	INSTAT	NA	NA	NA	NA	NA	NA
CO2 captured	NA	NA	NO	NA	NA	NO	NA	NA	NO
Waste incineration with energy recovery included	NA	NA	NO	NA	NA	NO	NA	NA	NO

Table 1-6 Summary report for methods and emission factors used and source of activity data in CRT sector 2 IPPU

CRT sector	CO2			CH4			N2O		
2 Industrial processes and product Use (IPPU)	Method aplied	Emission factor (EF)	Activity data	Method aplied	Emission factor (EF)	Activity data	Method aplied	Emission factor (EF)	Activity data
2.A Mineral industry									
2.A.1 Cement production	NA	NA	NO	NA	NA	NO	NA	NA	NO
2.A.2 Lime production	T1	D	INSTAT	NA	NA	NA	NA	NA	NA
2.A.3 Glass production	NA	NA	NO	NA	NA	NO	NA	NA	NO
2.A.4 Other process uses of carbonates	NA	NA	NO	NA	NA	NO	NA	NA	NO
2.A.4.d Other	NA	NA	NO	NA	NA	NO	NA	NA	NO
2.B Chemical industry	NA	NA	NO	NA	NA	NO	NA	NA	NO
2.C Metal industry									
2.C.1 Iron and steel production	NA	NA	NO	NA	NA	NO	NA	NA	NO
2.C.2 Ferroalloys production	NA	NA	NO	NA	NA	NO	NA	NA	NO
2.C.3 Aluminium production	T1	D	INSTAT	NA	NA	NA	NA	NA	NA
2.C.4 Magnesium production	NA	NA	NO	NA	NA	NO	NA	NA	NO
2.C.5 Lead production	NA	NA	NO	NA	NA	NO	NA	NA	NO
2.C.6 Zinc production	NA	NA	NO	NA	NA	NO	NA	NA	NO
2.C.7 Other	NA	NA	NO	NA	NA	NO	NA	NA	NO
2.D Non-energy products Solvent use									
2.D.1 Lubricant use	T1	D	INSTAT	NA	NA	NA	NA	NA	NA
2.D.2 Paraffin wax use	T1	D	INSTAT	NA	NA	NA	NA	NA	NA
2.D.3 Other	T1	D	INSTAT	NA	NA	NA	NA	NA	NA
2.E Electronics industry	NA	NA	NO	NA	NA	NO	NA	NA	NO
2.F. Product uses as substitutes for ODS	NA	NA	NA	NA	NA	NA	NA	NA	NA
2.G Other product manufacture and use									
2.G.1. Electrical equipment	NA	NA	NA	NA	NA	NA	NA	NA	NA
2.G.2. SF6 and PFCs from other product use	NA	NA	NO	NA	NA	NO	NA	NA	NO
2.G.3 N2O from product uses	NA	NA	NO	NA	NA	NO	NA	NA	NE
2.G.4 Other	NA	NA	NO	NA	NA	NO	NA	NA	NO
2.H Other	NA	NA	NO	NA	NA	NO	NA	NA	NO

Table 1-7 Summary report for methods and emission factors used and source of activity data in sector 2 IPPU – F-gases

CRT sector	HFCs			PFCs			SF6		
2 Industrial processes and product Use (IPPU)	Method aplied	Emission factor (EF)	Activity data	Method aplied	Emission factor (EF)	Activity data	Method aplied	Emission factor (EF)	Activity data
2.A Mineral industry	NA	NA	NA	NO	NA	NA	NA	NA	NA
2.B Chemical industry	NA	NA	NA	NO	NA	NA	NA	NA	NA
2.C Metal industry	NA	NA	NO	T2	CS	PS	NA	NA	NA

CRT sector	HFCs			PFCs			SF6		
2 Industrial processes and product Use (IPPU)	Method aplied	Emission factor (EF)	Activity data	Method aplied	Emission factor (EF)	Activity data	Method aplied	Emission factor (EF)	Activity data
2.D Non-energy products Solvent use	NA	NA	NA	NA	NA	NA	NA	NA	NA
2.E Electronics industry									
2.E.1 Integrated circuit or semiconductor	NA	NA	NO	NA	NA	NO	NA	NA	NO
2.E.2 TFT flat panel display	NA	NA	NO	NA	NA	NO	NA	NA	NO
2.E.3 Photovoltaics	NA	NA	NO	NA	NA	NO	NA	NA	NO
2.E.4 Heat transfer fluid	NA	NA	NO	NA	NA	NO	NA	NA	NO
2.E.5 Other	NA	NA	NO	NA	NA	NO	NA	NA	NO
2.F. Product uses as substitutes for ODS									
2.F.1. Refrigeration and air-conditioning									
2.F.1.a. Commercial refrigeration	NE	NA	EPA	NA	NA	NO	NA	NA	NO
2.F.1.b. Domestic refrigeration	T1	D	EPA	NA	NA	NO	NA	NA	NO
2.F.1.c. Industrial refrigeration	NE	NA	EPA	NA	NA	NO	NA	NA	NO
2.F.1.d. Transport refrigeration	NE	NA	EPA	NA	NA	NO	NA	NA	NO
2.F.1.e. Mobile air-conditioning	T1	D	EPA	NA	NA	NO	NA	NA	NO
2.F.1.f. Stationary air-conditioning	T1	D	EPA	NA	NA	NO	NA	NA	NO
2.F.2. Foam blowing agents	T1	D	EPA	NA	NA	NO	NA	NA	NO
2.F.3. Fire protection	T1	D	EPA	NA	NA	NO	NA	NA	NO
2.F.4. Aerosols	NA	NA	NE	NA	NA	NE	NA	NA	NE
2.F.5. Solvents	NA	NA	NE	NA	NA	NE	NA	NA	NE
2.F.6. Other applications	NA	NA	NE	NA	NA	NE	NA	NA	NE
2.G Other product manufacture and use									
2.G.1. Electrical equipment	T1	D	PS	T1	D	PS	T1	D	PS
2.G.2. SF6 and PFCs from other product use	NA	NA	NO	NA	NA	NO	NA	NA	NO
2.G.3 N2O from product uses	NA	NA	NO	NA	NA	NO	NA	NA	NO
2.G.4 Other	NA	NA	NO	NA	NA	NO	NA	NA	NO
2.H Other	NA	NA	NO	NA	NA	NO	NA	NA	NO

Table 1-8 Summary report for methods and emission factors used and source of activity data in CRT sector 3 Agriculture

CRT sector	CO2			CH4			N2O		
3 Agriculture	Method aplied	Emission factor (EF)	Activity data	Method aplied	Emission factor (EF)	Activity data	Method aplied	Emission factor (EF)	Activity data
3.A Enteric fermentation									
3.A.1 Cattle									
Option A:	NA	NA	NA	NA	NA	NA	NA	NA	NA
Option B (country-specific)									
3.A.1.a Other									
3.A.1.a.i Mature dairy cattle	NA	NA	NA	T2	D	INSTAT	NA	NA	NA
3.A.1.a.ii Other mature cattle	NA	NA	NA	T2	D	INSTAT	NA	NA	NA
3.A.1.a.iii Growing cattle	NA	NA	NA	T2	D	INSTAT	NA	NA	NA
3.A.1.a.iv Other	NA	NA	NA	NA	NA	NO	NA	NA	NA
3.A.2 Sheep	NA	NA	NA	T2	D	INSTAT	NA	NA	NA
3.A.3 Swine	NA	NA	NA	T2	D	INSTAT	NA	NA	NA
3.A.4 Other livestock									
3.A.4.a Buffalo	NA	NA	NA	NA	NA	NO	NA	NA	NA
3.A.4.b Camels	NA	NA	NA	NA	NA	NO	NA	NA	NA
3.A.4.c Deer	NA	NA	NA	NA	NA	NO	NA	NA	NA
3.A.4.d Goats	NA	NA	NA	T2	D	INSTAT	NA	NA	NA
3.A.4.e Horses	NA	NA	NA	T2	D	INSTAT	NA	NA	NA
3.A.4.f Mules and asses	NA	NA	NA	T2	D	INSTAT	NA	NA	NA
3.A.4.g Poultry	NA	NA	NA	NA	NA	NA	NA	NA	NA
3.A.4.h Other									
3.A.4.h.i Rabbit	NA	NA	NA	NA	NA	NO	NA	NA	NA
3.A.4.h.ii Reindeer	NA	NA	NA	NA	NA	NO	NA	NA	NA
3.A.4.h.iii Ostrich	NA	NA	NA	NA	NA	NO	NA	NA	NA
3.A.4.h.iv Fur-bearing animals	NA	NA	NA	NA	NA	NO	NA	NA	NA
3.A.4.h.v Other	NA	NA	NA	NA	NA	NO	NA	NA	NA
3.B Manure management									
3.B.1 Cattle									
Option A	NA	NA	NA	T2	D	INSTAT	T2	NA	INSTAT
Option B (country-specific)									
3.B.1.a Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
3.B.2 Sheep	NA	NA	NA	T2	D	INSTAT	T2	D	INSTAT
3.B.3 Swine	NA	NA	NA	T2	D	INSTAT	T2	D	INSTAT
3.B.4 Other livestock									
3.B.4.a Buffalo	NA	NA	NO	NA	NA	NO	NA	NA	NO
3.B.4.b Camels	NA	NA	NO	NA	NA	NO	NA	NA	NO
3.B.4.c Deer	NA	NA	NO	NA	NA	NO	NA	NA	NO
3.B.4.d Goats	NA	NA	NA	T2	D	INSTAT	T2	D	INSTAT
3.B.4.e Horses	NA	NA	NA	T2	D	INSTAT	T2	D	INSTAT
3.B.4.f Mules and Asses	NA	NA	NA	T2	D	INSTAT	T2	D	INSTAT
3.B.4.g Poultry	NA	NA	NA	T2	D	INSTAT	T2	D	INSTAT
3.B.4.h Other	NA	NA	NA	NA	NA	NO	NA	NA	NO
3.C Rice cultivation	NA	NA		NO	NA		NA	NA	

CRT sector	CO2			CH4			N2O		
3 Agriculture	**Method aplied**	**Emission factor (EF)**	**Activity data**	**Method aplied**	**Emission factor (EF)**	**Activity data**	**Method aplied**	**Emission factor (EF)**	**Activity data**
3.D Agricultural soils									
3.D.1 Direct N2O emissions from managed soils									
3.D.1.a Inorganic N fertilizers	NA	NA	NA	NA	NA	NA	T1	D	INSTAT
3.D.1.b Organic N fertilizers									
3.D.1.b.i Animal manure applied to soils	NA	NA	NA	NA	NA	NA	T2	D	INSTAT
3.D.1.b.ii Sewage sludge applied to soils	NA	NA	NA	NA	NA	NA	NA	NA	NE
3.D.1.b.iii Other organic fertilizers applied to soils	NA	NA	NA	NA	NA	NA	NA	NA	NE
3.D.1.c Urine and dung deposited by grazing animals	NA	NA	NA	NA	NA	NA	T2	D	INSTAT
3.D.1.d Crop residues	NA	NA	NA	NA	NA	NA	T1	D	INSTAT
3.D.1.e Mineralization immobilization loss-gain	NA	NA	NA	NA	NA	NA	NA	NA	NE
3.D.1.f Cultivation of organic soils histosols	NA	NA	NA	NA	NA	NA	NA	NA	NE
3.D.1.g Other	NA	NA	NA	NA	NA	NA	NA	NA	NO
3.D.2 Indirect N2O Emissions from managed soils	NA	NA	NA	NA	NA	NA	T1	D	INSTAT
3.E Prescribed burning of savannahs	NA	NA	NO	NA	NA	NO	NA	NA	NO
3.F Field burning of agricultural residues	T1	D	INSTAT	T1	D	INSTAT	T1	D	INSTAT
3.G Liming	T1	D	INSTAT	T1	D	INSTAT	T1	D	INSTAT
3.H Urea application	T1	D	INSTAT	T1	D	INSTAT	T1	D	INSTAT
3.I Other carbon-containing fertilizers	NA	NA	NO	NA	NA	NO	NA	NA	NO
3.J Other	NA	NA	NO	NA	NA	NO	NA	NA	NO

Table 1-9 Summary report for methods and emission factors used and source of activity data in CRT sector 5 Waste

CRT sector	CO2			CH4			N2O		
5 Waste	**Method aplied**	**Emission factor (EF)**	**Activity data**	**Method aplied**	**Emission factor (EF)**	**Activity data**	**Method aplied**	**Emission factor (EF)**	**Activity data**
5.A Solid waste disposal									
5.A.1 Managed waste disposal sites									
5.A.1.a Anaerobic	NA	NA	NA	T1	D	INSTAT	NA	NA	NA
5.A.1.b Semi-aerobic	NA	NA	NA	NA	NA	NO	NA	NA	NA
5.A.1.c Active aeration	NA	NA	NA	NA	NA	NO	NA	NA	NA
5.A.2 Unmanaged waste disposal sites	NA	NA	NA	T1	D	INSTAT	NA	NA	NA
5.A.3 Uncategorized waste disposal sites	NA	NA	NA	NA	NA	NO	NA	NA	NA
5.B Biological treatment of solid waste									

CRT sector	CO2			CH4			N2O		
5 Waste	**Method aplied**	**Emission factor (EF)**	**Activity data**	**Method aplied**	**Emission factor (EF)**	**Activity data**	**Method aplied**	**Emission factor (EF)**	**Activity data**
5.B.1 Composting	NA	NA	NA	NA	NA	NE	NA	NA	NA
5.B.2 Anaerobic digestion at biogas facilities	NA	NA	NA	NA	NA	NO	NA	NA	NA
5.C Incineration and open burning of waste									
5.C.1 Waste incineration	NA	NA	NO	NA	NA	NO	NA	NA	NO
5.C.2 Open burning of waste	NA	NA	NE	NA	NA	NE	NA	NA	NE
5.D Wastewater treatment and discharge									
5.D.1 Domestic wastewater	NA	NA	NA	T1	D	INSTAT	T1	D	INSTAT
5.D.2 Industrial wastewater	NA	NA	NA	NO	NA	IE	NA	NA	NE
5.D.3 Other	NA	NA	NA	NO	NA	NO	NA	NA	NO
5.E Other	NA	NA	NA	NO	NA	NO	NA	NA	NO

1.4 Brief description of key categories

The identification of key categories (KCA) is prepared in accordance with 2006 IPCC Guidelines[24]. It stipulates that a key category is one that is prioritized within the National System because its estimate has a significant influence on a country's total inventory of greenhouse gases in terms of the absolute level of emissions or removals, the trend in emissions or removals, or both.

Key categories according to the following equation are those that, when summed together in descending order of magnitude, add up to 95% of the sum of all Lx,t or any category meeting the 95% threshold in any year of the Level Assessment (LA) or in the Trend Assessment (TA) is considered a *key category*.

The identification of key categories consists in general of six steps. However, for the current submission a KCA no qualitative considerations were included.

- Identifying categories
- Level Assessment excluding LULUCF (Approach 1)
- Trend Assessment excluding LULUCF (Approach 1)
- Level Assessment including LULUCF (Approach 1)
- Trend Assessment including LULUCF (Approach 1)
- Qualitative considerations

1.4.1 Level of disaggregation and identification of key categories

Following *good practice* in determining the appropriate level of disaggregation of categories to identify key categories:

• The analysis is performed at the level of IPCC categories/subcategories at which the IPCC methods	✓
• Each greenhouse gas emitted from each category is considered separately.	✓
• An analysis should be performed for emissions and removals separately within a given category.	Not applicable for this submission

1.4.2 Level Assessment

The 2006 IPCC Guidelines Tier 1 approach has been applied: contribution of each source or sink category to the total national inventory.

Equation 4.1: Level Assessment (2006 IPCC GL, Vol. 1, Chap. 4.3.1)

$$\boldsymbol{Key\ category\ level\ assessment} = \frac{|\boldsymbol{source\ or\ sink\ category\ estimate}|}{|\boldsymbol{total\ contribution}|} \Rightarrow \boldsymbol{L_{x,t}} = \frac{|\boldsymbol{E_{x,t}}|}{\sum|\boldsymbol{E_{y,t}}|}$$

Where:

Lx,t = level assessment for source or sink x in latest inventory year (year t)

|Ex,t| = absolute value of emission or removal estimate of source or sink category x in year t

$\sum|\boldsymbol{E_{y,t}}|$ = total contribution, which is the sum of the absolute values of emissions and removals in year t calculated using the aggregation level chosen by the country for key category analysis. Because both emissions and removals are entered with positive sign, the total contribution/level can be larger than a country's total emissions less removals.

[24] IPCC. (2006). *Methodological Choice and Identification of Key Categories. Volume 1 - General Guidance and Reporting, Chapter 4.*

1.4.3 Trend Assessment

The 2006 IPCC Guidelines Tier 1 approach has been applied:

- The trend assessment identifies categories whose trend is different from the trend of the total inventory, regardless whether category trend is increasing or decreasing, or is a sink or source.
- Categories whose trend diverges most from the total trend should be identified as **key**, when this difference is weighted by the level of emissions or removals of the category in the base year.

Equation 4.2: Trend assessment (2006 IPCC GL, Vol. 1, Chap. 4.3.1)

$$\boldsymbol{Key\ category\ Trend\ assessment} = \quad \boldsymbol{T_{x,0}} = \underbrace{\frac{|\boldsymbol{E_{x,0}}|}{\sum_y |\boldsymbol{E_{y,0}}|}}_{\text{Category Significance}} \times \left| \underbrace{\left[\frac{(\boldsymbol{E_{x,t}} - \boldsymbol{E_{x,0}})}{|\boldsymbol{E_{x,0}}|}\right]}_{\text{Category Trend}} - \underbrace{\frac{(\sum_y \boldsymbol{E_{y,t}} - \sum_y \boldsymbol{E_{y,0}})}{\sum_y |\boldsymbol{E_{y,0}}|}}_{\text{Overall Trend}} \right|$$

Where:

$T_{x,0}$	= trend assessment of source or sink category x in year t as compared to the base year (year 0)
$\lvert Ex,0 \rvert$	= absolute value of emission or removal estimate of source or sink category x in year 0
$E_{x,t}$ *and* $E_{x,0}$	= real values of estimates of source or sink category x in years t and 0, respectively
$\sum_y E_{y,t}$, *and* $\sum_y E_{y,0}$	= total inventory estimates in years *t* and 0, respectively

1.4.4 Results of the Key Categories Analysis (KCA) with LULUCF

Figure 1-8 Key Categories including LULUCF.

Table 1-10 Level Assessment: Key categories including LULUCF 1990

Level Assessment - 1990		GHG	Year 1990 Estimate Ex,t	Absolute Value of Year 1990 Estimate Ex,t	Level Assessment $L_{x,t}$	Cumulative Total of $L_{x,t}$
IPCC Code	IPCC Category		Gg CO_2-equivalent			

Table 1-11 Level Assessment: Key categories including LULUCF 2022

Level Assessment - 2022		GHG	Year 2022 Estimate Ex,t	Absolute Value of Year 2022 Estimate Ex,t	Level Assessment $L_{x,t}$	Cumulative Total of $L_{x,t}$
IPCC Code	IPCC Category		Gg CO_2-equivalent			

Table 1-12 Trend Assessment: Key categories including LULUCF 2022

Trend Assessment		GHG	Base Year (1990) Estimate $E_{x,0}$	Latest Year (2022) Estimate $E_{x,t}$	Trend Assessment $L_{x,t}$	% Contribution to the trend	Cumulative Total of $L_{x,t}$
IPCC Code	IPCC Category		Gg CO_2-equivalent		$L_{x,t}$		

Table 1-13 Overview of Key categories including LULUCF

CRT category Code	CRT category	GHG	Level Assessment 1990	Level Assessment 2022	Trend Assessment 1990-2022	Base Year (1990) Estimate Ex,0	Latest Year (2021) Estimate Ex,t

1.4.5 Results of the Key Categories Analysis (KCA) without LULUCF

Figure 1-9 Key Categories without LULUCF

Table 1-14 Level Assessment: Key categories without LULUCF 1990

Level Assessment - 1990		GHG	Year 1990 Estimate Ex,t	Level Assessment $L_{x,t}$	Cumulative Total of $L_{x,t}$
IPCC Code	IPCC Category		Gg CO_2-equivalent		

Table 1-15 Level Assessment: Key categories without LULUCF 2022

Level Assessment - 2022		GHG	Year 2022 Estimate Ex,t	Level Assessment $L_{x,t}$	Cumulative Total of $L_{x,t}$
IPCC Code	IPCC Category		Gg CO_2-equivalent		

Table 1-16 Trend Assessment: Key categories without LULUCF 1990-2022

Trend Assessment		GHG	Base Year (1990) Estimate $E_{x,0}$	Latest Year (2022) Estimate $E_{x,t}$	Trend Assessment $L_{x,t}$	% Contribution to the trend	Cumulative Total of $L_{x,t}$
IPCC Code	IPCC Category		Gg CO_2-equivalent		$L_{x,t}$		

Table 1-17 Overview of Key categories including LULUCF

CRT category Code	CRT category	GHG	Level Assessment 1990	Level Assesment 2021	Trend Assessment 1990-2022	Base Year (1990) Estimate Ex,0	Latest Year (2021) Estimate Ex,t

1.5 Brief general description of QA/QC plan and implementation

The 2006 IPCC Guidelines set out the major elements of a QA/QC system to be implemented by inventory compilers

(1) inventory agency (Environmental Protection Agency) responsible for coordinating QA/QC activities and definition of roles and responsibilities,
(2) a QA/QC plan,
(3) general QC procedures (Tier 1) and source category-specific QC procedures (Tier 2)
(4) QA and review procedures, and verification activities,
(5) QA/QC system interaction with uncertainty analysis (see chapter on uncertainties),
(6) reporting, documentation and archiving.

The first steps to carry out **quality assurance (QA) and quality control (QC) procedures** have already been undertaken but need further improvement. The current status and planned improvements are described in the following sub-sections.

1.5.1 QA/QC plan

As described in the 2006 IPCC Guidelines, Chapter 6.5, a **QA/QC plan** is a **fundamental element of a QA/QC and verification system**. The QA/QC plan

- outlines the QA/QC and verification activities;
- include a scheduled time frame for the QA/QC activities;
- is an internal document to organize and implement QA/QC and verification activities that ensure the inventory is fit for purpose and allow for improvement.
    - QC activities
    - procedures for country specific methodologies
    - internal/external audits (QM specific)
    - inventory improvement plan
    - documentation and archiving
    - treatment of confidential data

1.5.1.1 Quality objectives

A **key component** of a QA/QC plan is the list of data **quality objectives**, against which an inventory can be measured in a review. However, a *good practice* approach is a pragmatic means of building inventories that are TACCC – and maintaining them in a manner that improves inventory quality over time. This means that the *good practice* approach reflects the national circumstances regarding financial and technical resources and capacities.

However, the GHG inventory - estimation of GHG emissions and removals including reporting elements - is subject to continuous improvement.

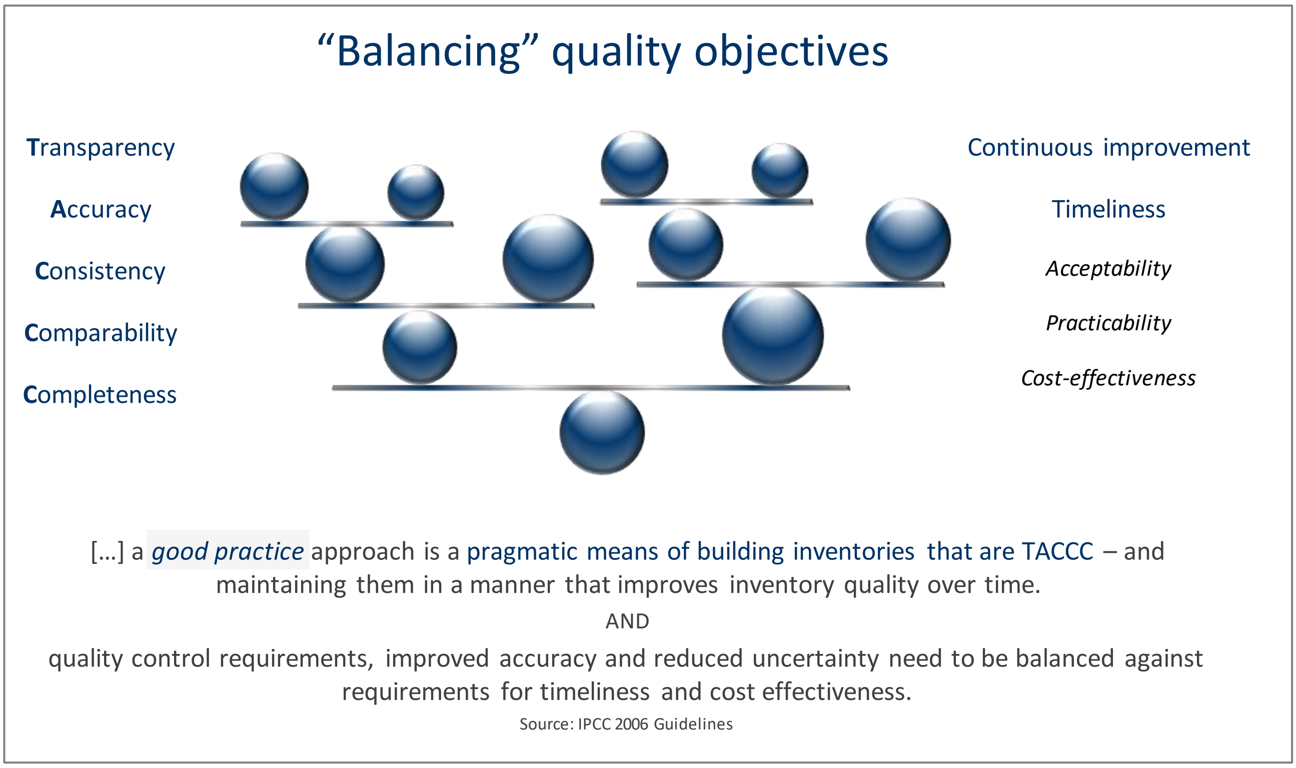


Figure 1-10 Balancing quality objectives

1.5.1.2 Inventory improvement plan

The planning of the GHG inventory preparation of each inventory cycle start with thoroughly analysis of the **QA/QC plan** and **Inventory improvement plan** in order to prioritize the tasks and available resources.

- QA/QC plan: bases on findings of internal and external audits; it also includes a training plan for sector experts;
- Inventory improvement plan: bases on findings of the International Consultation and Analysis (ICA), peer-reviews, audits of the GHG inventory.

The QA/QC plan and the improvement of the GHG inventory follows a Plan-Do-Check-Act-Cycle (PDCA-cycle)[25], which is an accepted model for pursuing a continual improvement of a process, product or service according to international standards and is in line within the General Guidance and Reporting of the 2006 IPCC Guidelines.

[25] https://asq.org/quality-resources/pdca-cycle

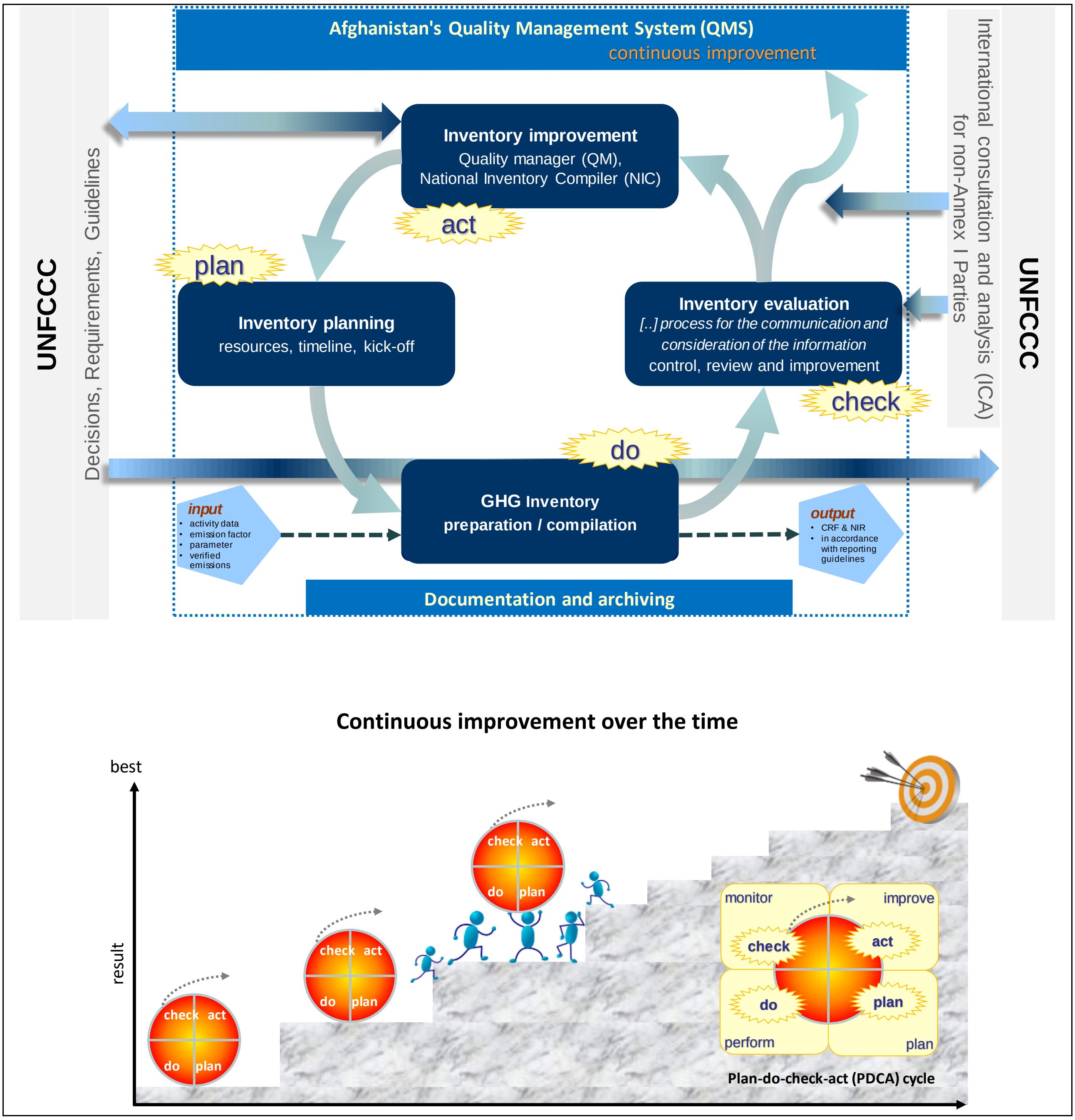
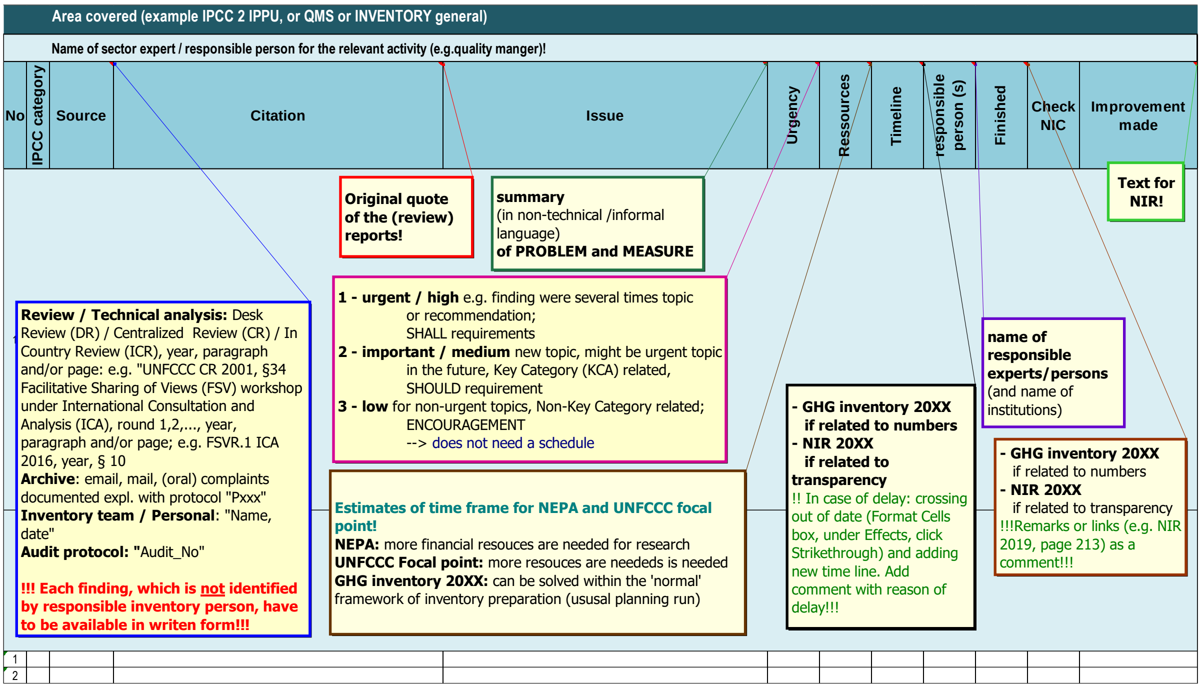


Figure 1-11 Continuous improvement

The results from internal/external audits, expert peer reviews and UNFCCC international consultation and analysis (ICA) are merged in the inventory improvement plan and Quality improvement plan. These plans lists the relevant sector, recommendations for improvement (reference and citation), priorities, responsibilities, deadlines and confirmation of implementation.

The following table presents the template of the inventory improvement plan which is prepared for each sector, QA/QC plan and Institutional arrangements.

Table 1-18 Template of the inventory improvement plan



1.5.1.3 Inventory development cycle and guidance

The biennial and/or annual preparation of the GHG inventory follows in general the **inventory development cycle** presented in the following figure and described in Chapter 1 *Introduction to the 2006 Guidelines* of Volume 1: General Guidance and Reporting (GGR).

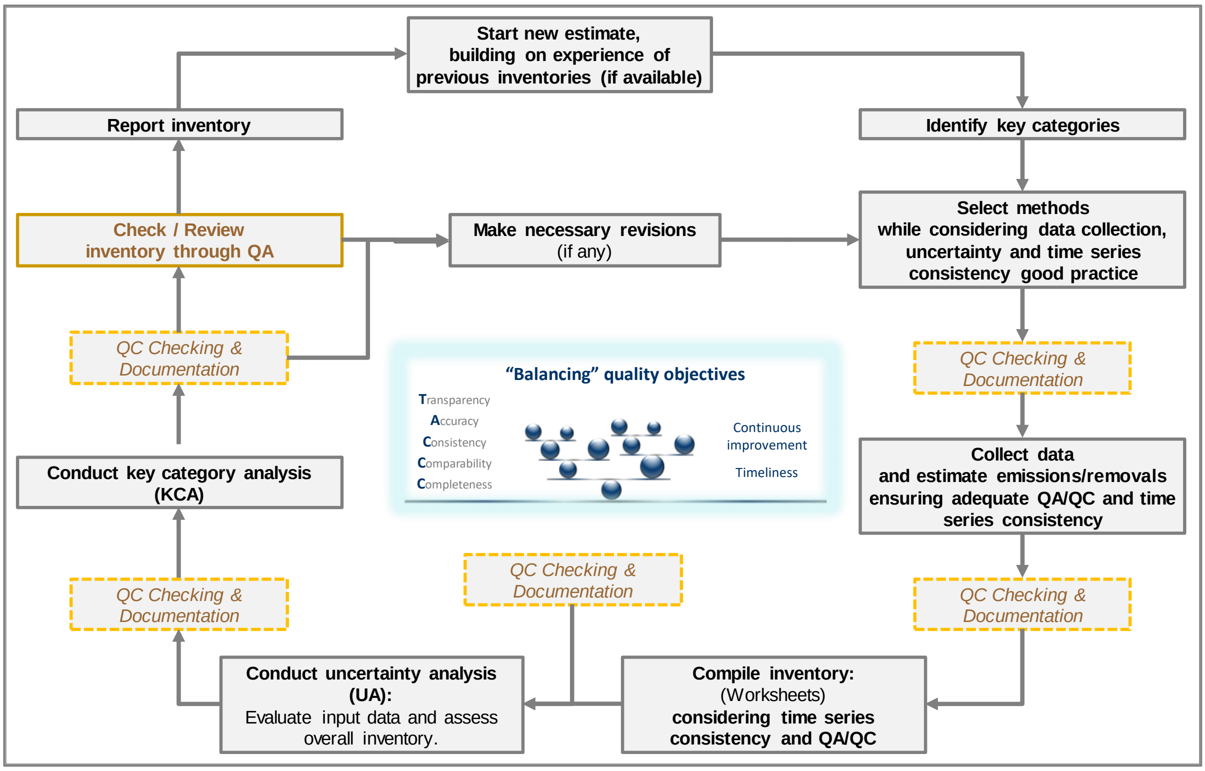


Figure 1-12 Inventory development cycle

Source: 2006 IPCC guidelines, Vol. 1: General Guidance and Reporting, Chap. 1: Introduction to the 2006 Guidelines, sub-chap. 1.5 Compiling an inventory, Figure 1.1, p. 1.9.

The preparation of the inventory starts always with identification of the key categories of the previous inventory followed by the selection of the appropriate identify the appropriate method for estimation for each category according to the **decision tree** of each source presented in Volume 2 – 5 of the 2006 IPCC guidelines.
The collection of activity data and relevant parameters and the estimation of emission by sources and removals by sinks should be follow the selection of the appropriate methods. As stated in the 2006 IPCC Guidelines the data collection activities should consider time series consistency and establish and maintain good verification, documentation and checking procedures (QA/QC) to minimize errors and inconsistencies in the inventory estimates.[26] Information and data on uncertainties should if possible be collected at the same time. The relevant QC Checking and documentation is done according to the QC TIER 1 & 2 Checklist which is presented in Chapter 1.5.2 (Table 1-20- Table 1-32).

The following table presents relevant inventory tasks which are based on each other. It is also indicated which documents (chapter and/or sheet) are required for the respective work steps. The relevant responsible experts involved in each step are also identified.

[26] 2006 IPCC guidelines, Vol. 1: General Guidance and Reporting, Chap. 1: Introduction to the 2006 Guidelines, 1.5 Compiling an inventory, p. 1.9.

Table 1-19 National Inventory preparation schedule / guidance

	When	Task	Where / What	BUR & NC coordinator	Focal point GHG inventory	National Inventory Compiler (NIC)	QA/QC coordinator	NID coordinator	Documentation & Archiving Lead	KCA & UA coordinator	Sector experts	Data provider	QA experts	tbd
1.		Start new estimate, building on experience of previous inventories												
2.		Meeting of BUR & NC coordinator, Focal point GHG inventory, National Inventory Compiler (NIC) and QA/QC Coordinator: • Analysing the QA/QC plan & Inventory improvement plan • Prioritizing the recommended improvements (including a timeline and responsibilities) • planning relevant resources.	Protocol (template) Inventory improvement plan.xlsx QA-QC improvement plan.xlsx											
3.		Kick-off meeting – GHG inventory team (News, deadlines, changes, etc.)	Protocol (template) Inventory improvement plan.xlsx QA-QC improvement plan.xlsx											
4.		Conducting Capacity trainings and/or refreshing general issues, sector-specific topics, QC activities	Training plan Inventory improvement plan											
5.		Identify key categories	NID 2019 chapter 1.5.docx ALB _KCA_2019.xlsx											
6.		Select methods while considering data collection, uncertainty and time series consistency good practice	2006 IPCC GL, Volume 2 – 5 NID – sectoral chapters											
7.		QC Checking & Documentation, updating Inventory improvement plan	ALB_Inventory improvement plan.xlsx QC checks according to part 1 of QC TIER 1 & 2 Checklist											
8.		Kick-off meeting – with data provider (with all / in groups)	Protocol (template)											
9.		Collection of activity data and relevant parameters ensuring adequate • QC Checking (completeness, transparency, accuracy) • time series consistency • documentation (if discrepancies, delay, etc.)	Data collection using data collection files (template) (source-specific) from data provider											
10.			Archiving response (letter, Email, etc.) in folder 04_Archive											
11.		Preparation/Updating of calculation sheets • adding new year • modification if higher TIER methodology will be applied • updating NID tables templates • updating graphs	source-specific calculation sheets, e.g. 1A1a_InventoryTool_ALB.xlsx											

	When	Task	Where / What	BUR & NC coordinator	Focal point GHG inventory	National Inventory Compiler (NIC)	QA/QC coordinator	NID coordinator	Documentation & Archiving Lead	KCA & UA coordinator	Sector experts	Data provider	QA experts	tbd
12.		Estimate emissions/removals ensuring adequate QA/QC and time series consistency	Inserting activity data or linking data collection files with calculation files											
13.		QC Checking & Documentation, updating Inventory improvement plan	• Documentation in column Update of each "source-specific" calculation file, sheet AD • QC checks according to part 1,2,3 and 6 of QC TIER 1 & 2 Checklist											
14.		Preparation/Updating of Inventory file • adding new year • adding new calculation file, if needed • updating NID tables templates • updating graphs	CTR-CommonReportingTables_ALB.xlsx											
15.		Compile inventory considering time series consistency and QA/QC: update links of all calculation sheets	CTR-CommonReportingTables_ALB.xlsx QC checks according to part 2b of *QC TIER 1 & 2 Checklist*											
16.		Sharing results with inventory team and QC check of Inventory file by sector experts and if needed revision of Inventory file	QC checks according to part 1, 2 and 3 of *QC TIER 1 & 2 Checklist*											
17.		Make necessary revisions (if any)												
18.		Conduct uncertainty analysis (UA): Evaluation of input data: AD and EF.	"source-specific" calculation files, sheet uncertainties											
19.		Conduct uncertainty analysis (UA): assessment of overall inventory uncertainty.	ALB_Uncertainties_Table6.1.xlsx QC checks according to part 4 and 5 of *QC TIER 1 & 2 Checklist*											
20.		QC Checking & Documentation, updating Inventory improvement plan	QC checks according to part 7 of *QC TIER 1 & 2 Checklist*											
21.		Sharing results with inventory team and QC check of UA file by sector experts and NID coordinator												
22.		Make necessary revisions (if any)												
23.		Conduct key category analysis (KCA) • Update formula for new inventory year • Update link with CTR-CommonReportingTables_ALB.xlsx	ME-KCA-2019.xlsx CTR-CommonReportingTables_ALB.xlsx											
24.		QC Checking & Documentation, updating Inventory improvement plan	QC checks according to part 1 of *QC TIER 1 & 2 Checklist*											

	When	Task	Where / What	BUR & NC coordinator	Focal point GHG inventory	National Inventory Compiler (NIC)	QA/QC coordinator	NID coordinator	Documentation & Archiving Lead	KCA & UA coordinator	Sector experts	Data provider	QA experts	tbd
25.		Sharing results with inventory team and QC check of KCA file by sector experts and NID coordinator	ME-KCA-2019.xlsx											
26.		Make necessary revisions of emission estimation if higher TIER methodology has to be applied according to decision tree of relevant source (if any)												
27.		Repeat step 14. to – 25. in case of revision												
28.		• Add new in IPCC software • Update of timeseries entry files for IPCC software • Update database (sector)												
29.		QC Checking & Documentation, updating Inventory improvement plan	QC checks according to part 2 and 3 of *QC TIER 1 & 2 Checklist*											
30.		Compile inventory with IPCC software as QC activity												
31.		QC Checking & Documentation, updating Inventory improvement plan	QC checks according to part 2 and 3 of *QC TIER 1 & 2 Checklist*											
32.		Update NID sectoral chapter												
33.		QC Checking & Documentation, Cross-checking with Inventory improvement plan	QC checks according to part 2 and 3 of *QC TIER 1 & 2 Checklist*											
34.		Update NID chapter 1 Introduction												
35.		QC Checking & Documentation, Cross-checking with Inventory improvement plan	QC checks according to part 2 and 3 of *QC TIER 1 & 2 Checklist*											
36.		Update NID chapter 1.6 KCA												
37.		QC Checking & Documentation, Cross-checking with Inventory improvement plan	QC checks according to part 2 and 3 of *QC TIER 1 & 2 Checklist*											
38.		Update NID chapter 1.7 Uncertainties												
39.		QC Checking & Documentation, Cross-checking with Inventory improvement plan	QC checks according to part 2 and 3 of *QC TIER 4 & 5 Checklist*											

	When	Task	Where / What	BUR & NC coordinator	Focal point GHG inventory	National Inventory Compiler (NIC)	QA/QC coordinator	NID coordinator	Documentation & Archiving Lead	KCA & UA coordinator	Sector experts	Data provider	QA experts	tbd
40.		Finalization of Inventory Improvement Plan and QA-QC improvement plan Finalization of NID Chapter 9 Recalculation and Improvement	Inventory improvement plan.xlsx QA-QC improvement plan.xlsx											
41.		Update NID chapter 1.6 QA/QC												
42.		QC Checking & Documentation, Cross-checking with Inventory improvement plan	QC checks according to part 2, 3, and 7 of *QC TIER 1 & 2 Checklist*											
43.		Update NID chapter 2 Trend												
44.		QC Checking & Documentation, Cross-checking with Inventory improvement plan	QC checks according to part 2 of *QC TIER 1 & 2 Checklist*											
45.		Treatment of confidentiality issues	Checklist - Confidential data											
46.		Update NID chapter # References												
47.		QC Checking & Documentation, Cross-checking with Inventory improvement plan	QC checks according to part 7 of *QC TIER 1 & 2 Checklist*											
48.		Check / Review inventory and NID through QA	QA checks using the *QC TIER 1 & 2 Checklist*											
49.		Make necessary revisions of emission estimation and /or NID based on findings and recommendations of QA (if any)												
50.		Repeat step 14. to – 47. in case of revision												
51.		Finalize National GHG Inventory and National Inventory Report (NID) for approval												
52.		Reporting of National Inventory and National Inventory Report (NID)												
53.		Collection of QC documents, QA documents, Inventory Improvement Plan												
54.		Archiving calculations files, Inventory files, KCA & UA file, NID, QC documents, QA documents, Inventory Improvement Plan	05_QA-QC\04_InventoryImprovementList 06_Inventory\2018\Submission 07_NID\2018_NID\02_Submission_UNFCCC											

1.5.2 Quality control (QC) procedures

As stated in the 2006 IPCCC Guidelines, Chapter 6.6, and presented in the following figure,

- general QC procedures include generic quality checks related to calculations, data processing, completeness, and documentation that are applicable to all inventory source and sink categories.
- category-specific QC complements general inventory QC procedures and is directed at specific types of data used in the methods for individual source or sink categories. These procedures require knowledge of the specific category, the types of data available and the parameters associated with emissions or removals, and are performed in addition to the general QC checks

QC procedures are performed as defined in the QC TIER 1 & 2 Checklist which is prepared according to IPCC 2006 Guidelines,

- Table 6.1 General inventory QC procedures
- A1. General QC checklist
- A2. Category-specific QC checklist

For each step of the inventory cycle relevant QC checks are prepared. Furthermore, the checks are divided in content checks and formal checks. As well checks could be done for activity data, emission factor, and emission factor separately. In case of higher Tier method, not only AD and EF are used but also other parameters. In case of reported AD and Emissions (e.g. Emission trading data (ETS) data or data from NAMA projects) the checks only of IEF are important.

As the estimation of the GHG emissions and removal and the preparation of the reporting elements NID and NAI tables are done at different stages of the inventory preparation cycle, the QC TIER 1 & 2 Checklist provides guidance on how and where the checks have to be done. Finally, each source has its own QC TIER 1 & 2 Checklist which can be individually refined.

1	Choosing Good Practice method
2	Activity data / Emission factors / Emissions– check regarding content
2a	Trend checks
2b	Check time series consistency (Recalculations due to methodological changes & refinements / Adding new categories / Tracking increases & decreases due to technological change etc.)
2c	Check completeness
2d	Direct emission measurement: Checks on procedures to measure emissions
3	Activity data / Emission factors / Emissions – Formal check - There shall be no transcription errors in the calculation and each data has a clear reference ?
3a	Check that assumptions and criteria for the selection of activity data are documented
3b	Check for transcription errors in data input and reference: There shall be no transcription errors in the activity data and each data has a clear reference (e.g. UNSD 2016)?
3c	Calculations correct / Check that parameters and units are correctly recorded and that appropriate conversion factors are used.
3d	Check for consistency in data between categories.
4	Uncertainties – Check regarding content
4a	Check that uncertainties in emissions and removals are estimated and calculated correctly
5	Uncertainties – Formal check - There shall be no transcription errors in the calculation and each data has a clear reference ?
6	Check the integrity of database files
7	Review of internal documentation/calculation sheet and archiving.

Table 1-20 QC TIER 1 & 2 Checklist according to IPCC 2006 Guidelines - Chapter 6

QC TIER 1 & 2 CHECKLIST according to IPCC 2006 Guidelines, Chapter 6						
Submission			**Source / Sink Category**			
Title of calculation sheets/internal_documentation/NIR/CTR (e.g. AFG-2019_v2.1.xls)**:**						
Insert of data path/folder						
Source/sink category estimates prepared by (name)						
Summary of general QC checks and corrective action						
Summary of results of checks and corrective actions taken						
Suggested checks to be performed in the future						
Any residual problems after corrective actions have been taken						
Other						
Date			**Signature**			
EXPLANATION & INSTRUCTION	*QC checks should be not seen as an additional task; QC should help you to document your QC checks which you are doing anyway*				**Abbreviation**	
Why checks for each gas? The estimations for the different GHG might be different!			TTE	Team of experts	NIR	National Inventory report
What kind of remarks have to be documented and why? Any comments, additional information, and/or corrective measures etc. should be documented; at the end of the inventory year, an analysis of the remarks will be done by the QM in order to undertake measures to prevent such findings (if possible :-).			ICA	International consultation and analysis	FSV	facilitative sharing of views
What is the reason for dating the checks? The inventory preparation process is a long and 'discontinuously' process; therefore the checklist serves also as a log / chronicle.			QA	Quality Assurance	sectoral chap	sectoral chapter
What should be mentioned under Reference? Here the exact location of the findings should be referenced!			QC	Quality Control	CTR	common reporting tables
Why have checks to be done for activity data, emission factor, and emission factor separately? In case of higher Tier method, not only AD and EF are used but also other parameters. In case of reported AD and Emissions (e.g. ETS data) the checks only of IEF are important.			ERT	Expert Review Team	NAI	Non Annex I Party
AD **Activity data**	**internal docu** **internal documentation**	**Y = Yes**	**NA = not applicable**	**NR = Not relevant**	**If not answered with YES, please provide all information regarding comments, corrective measures, etc.**	
EF **Emission factor**	**calc sheet** **calculation sheet**	**N = No**	**NC = not checked**	**NO = Not occurent**		
EMI **Emission**	**KCA** **key category analysis**		**C = Confidential**	**IE = Included elsewhere**		

Table 1-21 QC TIER 1 & 2 Checklist – (1) Choosing Good Practice method

QC TIER 1 & 2 CHECKLIST according to IPCC 2006 Guidelines, Chapter 6	Y = Yes N = No NC = not checked NA = not applicable NR = nor relevant NO = not occurent IE = Included	CO2	CH4	N2O	HFC	PFC	SF6	NF3	SO2	NOx	NMVOC	NH3	CO	Remarks Comments, Corrective measures	Check done Date	Finding Y/ N/ NR	Correction Date	Person	References
1 Choosing Good Practice method																			
Is a more detailed higher tier method selected for *key categories* according to the latest key category analysis (KCA)? If not, is a comprehensive and plausible explanation provided? *Any key categories where the good practice method cannot be used should have priority for future improvements.*	*calc sheets*																		
	NIR - sectoral chap																		
	NIR – chap 1.4																		
Is the methodological choice in line with the sectoral 'Decision Tree to choose a Good Practice method'? Is the methodological choice clearly documented?	*In line with Decision Tree*																		
	calc sheets / background documentation																		
	NIR - sectoral chap																		
Is the methodological choice in line with the Inventory Improvement plan? If not, are explanations and new schedule provided?	*calc sheets / background documentation*																		
	NIR - sectoral chap																		
Is the methodological choice applicable to the entire time series (starting from the base year)? If not, is an explanation and appropriate recalculation provided?	*time series consistent*																		
	calc sheets / background documentation																		
	NIR - sectoral chap																		
	NIR – chap 11																		

Table 1-22 QC TIER 1 & 2 Checklist - (2a) Check regarding content: Activity data / Emission factors / Emissions

	QC TIER 1 & 2 CHECKLIST according to IPCC 2006 Guidelines, Chapter 6	Y = Yes N = No NC = not checked NA = not applicable NR = nor relevant NO = not occurent IE = Included		CO2	CH4	N2O	HFC	PFC	SF6	NF3	SO2	NOx	NMVOC	NH3	CO	Remarks Comments, Corrective measures	Check done Date	Finding Y/ N/ NR	Correction Date	Person	References
38	2 Activity data / Emission factors / Emissions– check regarding content																				
39	**2a Trend checks**																				
40	Are the activity data applicable according to the sectoral 'Decision Tree' and sector-specific *good practice guidance* ?		*calc sheets / background documentation*																		
41			*NIR - sectoral chap*																		
42			*NIR – chap 1.4*																		
43			*NAI table - CTR*																		
44	Confirm consistency and plausibility of the trend of **activity data / emission factor / emissions**! If there are significant outlier (dips or jumps) from expected trends, has a re-check of the data been done? Are plausible explanations for any unexplained or unusual trends provided (documented)?	*documented*	*calc sheets*																		
45		*re-checked*	*calc sheets / background documentation*																		
46		*documented*																			
47		*documented*	*NIR - sectoral chap*																		
48		*documented*	*NIR - Chap 2*																		

Table 1-23 QC TIER 1 & 2 Checklist - (2a) Check regarding content: Activity data / Emission factors / Emissions

	QC TIER 1 & 2 CHECKLIST according to IPCC 2006 Guidelines, Chapter 6	Y = Yes N = No NC = not checked NA = not applicable NR = nor relevant NO = not occurent IE = Included		CO2	CH4	N2O	HFC	PFC	SF6	NF3	SO2	NOx	NMVOC	NH3	CO	Remarks Comments, Corrective measures	Check done Date	Finding Y/ N/ NR	Correction Date	Person	References
1	**2a Trend checks**																				
49	Are the **activity data (AD) and other parameters** plausible in comparison to / consistent with other references? (e.g. national statistics *versus* international statistics *versus* data from association *versus* plant specific data *versus* literature)	*Compared with*																			
50		AD- Official data	*calc sheets / background documentation*																		
51		AD- Other data																			
52		EF- Official data																			
53	Are the **emission factors (EF) and other parameters** plausible in comparison to / consistent with other references? (e.g. default, national values *versus* international values (Cross country) *versus* values from associations *versus* plant specific data *versus* literature)	EF- Other data																			
54		EMI- Official data																			
55		EMI- Other data																			
56		AD- Official data	*NIR - sectoral chap*																		
57		AD- Other data																			
58	Are the **emissions (EMI)** plausible in comparison to / consistent with other references? (e.g. national estimates *versus* international estimates *versus* estimates from associations *versus* plant specific estimates *versus* literature)	EF- Official data																			
59		EF- Other data																			
60		EMI- Official data																			
61		EMI- Other data																			
62	Is information about representativeness of emission factors, national circumstances and analogous emissions data provided?		*calc sheets / background documentation*																		
63			*NIR - sectoral chap*																		
64	Are the values of implied emission/removal factors across time series checked and are explanations for unexplained outliers provided?	Check	*calc sheets*																		
65		explanation																			
66			*NIR - sectoral chap*																		
67	Is a sufficient methodology for filling in time series (overlap, interpolation, trend extrapolation, etc.) for activity , emission factor that are not available annually applied?		*calc sheets / background documentation*																		
68			*NIR - sectoral chap*																		

Table 1-24 QC TIER 1 & 2 Checklist - (2b) Check time series consistency

	QC TIER 1 & 2 CHECKLIST according to IPCC 2006 Guidelines, Chapter 6	Y = Yes N = No NC = not checked NA = not applicable NR = nor relevant NO = not occurent IE = Included		CO2	CH4	N2O	HFC	PFC	SF6	NF3	SO2	NOx	NMVOC	NH3	CO	Remarks Comments, Corrective measures	Check done Date	Finding Y/ N/ NR	Correction Date	Person	References
69	**2b Check time series consistency** (Recalculations due to methodological changes & refinements / Adding new categories / Tracking increases & decreases due to technological change etc.)																				
70	For each category: Are plausible explanations on changes in activity data/ emission factors/ emissions resulting in recalculations provided (documentation)? If there is a change in AD/EF/EMI is the temporal consistency in time series ensured? Are plausible explanations on changes resulting in recalculations provided? If no consistency can be ensured, is an explanation provided?		*No change*																		
71		AD - Changes documented	*calc sheets / background documentation*																		
72		AD -Consistency ensured																			
73		AD - Explain for inconsistency																			
74		EF - Changes documented																			
75		EF -Consistency ensured																			
76		EF - Explain for inconsistency																			
77		EMI - Changes documented																			
78		EMI -Consistency ensured																			
79		EMI - Explain for inconsistency																			
80		AD - Changes documented	*NIR - sectoral chap*																		
81		AD -Consistency ensured																			
82		AD - Explain for inconsistency																			
83		EF - Changes documented																			
84		EF -Consistency ensured																			
85		EF - Explain for inconsistency																			
86		EMI - Changes documented																			
87		EMI -Consistency ensured																			
88		EMI - Explain for inconsistency																			
89		Changes documented	*NIR - Chap 11*																		

Table 1-25 QC TIER 1 & 2 Checklist – (2c) Check completeness

	QC TIER 1 & 2 CHECKLIST according to IPCC 2006 Guidelines, Chapter 6	Y = Yes N = No NC = not checked NA = not applicable NR = nor relevant NO = not occurent IE = Included	CO2	CH4	N2O	HFC	PFC	SF6	NF3	SO2	NOx	NMVOC	NH3	CO	Remarks Comments, Corrective measures	Check done Date	Finding Y/ N/ NR	Correction Date	Person	References
103	**2c Check completeness**																			
104	Confirm that activity data / emission factors / emissions are reported for all categories and for all years from the appropriate base year to the period of the current inventory!	*AD - calc sheets / background documentation*																		
105		*AD - NIR - sectoral chap*																		
106		*EF - calc sheets / background documentation*																		
107		*EF - NIR - sectoral chap*																		
108		*EMI - calc sheets / background documentation*																		
109		*EMI - NIR - sectoral chap*																		
110	For subcategories, confirm that the entire category is being covered.	*calc sheets / background documentation*																		
111		*NIR - sectoral chap*																		
112	Is a clear definition of 'Other' type categories (Non-specified) provided?	*calc sheets / background documentation*																		
113		*NIR - sectoral chap*																		
114		NAI table - CTR																		
115	Are there known data gaps that result in incomplete estimates (notation key NE)? Are these data gaps documented, including a qualitative evaluation of the importance of the estimate in relation to total emissions (e.g., subcategories classified as 'NE')?	*No data gaps*																		
116		*calc sheets / background documentation*																		
117		*NIR - sectoral chap*																		
118		*NIR – chap 1.8 & Annex*																		
119		*NAI table - CTR*																		
120	Are all information provided in respect to the notation key IE (allocation as per IPCC Guidelines)?	*calc sheets / background documentation*																		
121		*NIR - sectoral*																		
122		*NIR – chap 1.8 & Annex 5*																		
123		*NAI table - CTR*																		
124	Are the notation key NA and NO correctly used?	*calc sheets / background documentation*																		
125		*NIR - sectoral chap*																		
126		*NAI table - CTR*																		

Table 1-26 QC TIER 1 & 2 Checklist – (2d) Direct emission measurement: Checks on procedures to measure emissions

	QC TIER 1 & 2 CHECKLIST according to IPCC 2006 Guidelines, Chapter 6	Y = Yes N = No NC = not checked NA = not applicable NR = nor relevant NO = not occurent IE = Included	CO2	CH4	N2O	HFC	PFC	SF6	NF3	SO2	NOx	NMVOC	NH3	CO	Remarks Comments, Corrective measures	Check done Date	Finding Y/ N/ NR	Correction Date	Person	References
127	**2c Check completeness**																			
127	Are there confidential data used (notation key C)? ® **see section Checklist Confidential data !!!**																			
128	Have uncertainties for activity data been estimated and documented? ® **see section Uncertainty below!!!**																			
129	Do the activity / emission factors data relying on a legal reporting commitment (Stockholm convention, questionnaire of UN statistic devision (UNSD), International Energy Agency (IEA) questionnaire, etc.)?	*calc sheets / background documentation*																		
130		*NIR - sectoral chap*																		
131		*NIR - chap 1.4*																		
132	For site-specific activity data, are any national or international standards applicable to the measurement of the data? If so, have they been employed and documented?	*calc sheets / background documentation*																		
133		*NIR - sectoral chap*																		
134	**2d Direct emission measurement: Checks on procedures to measure emissions**																			
135	Which variables rely on direct emission measurements?	*calc sheets / background documentation*																		
136		*NIR - sectoral chap*																		
137	Are procedures used to measure emissions, including sampling procedures, equipment calibration and maintenance? Are these procedures documented?	*calc sheets / background documentation*																		
138		*NIR - sectoral chap*																		
139	Have standard procedures been used, where they exist (such as IPCC methods or ISO standards)?	*calc sheets / background documentation*																		
140		*NIR - sectoral chap*																		

Table 1-27 QC TIER 1 & 2 Checklist – (3a) Formal check: Activity data / Emission factors / Emissions

	QC TIER 1 & 2 CHECKLIST according to IPCC 2006 Guidelines, Chapter 6	Y = Yes N = No NC = not checked NA = not applicable NR = nor relevant NO = not occurent IE = Included	CO_2	CH_4	N_2O	HFC	PFC	SF_6	NF_3	SO_2	NO_x	NMVOC	NH_3	CO	Remarks Comments, Corrective measures	Check done Date	Finding Y/ N/ NR	Correction Date	Person	References
141	**3 Activity data / Emission factors / Emissions – Formal check -** There shall be no transcription errors in the calculation and each data has a clear reference ?																			
142	Is the collection of activity data, emission factor, emissions transparent (described)?	*calc sheets / background documentation*																		
143		*NIR*																		
144	**3a Check that assumptions and criteria for the selection of activity data are documented**																			
145	Are assumptions and criteria for the selection of activity data, emission factor, emissions (e.g. PS) and other relevant parameters documented?	*calc sheets / background documentation*																		
146		*NIR*																		
147	Cross-check descriptions of activity data, emission factor, emissions and other input data with information on categories and ensure that these are properly recorded and archived.	*calc sheets / background documentation*																		
148		*NIR*																		
149		*Archive*																		

Table 1-28 QC TIER 1 & 2 Checklist – (3b) Check for transcription errors in data input and reference

	QC TIER 1 & 2 CHECKLIST according to IPCC 2006 Guidelines, Chapter 6	Y = Yes N = No NC = not checked NA = not applicable NR = nor relevant NO = not occurent IE = Included	CO_2	CH_4	N_2O	HFC	PFC	SF_6	NF_3	SO_2	NO_x	NMVOC	NH_3	CO	Remarks Comments, Corrective measures	Check done Date	Finding Y/ N/ NR	Correction Date	Person	References
150	**3b Check for transcription errors in data input and reference:** *There shall be no transcription errors in the activity data and each data has a clear reference (e.g. UNSD 2016)?*																			
151	Are the activity data, emission factors, emissions and other input data correctly entered and transcribed? Samples in case of big data sets! Electronic data should be used where possible to minimize transcription errors!	*AD -From original source (data provider) to calculations sheet*																		
152		*AD - From calculation sheet to NAI table / CTR*																		
153		*AD - From calc sheets to NIR*																		
154		*AD - From calc sheets to uncertainty file*																		
155		*EF- From original source (data provider) to calculations sheet*																		
156		*EF - From calculation sheet to NAI table / CTR*																		
157		*EF - From calc sheets to NIR*																		
158		*EF - From calc sheets to uncertainty file*																		
159		*EMI - From original source (data provider) to calculations sheet*																		
160		*EMI - From calculation sheet to NAI table / CTR*																		
161		*EMI - From calc sheets to NIR*																		
162		*EMI - From calc sheets to uncertainty file*																		
163		*From calc sheets to 'KCA' file*																		
164	Confirm that bibliographical data references for every activity data, emission factors and other input data (primary data) are properly cited ! Confirm that bibliographical data references for every primary data - Emissions (e.g. EU ETS) are properly cited.	*From original source (data provider)*																		
165		*to calc sheets / background documentation*																		
166		*calc sheets / background documentation*																		
167		*to Model (e.g. energy/transport)*																		
168		*to NIR*																		
169	Do the citations in spreadsheets and NIR conform to acceptable style guidelines (UNFCCC reporting GL)?	*calc sheets / background documentation*																		
170		*Structure of NIR, proposed by the guidelines? (annotated NIR/Annex II: Recommended structure for the Informative Inventory Report)*																		
171	Randomly cross-check a sample of input data from each source category (either measurements or parameters used in calculations) for transcription errors																			
172																				
173	Randomly cross-check bibliographical citations for transcription errors																			
174																				
175	Randomly check that the originals of citations (including Contact Persons) contain the material & content referenced																			
176																				

Table 1-29 QC TIER 1 & 2 Checklist – (3c) Check calculations & Check for consistency in data between categories.

	QC TIER 1 & 2 CHECKLIST according to IPCC 2006 Guidelines, Chapter 6	Y = Yes N = No, NC = not checked, NA = not applicable, NR = nor relevant, NO = not occurent, IE = Included		CO2	CH4	N2O	HFC	PFC	SF6	NF3	SO2	NOx	NMVOC	NH3	CO	Remarks Comments, Corrective measures	Check done Date	Finding Y/ N/ NR	Correction Date	Person	References
177	**3c Calculations correct / Check that parameters and units are correctly recorded and that appropriate conversion factors are used.**																				
178	Are all calculation steps (intermediate results) regarding activity data, emission factor and emissions included (instead of presenting results only? Is the data transmission of intermediate result correct?	provided	*calc sheets / background documentation*																		
179		correct																			
180		provided	*NIR - sectoral chap*																		
181		correct																			
182	Are parameters presented/used appropriately in the spreadsheets and transferred accurately to the NIR & CTR?	appropriately used	*calc sheets / background documentation*																		
183		referenced																			
184		labelled																			
185		carried / go through	*NIR - sectoral chap*																		
186		transferred																			
187	Are conversion factors presented/used appropriately in the spreadsheets and transferred accurately to the NIR & CTR?	appropriately used	*calc sheets / background documentation*																		
188		referenced																			
189		carried / go through	*NIR - sectoral chap*																		
190		transferred																			
191	Are the temporal and spatial adjustments factors (conservative factors) are used correctly and documented ?	correct	*calc sheets / background documentation*																		
192		documented																			
193		correct	*NIR - sectoral chap*																		
194		documented																			
195	Are the units properly labelled and correctly carried through from beginning to end of calculations? Are the units transferred accurately to the NIR & CTR?	correct	*calc sheets / background documentation*																		
196		labelled																			
197		carried / go through																			
198		transferred	*NIR - sectoral chap*																		
199			*NAI table / CTR*																		
200	**3d Check for consistency in data between categories.**																				
201	Are parameters (e.g., activity data, constants) identified that are common to multiple categories? Confirm that there is consistency in the values used for these parameters in the emission/removal calculations?	*calc sheets & NIR of sector #*																			
202		*calc sheets & NIR of sector #*																			
203		*calc sheets & NIR of sector #*																			
204		*calc sheets & NIR of sector #*																			
205		*calc sheets & NIR of sector #*																			

Table 1-30 QC TIER 1 & 2 Checklist – (4) Uncertainties – Check regarding content

	QC TIER 1 & 2 CHECKLIST according to IPCC 2006 Guidelines, Chapter 6	Y = Yes N = No, NC = not checked, NA = not applicable, NR = nor relevant, NO = not occurent, IE = Included	CO2	CH4	N2O	HFC	PFC	SF6	NF3	SO2	NOx	NMVOC	NH3	CO	Remarks Comments, Corrective measures	Check done Date	Finding Y/ N/ NR	Correction Date	Person	References
206	**4 Uncertainties – Check regarding content**																			
207	**4a Check that uncertainties in emissions and removals are estimated and calculated correctly**																			
208	Is the uncertainty estimation of activity data plausible?	*Default*																		
209		*Expert judgement*																		
210																				
211	Are the qualifications of individuals providing expert judgement for uncertainty estimates appropriate?																			
212																				
213																				
214	Is the uncertainty estimation of emission factors plausible?	*Default*																		
215		*Expert judgement*																		
216																				
217	Are the qualifications of individuals providing expert judgement for uncertainty estimates appropriate?																			
218																				

Table 1-31 QC TIER 1 & 2 Checklist – (5) Uncertainties – Formal check

Y = Yes N = No; NC = not checked; NA = not applicable; NR = nor relevant; NO = not occurent; IE = Included

Row	QC TIER 1 & 2 CHECKLIST according to IPCC 2006 Guidelines, Chapter 6	Item	Source	CO_2	CH_4	N_2O	HFC	PFC	SF_6	NF_3	SO_2	NOx	NMVOC	NH_3	CO	Remarks, Comments, Corrective measures	Check done Date	Finding Y/ N/ NR	Correction Date	Person	References
219	**5 Uncertainties – Formal check** *There shall be no transcription errors in the calculation and each data has a clear reference ?*																				
220	Is the designation of uncertainties understandable?		*Sector calc sheets*																		
221			*NIR - sectoral chap*																		
222			*internal 'Uncertainty' calculation file*																		
223	Are the uncertainties estimates complete?		*Calc sheets / background documentation*																		
224			*NIR - sectoral chap*																		
225			*internal 'Uncertainty' calculation file*																		
226			*Table 6.1 GPG Uncertainty Analysis*																		
227	Are the Emissions and the Uncertainties of activity data and emission factor correctly entered and transcribed? *Electronic data should be used where possible to minimize transcription errors!*		*Sector calc sheets*																		
228			*NIR - sectoral chap*																		
229			*internal 'Uncertainty' calculation file*																		
230			*Table 6.1 GPG Uncertainty Analysis*																		
231	Confirm that bibliographical data references for each uncertainty of AD & EF are properly cited		*Calc sheets / background documentation*																		
232			*NIR - sectoral chap*																		
233			*internal 'Uncertainty' calculation file*																		
234	Are assumptions and criteria for the selection of uncertainty of activity data (AD) and emission factor (EF) concerning expert judgement documented?	qualifications	*Sector calc sheets*																		
235		assumptions																			
236		expert judgements																			
237		qualifications	*internal 'Uncertainty' calculation file*																		
238		assumptions																			
239		expert judgements																			
240		qualifications	*NIR - sectoral chap*																		
241		assumptions																			
242		expert judgements																			
243	The archiving of primary data and records has to be ensured! Are the originals of new citations (e-mails, mails, literature sources, statistics, etc.) in the archive?		*properly labelled*																		
244			*stored*																		
245			*stored*																		
246	Randomly cross-check bibliographical citations for transcription errors																				
247	Randomly cross-check: originals of citations (including Contact Reports) contain the material & content referenced																				

Table 1-32 QC TIER 1 & 2 Checklist – (6) Check the integrity of database files & (7) Review of internal documentation/calculation sheet and archiving.

Y = Yes N = No; NC = not checked; NA = not applicable; NR = nor relevant; NO = not occurent; IE = Included

Row	QC TIER 1 & 2 CHECKLIST according to IPCC 2006 Guidelines, Chapter 6	Item	Source	CO_2	CH_4	N_2O	HFC	PFC	SF_6	NF_3	SO_2	NOx	NMVOC	NH_3	CO	Remarks, Comments, Corrective measures	Check done Date	Finding Y/ N/ NR	Correction Date	Person	References
248	**6 Check the integrity of database files**																				
249	Are the data relationships and processing steps correct (e.g., equations) in the spreadsheets? Confirm the correctness of calculations (formulas)!		*calc sheets*																		
250																					
251	Are data path and data coherence understandable?		*calc sheets*																		
252																					
253	Are input data and calculated data (e.g. intra/extrapolated data) clearly differentiated in the spreadsheets?		*calc sheets*																		
254																					
255	Is a representative sample of calculations checked by hand or electronically (only for models and complex calculations)?		*calc sheets*																		
256																					
257	Is it ensued that data fields are properly labelled and have the correct design specifications?		*calc sheets*																		
258																					
259	Are the calculations cross-checked (tested) with "quick" calculations?		*calc sheets*																		
260																					
261	Is it ensured that adequate documentation of database and model structure and operation are archived.		*calc sheets*																		
262																					
263	**7 Review of internal documentation/calculation sheet and archiving.**																				
264	Is a detailed internal documentation to support the estimates and enable reproduction of the emission, removal and uncertainty estimates available?																				
265																					
266	Is the archiving of primary data – acticity data, other parameters and records - ensured?	properly labelled																			
267		stored																			
268	Are the originals of new citations (e-mails, mails, literature sources, statistics, etc.) in the archive and stored to facilitate detailed review?	properly labelled																			
269		stored																			
270																					
271	Is the archive closed and retained in secure place following completion of the inventory?																				
272																					
273	Is the integrity of any data archiving arrangements of outside organisations involved in inventory preparation ensured?																				
274																					

1.5.3 QA and review procedures, and verification activities

As stated in the 2006 IPCCC Guidelines, Chapter 6.8, and presented in **Error! Reference source not found.**, Quality assurance (QA) comprises activities outside the actual inventory compilation. Good practice for QA procedures includes reviews and audits to

- assess the quality of the inventory,
- determine the conformity of the procedures taken and to identify areas where improvements could be made.

QA procedures may be taken at different levels (internal/external), and they are used in addition to the general and category-specific QC procedures

Through internal/external audit and expert peer review an evaluation if TIER2 QC is effectively performed:

- GHG inventory preparation and the GHG inventory is in line with 2006 IPCC Guidelines;
- data collection, calculation, referencing and archiving is handled according to the QA/QC plan;
- enough resources for the preparation of the GHG inventory and related reporting elements (NAI/CTR) table and National Inventory Report (NID)) are guaranteed by relevant national institutions;
- relevant activity data (e.g. energy balance, livestock data) are available and if the reliability of external data is ensured;
- QA/QC plan needs improvement;
- recommendations of UNFCCC international consultation and analysis (ICA) and previous internal/external audits and expert peer reviews have been considered and implemented;
- tailor-made / suitable trainings for the sector experts, National Inventory Compiler and other experts involved in the inventory preparation are provided.

The QC TIER 1 & 2 Checklist which is presented in Chapter 1.5.2 (Table 1-20- Table 1-32) is also used for the QA procedures.

1.5.4 Treatment of confidentiality issues

Information or data is declared as confidential when it could directly or indirectly identify an individual person, business or organization. Following the Statistics Law Article, confidential data should not be published. To ensure completeness confidential data may be used to estimation of GHG emissions and removal, but these emissions can be reported at a higher aggregated level so that confidentiality is no longer an issue.

The checklist *Confidential data*, which is presented in the next Table, should be used in order to ensure, that confidential data used in the inventory is not published.

In the current GHG Inventory no confidential data are used.

Table 1-33 Checklist - Confidential data

	CHECKLIST CONFIDENTIAL DATA according to IPCC 2006 Guidelines - Chapter 6				
1	Submission:		Source / Sink Category:		
2	DATA USE				
3	Title of calculation sheets / internal_documentation / NIR / CTR				
4	Insert of data path/folder				
5	Source/sink category estimates prepared by (name):				
6	Source of confidential data				
7	Description of confidential data				
8	RELEASE OF RESULTS		YES	NO	Comment
9	Data in calculations sheets (Background calculation) visible / marked as confidential data				
10	Data in NAI table / CTR visible directly or indirectly or marked as confidential data (example in „Recalculations“)				
11	Data in NIR not reproducible				
12	RESULTS	confidentiality ensured, publication of results allowed			
13		confidentiality not ensured, publication of results not allowed			
14		Remarks			
15		If confidentiality not ensured, publication of results not allowed			
16		required action / measurements (e.g. higher aggregation)			
17	DATA USED / Acknowledgement of confidential data				
18	Date		Signature (sector expert)		
19	Date		Signature (National Inventory Compiler (NIC))		

1.6 General uncertainty assessment, including data pertaining to the overall uncertainty of inventory totals

A general uncertainty assessment is not performed for this inventory cycle. However, for all sources uncertainties for activity data and emission factors used are provided in the sectoral chapters. The provided information on uncertainties is mainly based on default uncertainties provided in the 2006 IPCC Guidelines.

Uncertainty estimates are an essential element of a complete inventory of greenhouse gas emissions and removals and require a detailed understanding of the uncertainties of the respective input parameters. They should be derived for both the national level and the trend estimate, as well as for the component parts such as emission factors, activity data and other estimation parameters for each category.

As presented in the 2019 Refinement to the 2006 IPCC Guidelines, two approaches for the estimation of combined uncertainties can be applied.

- Approach 1 uses simple error propagation equations and is used to estimate uncertainty in individual categories, in the inventory as a whole, and in trends between a year of interest and a base year.
- Approach 2 uses Monte Carlo or similar techniques.

However, the GHG inventory for 1990 – 2022 is prepared mainly applying TIER 1 methodology including TIER 1 emission factor of the 2006 IPCC guidelines and the 2019 Refinement to the 2006 IPCC Guidelines. Therefore, the default uncertainties associated with the activity data and emission factors were selected.
TIER 1 should be implemented using Table 3.2 of the 2019 Refinement to the 2006 IPCC GL.

- The excel based tool '19R_V1_Ch03_Ad_IPCC_Tool_for_Approach_1_Uncertainty_Analysis.xlsx' provided with the 2019 Refinement to the 2006 IPCC GL[27] was applied.
- The uncertainty calculation was performed applying TIER 1 of the 2019 Refinements to the IPCC 2006 GL, for all sectors excluding LULUCF.

As a result of the uncertainty analysis, the following tables show a total uncertainty of ##% for 2022 (excluding LULUCF) and a total trend uncertainty of ##% for 1990 – 2022.

Table 1-34 Summary report of uncertainties analysis

Sector	Emissions / removals in base year (1990)	Emissions / removals in year t (2022)	Contribution to total uncertainty by sector in year t	Contribution to total trend uncertainty by sector
	kt CO_2 equivalent	kt CO_2 equivalent	%	%
Energy				
IPPU				
Agriculture				
LULUCF				
Waste				
Other				
Total				
Uncertainty in total inventory				

In the Annex II is provided detailed information on the Approach 1 uncertainty analysis using the IPCC tool of the 2019 Refinement to the 2006 IPCC Guidelines.

[27] https://www.ipcc-nggip.iges.or.jp/public/2019rf/vol1.html

1.7 General assessment of the completeness

1.7.1 Information on completeness

Notation keys - NA, NO, NE, IE, C - used are in accordance with the 2006 IPCC Guidelines[28] and MPG[29]:

NO	**not occurring**	for categories or processes, including recovery, under a particular source or sink category that do not occur within a Party;
NE	**not estimated**	for activity data and/or emissions by sources and removals by sinks of GHGs that have not been estimated but for which a corresponding activity may occur within a Party;
NA	**not applicable**	for activities under a given source/sink category that do occur within the Party but do not result in emissions or removals of a specific gas;
IE	**included elsewhere**	for emissions by sources and removals by sinks of GHGs estimated but included elsewhere in the inventory instead of under the expected source/sink category;
C	**confidential**	for emissions by sources and removals by sinks of GHGs where the reporting would involve the disclosure of confidential information.

The sources and sinks not considered in the inventory but included in the IPCC 2006 Guidelines are clearly indicated, the reasons for such exclusion are explained (see relevant sectoral chapters).

Gases	Both direct GHGs as well as precursor gases are covered by the GHG inventory of Albania.
Geographic coverage	The geographic coverage is complete. There is no part of the Albania's territory not covered by the inventory.
Sources and sinks	All sources and sinks included in the IPCC 2006 Guidelines are addressed. No additional sources and sinks specific to Albania have been identified. Currently the source and sink categories, listed in the following table, could not be estimated due to lack of data and resources

Table 1-35 List of sources and sinks that have been not estimated (NE)

IPCC Code	IPCC description	CO_2	N_2O	CH_4	HFC/PFC	SF_6	NF_3
1	**Energy**						
1.A	Fuel Combustion Activities						
1.A.1	Energy Industries						
1.A.1.c.i	Manufacture of Solid Fuels						
1.A.3	Transport						
1.A.3.b.v	Evaporative emissions from vehicles						
1.A.3.b.vi	Urea-based catalysts						
1.A.5	Non-Specified						

[28] 2006 IPCC Guidelines, Volume 1: General Guidance and Reporting, Chapter 8: Reporting Guidance and Tables, TABLE 8, page 8.7.

[29] Modalities, procedures and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement, Para 31, https://unfccc.int/sites/default/files/resource/CMA2018_03a02E.pdf

IPCC Code	IPCC description	CO_2	N_2O	CH_4	HFC/PFC	SF_6	NF_3
2	**Industrial processes**						
2.F	Product Uses as Substitutes for Ozone Depleting Substances						
2.F.4	Aerosols						
2.F.5	Solvents						
2.F.6	Other Applications						
2.G	Other Product Manufacture and Use						
2.G.2	SF_6 and PFCs from Other Product Uses						
2.G.2.b	Accelerators						
2.G.3	N_2O from Product Uses						
2.G.3.a	Medical Applications						
2.G.3.b	Propellant for pressure and aerosol products						
3	**Agriculture**						
3.D.a	Direct N_2O emissions from managed soils						
3.D.a.2.b	Sewage sludge applied to soils						
3.D.a.2.c	Other organic fertilizers applied to soils						
3.D.a.5	Mineralization/immobilization associated with loss/ gain of soil organic matter						
3.D.a.6	Cultivation of organic soils (i.e. histosols)						
3.D.b	Indirect N_2O Emissions from managed soils						
3.D.b.1	Atmospheric deposition						
3.D.b.2	Nitrogen leaching and run-off						
4	**Land use, Land-use change and Forestry**						
4.B	Cropland						
4.B.2	Land converted to cropland						
4.B.2.3	Carbon stock change in soils (Land converted to cropland)						
4.B.2.5	Carbon stock change in soils (Other land converted to cropland)						
4.D	Wetlands						
4.D.1	Wetlands remaining wetlands						
4.E	Settlements						
4.E.1	Settlements remaining settlements						
4.F	Other Land						
4.F.1	Other land remaining other land						
4.F.2.1	Carbon stock change in soil (Forest land converted to other land)						
4(V) 4 B 1	Biomass burning: controlled: residues of perennial cropland						
5	**Waste**						
5.B	Biological Treatment of Solid Waste						
5.C	Incineration and Open Burning of Waste						
5.C.1	Waste Incineration						
5.C.2	Open Burning of Waste						
5.D	Wastewater Treatment and Discharge						

IPCC Code	IPCC description	CO_2	N_2O	CH_4	HFC/PFC	SF_6	NF_3
5.D.2	Industrial Wastewater Treatment and Discharge						
	Memo Items						
	International Bunkers						
1.A.3.a.i	Multilateral Operations						

1.7.2 Description of insignificant categories

No insignificant categories have been identified.

1.7.3 Total aggregate emissions considered insignificant

No insignificant total aggregate emissions have been identified**.**

1.8 Metrics

The aggregated greenhouse gases (GHG in CO_2 equivalents) are prepared using the global warming potentials (GWP) provided by the IPCC Fourth Assessment Report (AR4)[30] based on the effects of GHGs over a 100-year time horizon.

Table 1-36 Global warming potentials (GWP) provided by the IPCC Fifth Assessment Report (AR5).

Gas name	Chemical formula / Abbreviation	Global Warming Potential (Time Horizon) based on the effects of GHGs over a 100-year time horizon
Carbon dioxide	CO_2	1
Methane	CH_4	28
Nitrous oxide	N_2O	265
Sulphur hexafluoride	SF_6	23 500
Hydrofluorocarbons	HFC	hydrofluorocarbons (HFCs) consist of different substances, therefore GWPs have to be calculated individually depending on the substances
Perfluorocarbons	PFC	perfluorocarbons (PFCs) consist of different substances, therefore GWPs have to be calculated individually depending on the substances
Nitrogen trifluoride	NFH_3	16 100

1.9 Summary of any flexibility applied

No flexibilities within the meaning of para 3(c) of the Modalities, procedures and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement have been applied.

[30] IPCC. (2007). *Climate Change 2007 - The Physical Science Basis Contribution of Working Group I to the Fourth Assessment Report of the IPCC. (Table TS.2).* Available (12 May 2019) at: https://www.ipcc.ch/site/assets/uploads/2018/05/ar4_wg1_full_report-1.pdf

2 Trends in greenhouse gas emissions and removals

3 Energy (CRT sector 1)

3.1 Overview of the sector

In the Energy Sector, emissions originating from, fuel combustion activities in road traffic, in the energy and manufacturing industry and in the commercial, agricultural and residential sector (Category 1.A) as well as fugitive emissions from fuels (Category 1.B) are considered.

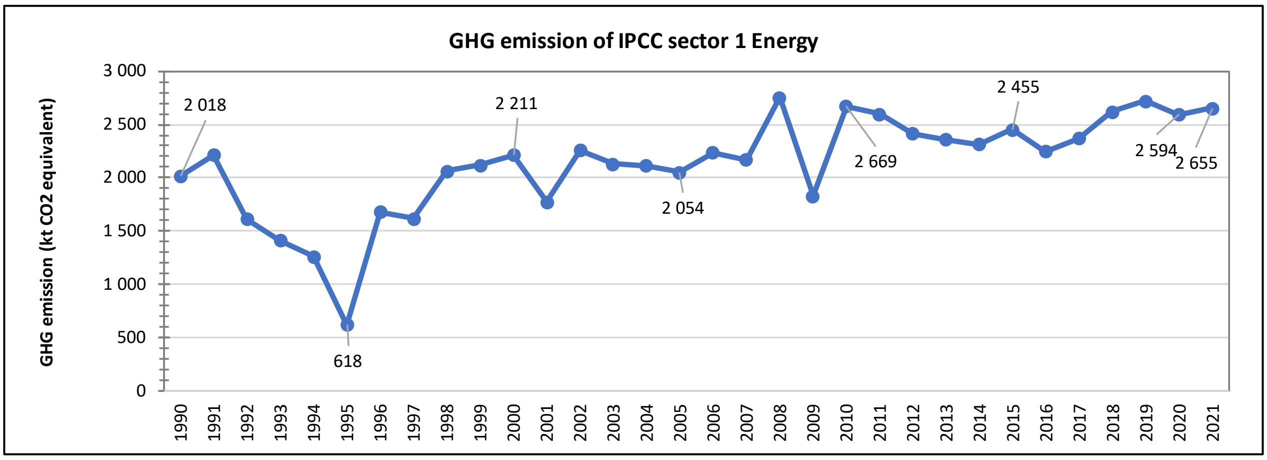


Figure 3-1 Trend of GHG emissions from CRT sector 1 Energy: 1990 – 2022

In 2022, greenhouse gas emissions from CRT sector 1 *Energy* amounted to ## kt CO_2 equivalents which corresponds to ##% of the total national emissions (without LULUCF). ##% of the emissions from this sector originate from fuel combustion (1.A) while fugitive emissions from fuels (1.B) contribute with about ##%. the main sub-categories within 1.A fuel combustion are 1.A.1. Energy industries and 1.A.3. Transport (here road transport)

The **overall trend** in GHG emissions from the sector *Energy* shows increasing emissions with a increase of ##% from 1990 to 2022, ##% from 1990 to 2022, and ###% from 1990 to 2022.

Fugitive emissions decreased by ###% since 1990 due to slightly decreasing mining and post-mining activities.

Fluctuation of emissions in CRT sector 1 Energy are due to stopped/shut-down electricity and industrial production and/or limited public life during the time of

Fluctuation of emissions are due to stopped/shut-down industrial production and limited public life during the time of please check reasons and provide more reasons

- overall economic downturn in the country after 1994;
- world-wide economic crisis in 2007/2008;
- increased electricity production by hydropower and solar photovoltaic.
- agricultural activities;
- change in number of population;
- increasing road transport;
- worldwide COVID pandemic and the lockdown.

The CRT category 1.C. Carbon capture and storage (CCS) does not exist in Albania.

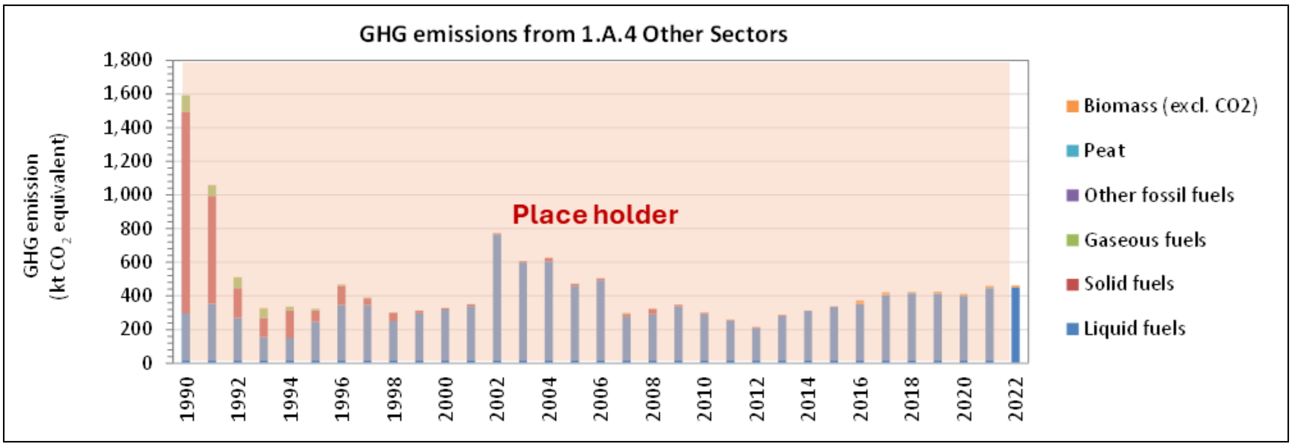


Figure 3-2 Trend of GHG emissions of CRT category 1.A Fuel combustion and 1.B Fugitive emissions for the period 1990 – 2022

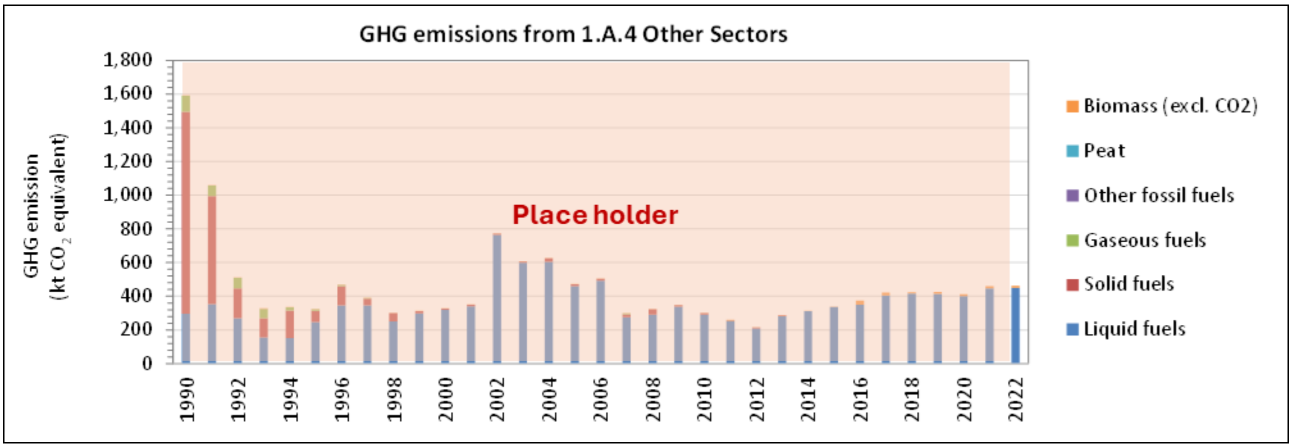


Figure 3-3 Trend of GHG emissions of CRT sector 1 Energy by category for the period 1990 – 2022

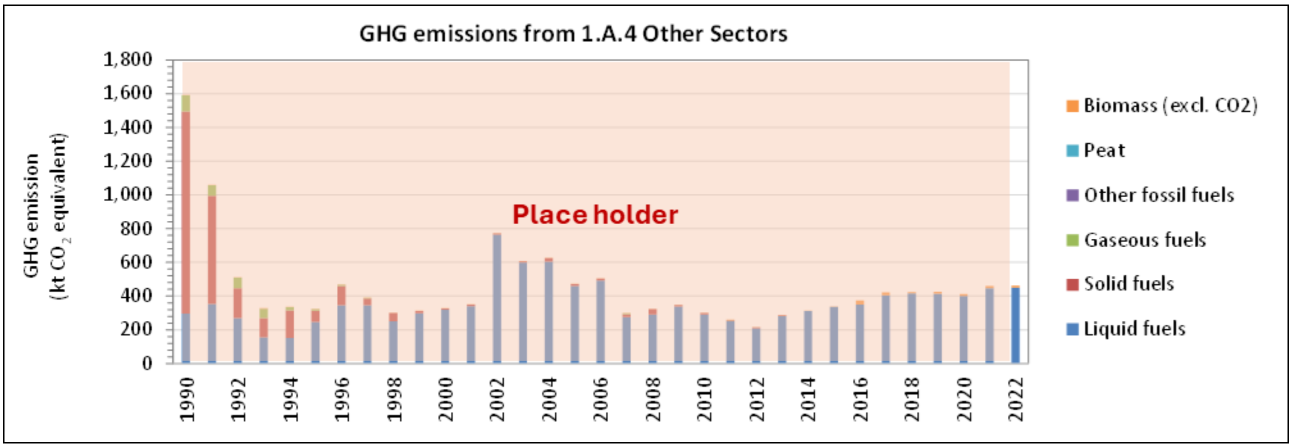


Figure 3-4 Trend of emissions from CRT sector 1 Energy in index form (base year = 100) by category for the period 1990 – 2022

Table 3-1 GHG Emissions from CRT category 1 Energy by sub-categories for the period 1990-2022

GHG emissions	1 Energy	1.A Fuel Combustion Activities	1.A.1 Energy Industries	1.A.2 Manufacturing Industries and Construction	1.A.3 Transport	1.A.4 Other Sectors	1.A.5 Non-Specified	1.B Fugitive emissions from fuels
	kt CO_2 equivalent							
1990								
1991								
1992								
1993								
1994								
1995								
1996								
1997								
1998								
1999								
2000								
2001								
2002								
2003								
2004								
2005								
2006								
2007								
2008								
2009								
2010								
2011								
2012								
2013								
2014								
2015								
2016								
2017								
2018								
2019								
2020								
2021								
2022								
Trend								
1990 - 2022								
2005 - 2022								
2021 - 2022								

Table 3-2 CO_2 Emissions from CRT category 1 Energy by sub-categories for the period 1990-2022

CO_2 emissions	1 Energy	1.A Fuel Combustion Activities	1.A.1 Energy Industries	1.A.2 Manufacturing Industries and Construction	1.A.3 Transport	1.A.4 Other Sectors	1.A.5 Non-Specified	1.B Fugitive emissions from fuels
	kt							
1990								
1991								
1992								
1993								
1994								
1995								
1996								
1997								
1998								
1999								
2000								
2001								
2002								
2003								
2004								
2005								
2006								
2007								
2008								
2009								
2010								
2011								
2012								
2013								
2014								
2015								
2016								
2017								
2018								
2019								
2020								
2021								
2022								
Trend								
1990 - 2022								
2005 - 2022								
2021 - 2022								

Table 3-3 CH_4 Emissions from CRT category 1 Energy by sub-categories for the period 1990-2022

CH_4 emissions	1 Energy	1.A Fuel Combustion Activities	1.A.1 Energy Industries	1.A.2 Manufacturing Industries and Construction	1.A.3 Transport	1.A.4 Other Sectors	1.A.5 Non-Specified	1.B Fugitive emissions from fuels
	kt CO2 equivalent							
1990								
1991								
1992								
1993								
1994								
1995								
1996								
1997								
1998								
1999								
2000								
2001								
2002								
2003								
2004								
2005								
2006								
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2008								
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2010								
2011								
2012								
2013								
2014								
2015								
2016								
2017								
2018								
2019								
2020								
2021								
2022								
Trend								
1990 - 2022								
2005 - 2022								
2021 - 2022								

Table 3-4 N_2O Emissions from CRT category 1 Energy by sub-categories for the period 1990-2022

N_2O emissions	1 Energy	1.A Fuel Combustion Activities	1.A.1 Energy Industries	1.A.2 Manufacturing Industries and Construction	1.A.3 Transport	1.A.4 Other Sectors	1.A.5 Non-Specified	1.B Fugitive emissions from fuels
	kt CO2 equivalent							
1990								
1991								
1992								
1993								
1994								
1995								
1996								
1997								
1998								
1999								
2000								
2001								
2002								
2003								
2004								
2005								
2006								
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2010								
2011								
2012								
2013								
2014								
2015								
2016								
2017								
2018								
2019								
2020								
2021								
2022								
Trend								
1990 - 2022								
2005 - 2022								
2021 - 2022								

3.2 Fuel combustion

3.2.1 Comparison of the Sectoral Approach (SA) with the Reference Approach (RA)

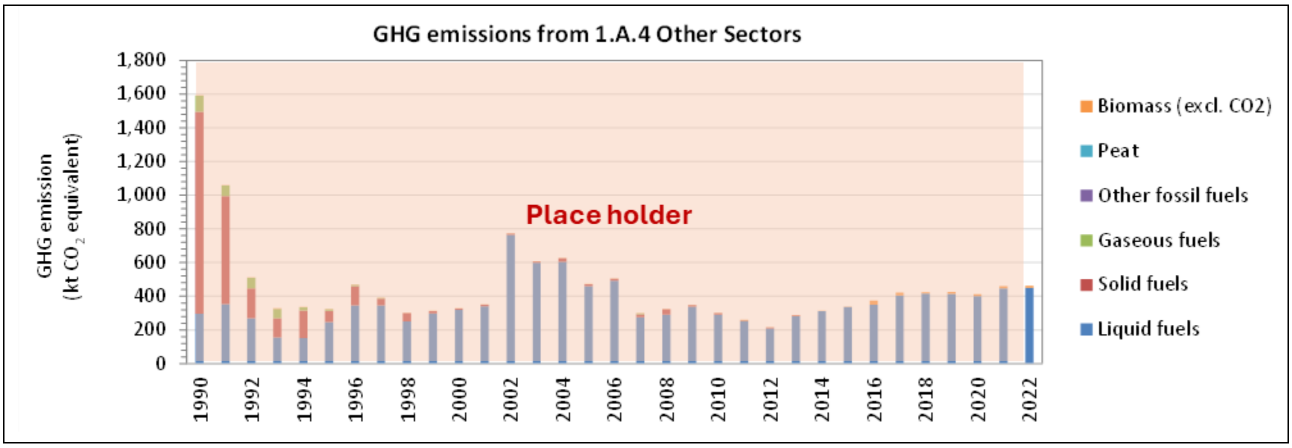


Figure 3-5 CO_2 emissions (Total) of the Reference and Sectoral Approach 1990 to 2022.

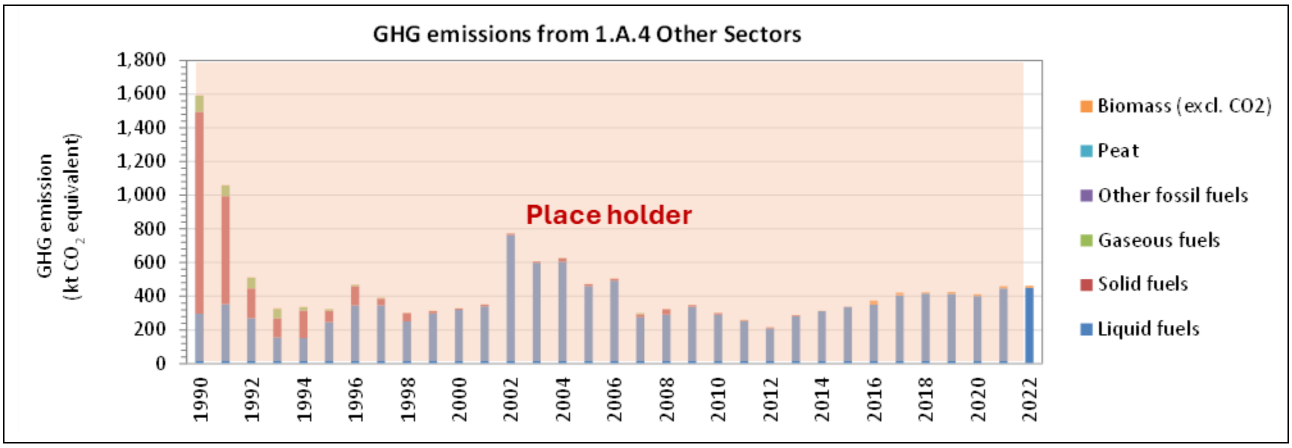


Figure 3-6 CO_2 emissions (detailed) of the Reference and Sectoral Approach 1990 to 2021.

Explanation of differences

- Use of country specific NCV (CS NCV) for solid fuels – Lignite.
- Use of country specific emissions factor.
- Non-energy use consumption of fuels like bitumen and luibricants

The following table provides the results of the CO_2 emissions of the reference and sectoral approaches.

Table 3-5 CO_2 emissions of the Reference and Sectoral Approach 1990 to 2022

	Reference Approach					Sectoral Approach 1.A Fuel Combustion				
	Total fossil fuels	Liquid fossil fuels	Solid fossil fuels	Gaseous fossil fuels	Other fossil fuels	Total fossil fuels	Liquid fossil fuels	Solid fossil fuels	Gaseous fossil fuels	Other fossil fuels
	kt					kt				
1990										
1991										
1992										
1993										
1994										
1995										
1996										
1997										
1998										
1999										
2000										
2001										
2002										
2003										
2004										
2005										
2006										
2007										
2008										
2009										
2010										
2011										
2012										
2013										
2014										
2015										
2016										
2017										
2018										
2019										
2020										
2021										

The following tables provide the differences of CO_2 emissions in percent between reference and sectoral approaches.

Table 3-6 Differences of CO_2 emissions of the Reference and Sectoral Approaches by type of fuel in percent

	Total	Liquid	Solid	Gaseous	Peat	Other fossil fuels
1990						
1991						
1992						
1993						
1994						
1995						
1996						
1997						
1998						
1999						
2000						
2001						
2002						
2003						
2004						
2005						
2006						
2007						
2008						
2009						
2010						
2011						
2012						
2013						
2014						
2015						
2016						
2017						
2018						
2019						
2020						
2021						
2022						

3.2.1.1 Methodology

The default methodology is applied according to 2006 IPCC Guidelines[31]. The Reference Approach methodology breaks the calculation of carbon dioxide emissions from fuel combustion into 5 steps:

Step 1: Estimate apparent fuel consumption in original units

Step 2: Convert to a common energy unit

Step 3: Multiply by carbon content to compute the total carbon

Step 4: Compute the excluded carbon

Step 5a: Correct for carbon unoxidized

Step 5b: Convert to CO_2 emissions

These steps are expressed in the following equation.

Equation 6.1: CO_2 Emissions from fuel combustion using the Reference approach (2006 IPCC GL, Vol. 2, Chap. 6.3)

$$CO_2 Emissions = \sum_{all\ fuels}\left[\left(\left(\mathbf{Apparent\ Consumption}_{fuel} \times \mathbf{ConversionFactor}_{fuel} \times \mathbf{Carbon\ Content}_{fuel}\right) \times \mathbf{10^{-3}} - \mathbf{Excluded\ Carbon}_{fuel}\right) \times \mathbf{Fraction\ of\ carbon\ oxidised}_{fuel} \times \frac{\mathbf{44}}{\mathbf{12}}\right]$$

Where:

Emissions $_{CO2}$	= CO_2 emissions (Gg CO_2)
Apparent Consumption	= production + imports – exports – international bunkers - stock change
Conversion Factor (ConVer)	= conversion factor for the fuel to energy units (TJ) on a net calorific value basis
Carbon content (CC)	= carbon content (tonne C/TJ) *Note that tonne C/TJ is identical to kg C/GJ*
Excluded Carbon	= carbon in feedstocks and non-energy use excluded from fuel combustion emissions (Gg C)
Fraction of carbon oxidised (COF)	= fraction of carbon oxidised. *Usually the value is 1, reflecting complete oxidation. Lower values are used only to account for carbon retained indefinitely in ash or soot*
44/12	= molecular weight ratio of CO_2 to C

3.2.1.2 Activity data

3.2.1.2.1 Apparent consumption of fuels

***Step 1**: Estimate apparent fuel consumption in original units*

According to 2006 IPCC Guidelines the supply of fuels is calculated based on data for each fuel and inventory year:

- ⇨ the amounts of primary fuels **produced**[32] (production of secondary fuels and fuel products is not included);
- ⇨ the amounts of primary and secondary fuels **imported**;

[31] 2006 IPCC Guidelines, Volume 2: Energy, Chapter 6: Reference Approach, sub-chapter 6.3 ALGORITHM , page 6.5

[32] Production of coal includes the quantities extracted or produced calculated after any operation for removal of inert matter.

- ⇨ the amounts of primary and secondary fuels **exported**;
- ⇨ the amounts of primary and secondary fuels **used in international bunkers**;
- ⇨ the net **increases or decreases** in **stocks** of primary and secondary fuels.

The production of secondary fuels should be ignored in the calculations because the carbon in these fuels is already included in the supply of primary fuels from which they were derived.

The **apparent consumption of a primary fuel** is calculated as follows:

Equation 6.2: Apparent consumption of primary fuel (2006 IPCC GL, Vol. 2, Chap. 6.3)

$$\begin{aligned}\text{Apparent Consumption}_{fuel} = \text{Production}_{fuel} \\ +\text{Imports}_{fuel} \\ -\text{Exports}_{fuel} \\ -\text{International Bunkers}_{fuel} \\ -\text{Stock Change}_{fuel}\end{aligned}$$

The **apparent consumption of a secondary fuel** is calculated as follows:

Equation 6.3: Apparent consumption of secondary fuel (2006 IPCC GL, Vol. 2, Chap. 6.3)

$$\begin{aligned}\text{Apparent Consumption}_{fuel} = \text{Imports}_{fuel} \\ -\text{Exports}_{fuel} \\ -\text{International Bunkers}_{fuel} \\ -\text{Stock Change}_{fuel}\end{aligned}$$

3.2.1.2.2 Conversion to energy units

***Step 2**: Convert to a common energy unit*

In energy statistics, production, transformation and consumption of solid, liquid, gaseous and renewable fuels are specified in physical units, e.g. in tonnes or cubic meters. To convert these data to energy units, in this case terajoules, requires calorific values. For estimation of emissions that arise from combustion of fossil fuels, the default net caloric values (NCV) have been used according to 2006 IPCC Guidelines and presented in the following table.

3.2.1.2.3 Excluded carbon

***Step 4**: Compute the excluded carbon*

The amount of carbon which does not lead to fuel combustion emissions has to be excluded, as the because the aim is to provide an estimate of fuel combustion emissions (Source category 1A).

Carbon excluded from fuel combustion is either emitted in another sector of the inventory (for example as an industrial process emission) or is stored in a product manufactured from the fuel. In the 1996 Guidelines, carbon in the apparent consumption that does not lead to fuel combustion emissions has been referred to as “stored carbon” but, as the above definition makes clear, stored carbon is only part of the carbon to be excluded from “total carbon” in the 2006 IPCC Guidelines. The main flows of carbon concerned in the calculation of excluded carbon are those used as feedstock, reductant or as non-energy products. Table 6.1 sets out the main products in each group. If countries have other fossil fuel carbon products, which should be excluded, they should be taken into consideration and documented.

Table 3-7 Overview of fuel used as feedstock, reductant and/or non-energy products in Albania

	Fuel	Non-energy fuel use in Albania
Feedstock: Feedstocks are fossil fuels that are used as raw materials in chemical conversion processes in order to produce primarily organic chemicals and, to a lesser extent, inorganic chemicals (especially ammonia) and their derivatives. In most cases, part of the carbon remains embodied in the product manufactured. The use of hydrocarbon feedstocks in chemical conversion processes is almost entirely confined to the chemical and petrochemical industries.	Naphtha	—
	LPG (butane/propane)	—
	Gas/diesel oil and Kerosene	—
	Natural gas	—
	Ethane	—
	Other	—
Reductant: Carbon is used as reducing agent for the production of various metals and inorganic products. It is either used directly as reducing agent or indirectly via the intermediate production of electrodes used for electrolysis. In most cases, only very small amounts of carbon are embodied in the product manufactured, while the major part is oxidised during the reduction process.	Coke oven coke (metallurgical coke) and petroleum coke	X
	Coal and coal tar/pitch	—
	Natural gas	
	Other	—
Non-energy products: Apart from fuels, refineries and also coke ovens produce some non-energy products which are used directly (i.e., without chemical conversion) for their physical or diluent properties or which are sold to the chemical industry as chemical intermediate. Lubricants and greases are used in engines for their lubricating properties; paraffin waxes are used as candles, for paper coating etc.; bitumen on roofs and roads for its waterproofing and wear qualities. Refineries also produce white spirits, which are used for their solvent properties.	Bitumen	X
	Lubricants	X
	Paraffin waxes	—
	White spirit	X
	Other	—

Table 3-8 Fuel used as feedstock, reductant and/or non-energy products in Albania

	Coke oven coke (metallurgical coke)	Bitumen	Lubricants	White spirit	Naphtha
	[TJ]	[TJ]	[TJ]	[TJ]	[TJ]
1990	225.60	2,104.87	671.90	0	0
1991	197.40	818.56	335.95	0	0
1992	NO	428.77	125.98	0	0
1993	NO	740.60	125.98	0	0
1994	NO	1,325.29	41.99	0	0
1995	NO	1,286.31	0	0	0
1996	NO	779.58	0	0	0
1997	NO	662.64	0	0	0
1998	NO	623.66	0	0	0
1999	NO	662.64	1,217.83	902.96	0
2000	NO	623.66	1,217.83	859.96	0
2001	NO	623.66	1,175.83	902.96	0
2002	NO	38.98	839.88	257.99	0
2003	NO	623.66	1,049.85	257.99	0
2004	NO	1,247.33	1,175.83	386.98	0
2005	NO	1,559.16	1,133.84	386.98	0
2006	NO	3,352.19	1,133.84	257.99	0
2007	NO	1,130.39	1,217.83	1,934.91	0
2008	NO	623.66	1,217.83	945.96	0
2009	NO	5,690.93	377.95	558.97	0

	Coke oven coke (metallurgical coke)	Bitumen	Lubricants	White spirit	Naphtha
	[TJ]	[TJ]	[TJ]	[TJ]	[TJ]
2010	NO	3,157.30	377.95	1,074.95	0
2011	NO	1,325.29	335.95	214.99	0
2012	NO	818.56	713.90	43.00	0
2013	NO	389.79	293.96	43.00	0
2014	NO	77.96	293.96	0	360.064
2015	NO	1,013.45	0	43.00	0
2016	NO	2,494.66	0	0	0
2017	NO	577.28	0	16.34	0
2018	NO	167.77	0	16.34	0
2019	NO	1,324.78	0	19.26	0
2020	NO	806.87	0	23.22	0
2021	NO	1,246.35	0	26.66	0
2022	NO	1,095.82	0.00	27.52	0
Note: Does the value 0 means NR (not reported) or NO (not occurrent); please check with INSTAT, Energy balance					

3.2.1.3 Emission factor

3.2.1.3.1 Carbon content

Step 3: Multiply by carbon content to compute the total carbon

For estimation of emissions that arise from combustion of fossil fuels, the default carbon content has been used according to 2006 IPCC Guidelines and presented in the following table.

3.2.1.3.2 Fraction of carbon oxidized

Step 5a: Correct for carbon unoxidized

For estimation of emissions that arise from combustion of fossil fuels, the default fraction of carbon oxidated has been used according to 2006 IPCC Guidelines and presented in the following table.

A small part of the fuel carbon entering the combustion process escapes oxidation. This fraction is usually small (99 to 100 % of the carbon is oxidized) and it is assumed that 100% is oxidated.

Table 3-9 Default net calorific values (NCVs), default values of carbon content (CC), default fraction of carbon oxidized and indication which fuel was used in Albania

		Default Net Calorific Values (NCVs)	Default values of Carbon Content (CC)	Default Fraction of carbon oxidized	Fuel used in Albania
		TJ/Gg	kg/GJ	%	
LIQUID (Crude oil and petroleum products)					
Gasoline	Motor Gasoline	44.3	18.9	1	X
Jet Kerosene		44.1	19.5	1	X
Gas/Diesel Oil		43.0	20.2	1	X
Residual Fuel Oil		40.4	21.1	1	X

		Default Net Calorific Values (NCVs)	Default values of Carbon Content (CC)	Default Fraction of carbon oxidized	Fuel used in Albania
		TJ/Gg	kg/GJ	%	
Liquefied Petroleum Gases		47.3	17.2	1	X
Bitumen		40.2	22	1	x
Lubricants		40.2	20	1	x
Other Oil	Paraffin Waxes	40.2	20	1	
	White Spirit and SBP	40.2	20	1	
	Other Petroleum Products	40.2	20	1	x
SOLID (Coal and coal products)					
Lignite		11.9	27.6	1	x
GAS (Natural Gas)					
OTHER FOSSIL FUELS					
PEAT					
BIOMASS					
Source *Footnote (above) in this tables are referred to footnotes provided in tables in 2006 IPCC Guidelines.*		*TABLE 1.2* [33]	*TABLE 1.3* [34]	*TABLE 1.4* [35]	

[33] 2006 IPCC Guidelines, Volume 2: Energy, Chapter 1: Introduction, sub-chapter 1.4.1.3 ACTIVITY DATA SOURCES, page 1.17

[34] 2006 IPCC Guidelines, Volume 2: Energy, Chapter 1: Introduction, sub-chapter 1.4.2.1 CO2 EMISSION FACTORS, page 1.20

[35] 2006 IPCC Guidelines, Volume 2: Energy, Chapter 1: Introduction, sub-chapter 1.4.2.1 CO2 EMISSION FACTORS, page 1.23

3.2.2 International bunker fuels

International bunkers are relevant for

- International aviation: Tirana, Vlora and Kukës
- International navigation on Adriatic Sea (Mediterranean Sea) and Lake Skadar

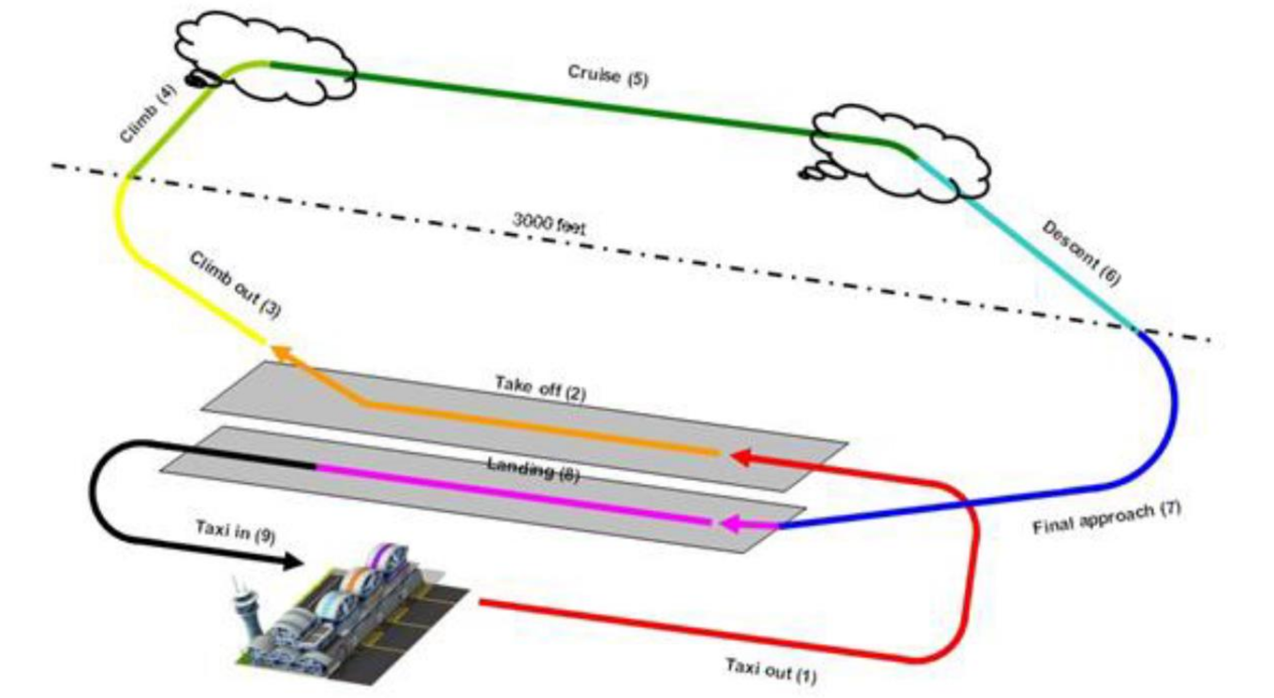
3.2.2.1 International Aviation (International bunkers)

As described in the 2006 IPCC Guidelines, the CRT category *International Aviation (International bunkers)* includes emissions from flights that depart in one country and arrive in a different country. Also, International navigations include take-offs and landings for these flight stages. It is *good practice*, that emissions from domestic navigation are reported separately from international navigation and it is *good practice* to apply the definition presented in the following table.

Table 3-10 Criteria for defining international or domestic *Aviation*

Criteria for defining international or domestic navigation (applies to individual legs of journeys with more than one take-off and landing)		
Journey type between two airports	**Domestic**	**International**
• Departs and arrives in same country	Yes	No
• Departs from one country and arrives in another	No	Yes
Source: 2006 IPCC Guidelines, Volume 2, Chapter 3: Mobile Combustion, 3.6.1.3 Choice of activity data, TABLE 3.6.		

Furthermore, the flight is composed of several distinct phases of flight as presented in the figure below.[36]



(1) taxi-out	(2) taxi-off	(3) climb-out	(4) climb	(5) cruise
(6) descent	(7) final approach	(8) landing	(9) taxi-in	

Figure 3-7 Typical phases of flight

[36] EMEP/EEA air pollutant emission inventory guidebook 2023, Chapter Aviation 1.A.3.a, Page 7, Figure 3–3 Typical phases of flight.

Figure 3-8 Map of Albania with airports und airfields

Tirana

- IATA code: TIA, ICAO code: LATI
- built during the period 1955-1957
- length of runway: 2,750
- passenger: about 5,198,550 (2022)
- cargo: 2,045 metric tons
- aircraft movements: 38,517 (2022)

Kukës

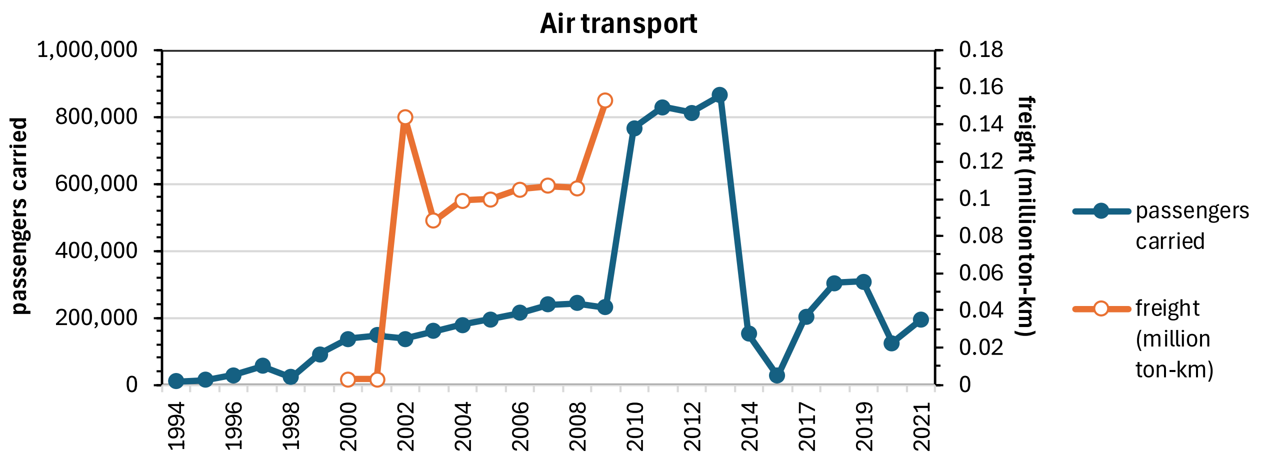
- IATA CODE: KFZ, ICAO: LOOP
- Start of operation: 1999,
  since 2021 international airport
- length of runway: 2,198 m
- passenger: about 39,752 (2022)
- aircraft movements: 545 (2022)

Vlora

- start of operation: under construction

Source: Wikipedia: List of airports in Albania[37]

Albania has three international airports and several airfields. The number of passengers carried by international aviation but also the international freight transport increased but was also subject to considerable fluctuations. The drop in 2020 is due to worldwide covid pandemic. PLEASE PROVIDE MORE EXPLANATION



Source: UNstatistics / Worldbank: World Development Indicators

Note: For freight transport after 2009 no data available

Figure 3-9 Air transport - passengers carried and freight (million ton-km)

[37] https://en.wikipedia.org/wiki/List_of_airports_in_Albania

GHG emissions from combustion of fuel in *international aviation* amounted to

- 205.43 kt CO_2 equivalent in the year 2005.
- 124.57 kt CO_2 equivalent in the year 2022.

Data on fuel consumption or flight movements for period 1990 – 1998 are currently not available and therefore GHG emissions were not estimated.

GHG emissions from *international aviation* decreased by -39.4% % in the period 2005 – 2022, which is mainly caused by decreasing activities in freight transport.

PLEASE PROVIDE MORE EXPLANATION for trend

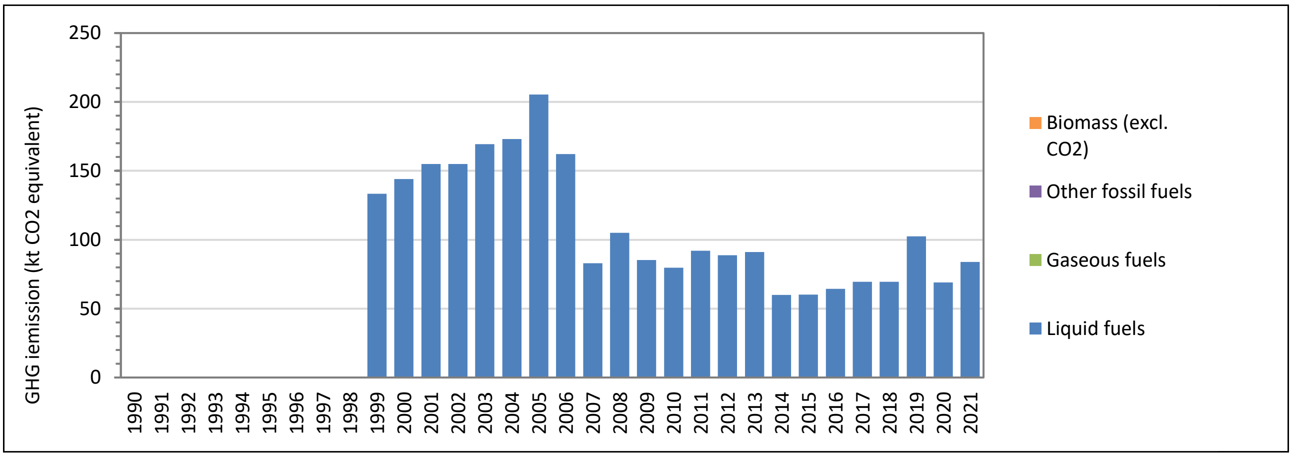


Figure 3-10 GHG emissions from International Bunkers: International aviation

Table 3-11 Activity data and Emissions from International Bunkers - International aviation

International aviation	Emission				Activity data		
	GHG	CO_2	N_2O	CH_4	Jet Kerosene	Aviation fuel	Biomass
	kt CO_2 equivalent	kt	kt	kt	[TJ]		
1990	NE	NE	NE	NE	NO	NO	NO
1991	NE	NE	NE	NE	NO	NO	NO
1992	NE	NE	NE	NE	NO	NO	NO
1993	NE	NE	NE	NE	NO	NO	NO
1994	NE	NE	NE	NE	NO	NO	NO
1995	NE	NE	NE	NE	NO	NO	NO
1996	NE	NE	NE	NE	NO	NO	NO
1997	NE	NE	NE	NE	NO	NO	NO
1998	NE	NE	NE	NE	NO	NO	NO
1999	133.35	132.25	0.0040	0.0013	1,591.00	NO	NO
2000	144.16	142.98	0.0043	0.0014	1,720.00	NO	NO
2001	154.97	153.70	0.0046	0.0015	1,849.00	NO	NO
2002	154.97	153.70	0.0046	0.0015	1,849.00	NO	NO
2003	169.39	168.00	0.0051	0.0017	2,021.00	NO	NO
2004	172.99	171.57	0.0052	0.0017	2,064.00	NO	NO
2005	205.43	203.74	0.0061	0.0020	2,451.00	NO	NO
2006	162.18	160.85	0.0048	0.0016	1,935.00	NO	NO

International aviation	Emission				Activity data		
	GHG	CO_2	N_2O	CH_4	Jet Kerosene	Aviation fuel	Biomass
	kt CO_2 equivalent	kt	kt	kt	[TJ]		
2007	82.97	81.46	0.0055	0.0018	817.00	NO	NO
2008	105.02	103.51	0.0055	0.0018	1,118.00	NO	NO
2009	85.42	83.75	0.0061	0.0020	817.00	NO	NO
2010	79.83	78.12	0.0062	0.0021	731.00	NO	NO
2011	92.00	90.12	0.0069	0.0023	860.00	NO	NO
2012	88.81	87.13	0.0061	0.0020	860.00	NO	NO
2013	91.19	89.56	0.0059	0.0020	903.00	NO	NO
2014	60.04	58.52	0.0055	0.0018	344.00	NO	NO
2015	60.21	58.45	0.0064	0.0021	86.00	NO	NO
2016	61.25	62.56	0.0067	0.0022	258.00	NO	NO
2017	69.48	67.45	0.0074	0.0025	313.04	NO	NO
2018	69.41	67.31	0.0077	0.0026	287.67	NO	NO
2019	102.44	100.08	0.0086	0.0029	903.00	NO	NO
2020	69.10	67.84	0.0046	0.0015	679.40	NO	NO
2021	83.86	81.70	0.0079	0.0026	690.15	NO	NO
2022	190.17	186.96	0.0117	0.0039	1,585.63	NO	NO
Trend							
1990 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
2005 - 2022	*-39.4%*	*-40.4%*	*90.9%*	*90.9%*	*-71.8%*	*NA*	*NA*
2021- 2022	*48.5%*	*48.5%*	*48.3%*	*48.3%*	*0.0%*	*NA*	*NA*

3.2.2.1.1 Methodological issues

3.2.2.1.1.1 Choice of methods – TIER 2

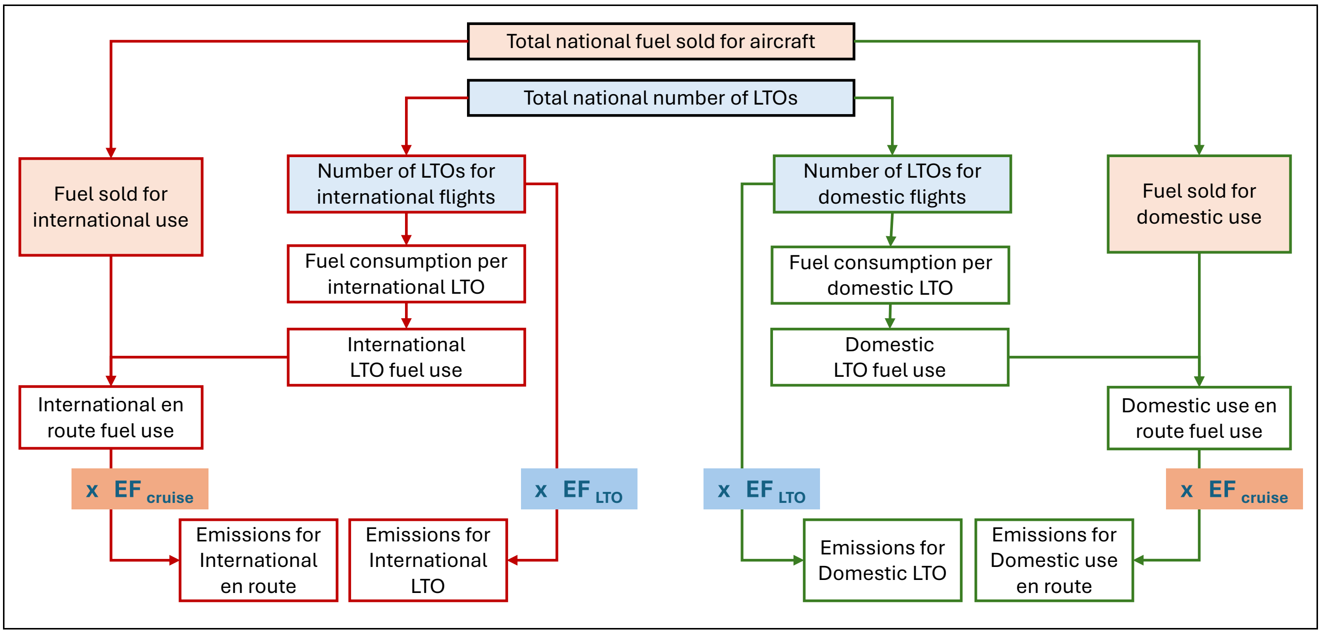


Figure 3.11 Estimation of aircraft emissions using the Tier 1 and Tier 2 methodologies (EMEP/EEA 2023)

For estimating the CO_2, CH_4 and N_2O emissions the 2006 IPCC Guidelines Tier 2 approach[38] has been applied:

Equation 3.6.2: Aviation equation (2) (2006 IPCC GL, Vol. 3, Chap. 3.6.1.1)

$$\boldsymbol{Total\ Emissions_{GHG,\ fuel} = LTO\ \ emissions\ _{GHG,fuel} + Cruise\ emissions_{GHG,\ fuel}}$$

Equation 3.6.3: Aviation equation (3) (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{LTO\ Emissions_{GHG} = number\ of\ LTOs \times EF\ LTO_{\mathrm{GHG,\ fuel}}}$$

Equation 3.6.4: Aviation equation (4) (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{LTO\ Fuel\ consumption\ _{fuel} = number\ of\ LTOs \times LTO\ fuel\ consumption\ _{\mathrm{fuel}}}$$

Equation 3.6.4: Aviation equation (4) (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Cruise\ emissions_{GHG,fuel} = (Total\ fuel\ consumption - LTO\ Fuel\ consumption) \times EF\ cruise_{\mathrm{GHG,fuel}}}$$

Where:

Total emissions $_{GHG,\ fuel}$	= emissions of a given GHG by type of fuel (kg GHG)
LTO emissions $_{GHG,\ fuel}$	= emissions for LTO of a given GHG by type of fuel (kg GHG)
Cruise emissions $_{GHG,\ fuel}$	= emissions for cruise of a given GHG by type of fuel (kg GHG)
Fuel consumption $_{fuel}$	= amount of fuel combusted (TJ)
LTO fuel consumption $_{fuel}$	= amount of fuel combusted (kg/LTO)
EF LTO $_{GHG,\ fuel}$	= default emission factor for LTO of a given GHG by type of fuel (kg GHG/LTO)
EF cruise $_{GHG,\ fuel}$	= default emission factor for LTO of a given GHG by type of fuel (kg GHG/TJ)
GHG	= CO_2, CH_4, N_2O
Fuel	= jet kerosene, aviation gasoline

3.2.2.1.1.2 Choice of activity data

The following fuels are used in international aviation:

Fuel type	Fuel types
Liquid fuels	• Kerosene

Fuel consumption used for estimating the GHG emissions for the years 1990 - 2022 were taken from EUROSTAT but were prepared by Albanian Institute of Statistics (INSTAT). The fuel consumption is presented in the following table.

As the fuel consumption (national and international fuel consumption (Energy balance)) and the number of LTOs for domestic and international flights were available, the assumptions on LTO fuel consumption below can be used to divide these data into LTO and CCD data using the following equation.

The LTOs were taken from airport statistic of INSTAT and presented in the following table.

[38] Source: 2006 IPCC Guidelines, Volume 2: Energy, Chapter 3: Mobile Combustion - 3.6.1.1 Methodological issues - Choice of method

(Equation 1 Total fuel consumption*)*

Total fuel = LTO fuel + CCD fuel

where

LTO fuel = number of LTOs x fuel consumption per LTO

CCD fuel = total fuel consumption – LTO fuel consumption

Where:

LTO fuel = fuel consumed during LTOs (Landing and Take-Off)

CCD fuel = fuel consumed during CCD (Climb-Cruise-Descent)

A default consumption factor for LTO of 450 kg/LTO was applied, which is representation for an average fleet and short distances (where mainly A320, B738, B38M, A20N, A21N, A321 and several ATR and other smaller aircraft).[39]

Table 3.12 Calculation of fuel consumption per LTO and Cruise

	Number of LTO cycles	Source	Energy Balance International aviation		Fuel consumption Reference[40]			
			Kerosene	NCV (CS) [GJ/t]	LTO [kg/LTO]	NCV (CS) [GJ/t]	Cruise	NCV (CS) [GJ/t]
				43.00	450	43.00	Difference (Fuel sold - Fuel for LTO`s)	43.00
					Fuel consumption			
			t	GJ	t	GJ	t	GJ
1990	NE		NE	NA	NE	NA	NE	NA
1991	NE		NE	NA	NE	NA	NE	NA
1992	NE		NE	NA	NE	NA	NE	NA
1993	NE		NE	NA	NE	NA	NE	NA
1994	NE		NE	NA	NE	NA	NE	NA
1995	NE		NE	NA	NE	NA	NE	NA
1996	NE		NE	NA	NE	NA	NE	NA
1997	NE		NE	NA	NE	NA	NE	NA
1998	NE		NE	NA	NE	NA	NE	NA
1999	13,281	Calculated based on ratio to fuel consumption to LTO in 2006	37,000	1,591,000	10,956	471,127	26,044	1,119,873
2000	14,357		40,000	1,720,000	11,845	509,326	28,155	1,210,674
2001	15,434		43,000	1,849,000	12,733	547,526	30,267	1,301,474
2002	15,434		43,000	1,849,000	12,733	547,526	30,267	1,301,474
2003	16,870		47,000	2,021,000	13,918	598,459	33,082	1,422,541
2004	17,229		48,000	2,064,000	14,214	611,192	33,786	1,452,808
2005	20,459		57,000	2,451,000	16,879	725,790	40,121	1,725,210
2006	16,152	INSTAT Airport	45,000	1,935,000	13,325	572,992	31,675	1,362,008
2007	18,276		19,000	817,000	15,078	648,341	3,922	168,659

[39] Table 3–3 Emission factors and fuel use for the Tier 1 methodology using jet kerosene as fuel. EMEP/EEA emission inventory guidebook 2023. Chapter 1.A.3.a, 1.A.5.b Aviation.

[40] EMEP/EEA air pollutant emission inventory guidebook 2023, Chapter Aviation 1.A.3.a, Page 18, Table 3–3 Emission factors and fuel use for the Tier 1 methodology using jet kerosene as fuel.

	Number of LTO cycles	Source	Energy Balance International aviation		Fuel consumption Reference[40]			
			Kerosene	NCV (CS) [GJ/t]	LTO [kg/LTO]	NCV (CS) [GJ/t]	Cruise	NCV (CS) [GJ/t]
				43.00	450	43.00	Difference (Fuel sold - Fuel for LTO`s)	43.00
					Fuel consumption			
			t	GJ	t	GJ	t	GJ
2008	18,276	statistic	26,000	1,118,000	15,078	648,341	10,922	469,659
2009	20,214		19,000	817,000	16,677	717,092	2,323	99,908
2010	20,775		17,000	731,000	17,139	736,993	NO	NO
2011	22,932		20,000	860,000	18,919	813,513	1,081	46,487
2012	20,408		20,000	860,000	16,837	723,974	3,163	136,026
2013	19,799		21,000	903,000	16,334	702,370	4,666	200,630
2014	18,385		8,000	344,000	15,168	652,208	NO	NO
2015	21,351		2,000	86,000	17,615	757,427	NO	NO
2016	22,352		6,000	258,000	18,440	792,937	NO	NO
2017	24,564		7,280	313,040	20,265	871,408	NO	NO
2018	25,510		6,690	287,670	21,046	904,967	NO	NO
2019	28,695		21,000	903,000	23,673	1,017,955	NO	NO
2020	15,280		15,800	679,400	12,606	542,058	3,194	137,342
2021	26,334		16,050	690,150	21,726	934,199	NO	NO
2022	39,062		16,050	690,150	32,226	1,385,724	NO	NO
Trend								
1990-2022	*NA*		*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
2005-2022	*90.9%*		*-71.8%*	*-71.8%*	*90.9%*	*90.9%*	*NA*	*NA*
2021-2022	*48.3%*		*0.0%*	*0.0%*	*48.3%*	*48.3%*	*NA*	*NA*

3.2.2.1.1.3 Choice of emission factors

Default emission factors for CO_2, CH_4 and N_2O for Jet Kerosene were taken from EMEP/EEA GB 2019 and are presented in the following table.

Table 3-13 GHG Emission factors TIER 1 for CRT category 1.A.3.a.i *International aviation.*

Fuel type	Fuel			CO_2		CH_4		N_2O	
				EF	type	EF	type	EF	type
liquid	Jet Kerosene	LTO	t/LTO	2.6	D	0.0001	D	0.0001	D
		Cruise	t/t Fuel	3.15	D	NA	D	0.0002	D
Source	EMEP/EEA GB 2019, Chapter Aviation 1.A.3.a Table 3–3 Emission factors and fuel use for the Tier 1 methodology using jet kerosene as fuel.								
Note:									
D	Default	CS	Country specific	PS	Plant specific	IEF	Implied emission factor		

3.2.2.1.2 Uncertainty assessment and time-series consistency

The uncertainties for activity data and emission factors used for CRT category CRT category 1.A.3.a.i *International aviation* are presented in the following table.

Table 3-14 Uncertainty for CRT category 1.A.3.a.i *International aviation.*

Uncertainty	Jet Kerosene			Reference
	CO_2	CH_4	N_2O	
Activity data (AD)	5%	5%	5%	2006 IPCC GL, Vol. 2, Chap. 3.6.1.7
Emission factor (EF)	5%	82%	133%	
Combined Uncertainty (U)	7%	82%	133%	$U_{total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

The time-series are considered to be consistent as the same methodology is applied to the whole period.

3.2.2.1.3 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed out:

⇒ Checked of calculations by spreadsheets
- consistent use of energy balance data (preparation of a time series),
- documented sources,
- use of units and conversion factors,
- strictly defined interfaces between spreadsheets/calculation modules,
- unique structure of sheets which do the same,
- record keeping, use of write protection,
- unique use of formulas, special cases are documented/highlighted,
- quick-control checks for data consistency through all steps of calculation.

⇒ cross-checked from different sources:
- national statistic of LTO published by INSTAT and EUROCONTROL[41]
- Eurostat[42] and energy statistics of UN statistics[43]

⇒ time series consistency - plausibility checks of dips and jumps.

3.2.2.1.4 Category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends for recalculations

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category 1.A.3.a.i *International aviation.*

[41] EUROCONTROL (2024: Operations at Airports. https://ansperformance.eu/data/

[42] Data and statistics - https://ec.europa.eu/eurostat/web/main/data/database

[43] United Nations - Department of Economic and Social Affairs - Statistics Division Statistics - Energy Statistics https://unstats.un.org/unsd/energystats/

Table 3-15 Recalculations done since NC in CRT category 1.A.3.a.i *International aviation*

Source category	Revisions of data	Type of revision	Type of improvement
1.3.1.a.i	Application of TIER 2 of 2006 IPCC Guidelines methodology and estimation of GHG emissions	method	Comparability Completeness

3.2.2.1.5 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 3-16 Planned improvements for CRT category 1.A.3.a.i *International aviation*

GHG source & sink category	Planned improvement	Type of improvement		Priority
1.A.3.a.i 1.A.3.a.ii	Energy balance (1990-2022) • improvement of time series completeness and consistency and especially for 1990 – 2010) • for all aviation related fuels ○ Jet kerosene ○ aviation gasoline • Investigation regarding fuel consumption of aviation gasoline used by small planes and helicopters.	AD	Accuracy Completeness Comparability Transparency Consistency	high
1.A.3.a.i 1.A.3.a.ii	Aircraft movement • international aviation by aircraft and destination • domestic aviation by aircraft and destination	AD	Accuracy Completeness Transparency	medium
1.A.3.a.i 1.A.3.a.ii	Application of Tier 3 methodology using data on aircraft movement • Estimate fuel consumption for LTO and cruise for ○ *International aviation* ○ domestic aviation (if occurrent) • Estimate emissions from LTO and cruise phases for ○ *International aviation* ○ domestic *aviation* (if occurrent)	M EF	Accuracy Completeness Comparability Transparency Consistency	medium
1.A.3.a.ii 1.A.5.b	Investigation regarding fuel consumption from military aviation.	AD	Completeness Transparency	Medium

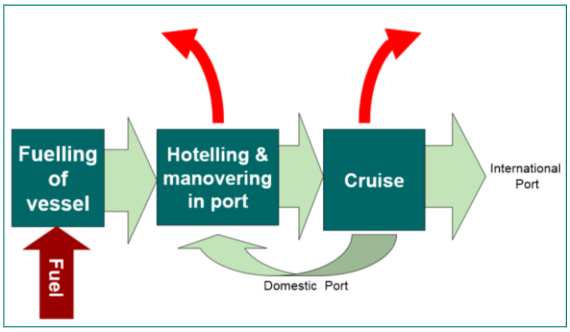
3.2.2.2 International navigation (International bunkers)

As described in the 2006 IPCC Guidelines, the CRT category *International Water-borne Navigation (International bunkers)* includes emissions from fuels used by vessels of all flags that are engaged in international water-borne navigation. The international navigation may take place at sea, on inland lakes and waterways and in coastal waters. This category includes emissions from journeys that depart in one country and arrive in a different country. The category exclude consumption by fishing vessels (see here Other Sector - Fishing). It is *good practice*, that emissions from domestic navigation are reported separately from international navigation and it is *good practice* to apply the definition presented in the following table.

Table 3-17 Criteria for defining international or domestic water-borne navigation

Criteria for defining international or domestic water-borne navigation (applies to each segment of a voyage calling at more than two ports)		
Journey type between two ports	**Domestic**	**International**
Departs and arrives in same country	Yes	No
Departs from one country and arrives in another	No	Yes

Source: 2006 IPCC Guidelines, Volume 2, Chapter 3: Mobile Combustion, 3.5.1.3 Choice of activity data, TABLE 3.5.4.[44]



Source: EMEP/EEA air pollutant emission inventory guidebook 2019, Chapter 1.A.3.d Navigation (shipping) 2019, Figure 2–1[45]

Figure 3-12 Map of Albania with main ports[46]

Albania stretches for 380 km along the coastline including four commercial ports, two petroleum port and five tourism ports. However, all ports except the petroleum ports are mainly used in the touristic sector and presented below. Durrës is the busiest and largest seaport in the country, followed by Vlorë, Shëngjin and Sarandë. The principal ports serve a system of ferries connecting Albania with islands and coastal cities in Croatia, Greece, and Italy.

Furthermore, small number of international navigations (mainly fishery and touristic) takes place on the

- Shkodar lake to Montenegro
- Lake Ohrid to North Macedonia
- Large Lake Prespa to North Macedonia
- Small Lake Prespa to Greece

[44] https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_3_Ch3_Mobile_Combustion.pdf

[45] Source: EMEP/EEA air pollutant emission inventory guidebook 2016, Part B: sectoral guidance chapters, 1. Energy , 1.A Combustion, Chapter 1.A.3.d Navigation (shipping) 2024; https://www.eea.europa.eu/publications/emep-eea-guidebook-2023/part-b-sectoral-guidance-chapters/1-energy/1-a-combustion/1-a-3-d-navigation/view

[46] https://en.wikiversity.org/wiki/Albanian_sea_port_history

Table 3-18 Maritime freight transport and the maritime passenger transport by port

	Main ports[47]		Petroleum port	Tourism ports
	Cargo handled (1000 tons)	Passenger Traffic		
Port of Durrës	5,977	802,679		
Durrës Yacht & Marina				marina
Port of Vlorë	107	198,175		
Vlora Bay Marina				marina
Orikum Marina				marina
Port of Port of Limjoni, Sarandë	41	366,154		
Saranda Bay Marina				x
Port of Shëngjin	123			
Petrolifera			oil storage	
MBM Port			oil storage	
Porto Albania				x
TOTAL	**6,248**	**1,367,008**		

GHG emissions from international shipping are not well reported due to allocation of the fuel in the Energy balance. The emissions of fuels used in international navigation is included in Road transport.

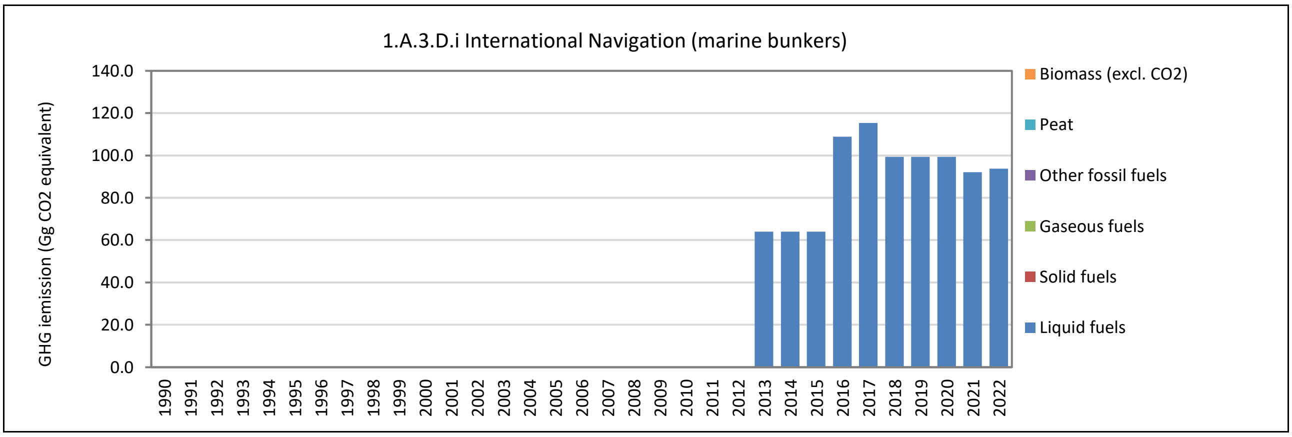


Figure 3-13 GHG emissions from *International Bunkers - International Navigation*

[47] INSTAT (2023): TRANSPORT IN FIGURES 2022. Tirana. https://www.instat.gov.al/media/12678/transporti-2022-en.pdf

Table 3-19 Emissions and activity data from *International Bunkers - International Navigation*

International Navigation	Emission				Activity data		
	GHG	CO_2	N_2O	CH_4	Total Fuel consumption	Residual fuel oil	Gas/diesel oil
	Kt CO_2 equivalent	Gg	Gg	Gg	[TJ]	[TJ]	[TJ]
1990	IE	IE	IE	IE	IE	NO	IE
1991	IE	IE	IE	IE	IE	NO	IE
1992	IE	IE	IE	IE	IE	NO	IE
1993	IE	IE	IE	IE	IE	NO	IE
1994	IE	IE	IE	IE	IE	NO	IE
1995	IE	IE	IE	IE	IE	NO	IE
1996	IE	IE	IE	IE	IE	NO	IE
1997	IE	IE	IE	IE	IE	NO	IE
1998	IE	IE	IE	IE	IE	NO	IE
1999	IE	IE	IE	IE	IE	NO	IE
2000	IE	IE	IE	IE	IE	NO	IE
2001	IE	IE	IE	IE	IE	NO	IE
2002	IE	IE	IE	IE	IE	NO	IE
2003	IE	IE	IE	IE	IE	NO	IE
2004	IE	IE	IE	IE	IE	NO	IE
2005	IE	IE	IE	IE	IE	NO	IE
2006	IE	IE	IE	IE	IE	NO	IE
2007	IE	IE	IE	IE	IE	NO	IE
2008	IE	IE	IE	IE	IE	NO	IE
2009	IE	IE	IE	IE	IE	NO	IE
2010	IE	IE	IE	IE	IE	NO	IE
2011	IE	IE	IE	IE	IE	NO	IE
2012	IE	IE	IE	IE	IE	NO	IE
2013	64.05	63.430	0.002	0.006	856.00	NO	856.00
2014	64.05	63.430	0.002	0.006	856.00	NO	856.00
2015	64.05	63.430	0.002	0.006	856.00	NO	856.00
2016	108.89	107.830	0.003	0.010	1,455.20	NO	1,455.20
2017	115.29	114.173	0.003	0.011	1,540.80	NO	1,540.80
2018	99.28	98.316	0.003	0.009	1,326.80	NO	1,326.80
2019	99.28	98.316	0.003	0.009	1,326.80	NO	1,326.80
2020	99.28	98.316	0.003	0.009	1,326.80	NO	1,326.80
2021	92.17	91.275	0.002	0.009	1,231.78	NO	1,231.78
2022	93.83	92.924	0.003	0.009	1,254.04	NO	1,254.04
Trend							
1990 - 2022	NA	NA	NA	NA	NA	NA	NA
2005 - 2022	NA	NA	NA	NA	NA	NA	NA
2021 - 2022	1.8%	1.8%	1.8%	1.8%	1.8%	NA	1.8%

3.2.2.2.1 Methodological issues

3.2.2.2.1.1 Choice of methods

For estimating the CO_2, CH_4 and N_2O emissions the 2006 IPCC Guidelines Tier 1 approach[48] has been applied:

Equation 3.5.1: Water-borne navigation equation (2006 IPCC GL, Vol. 3, Chap. 3.5.1.1)

$$\boldsymbol{Emissions_{GHG,\,fuel} = Fuel\ Consumption_{fuel} \times Emission\ Factor_{GHG,\,fuel}}$$

Equation 2.2: Total emissions by greenhouse gas (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Emissions_{GHG} = \sum_{fuel} emissions_{\mathbf{GHG,\,fuel}}}$$

Where:

Emissions $_{GHG,\,fuel}$	= emissions of a given GHG by type of fuel (kg GHG)
Fuel consumption $_{fuel}$	= amount of fuel combusted (TJ)
Emission factor $_{GHG,\,fuel}$	= default emission factor of a given GHG by type of fuel (kg gas/TJ)
GHG	= CO_2, CH_4, N_2O
Fuel	= liquid fuels, e.g., Residual fuel oil, Gas/diesel oil

3.2.2.2.1.2 Choice of activity data

The following fuels are used in international navigation:

Liquid fuels:
- Gas/Diesel Oil

Fuel consumption used for estimating the Air pollutant emissions for the years 1990 - 2022 were taken from EUROSTAT, prepared by Albanian Institute of Statistics (INSTAT).

In energy statistics production, transformation and consumption of solid, liquid, gaseous and renewable fuels are specified in physical units, e.g., in tonnes or cubic metres. To convert these data to energy units, in this case terajoules, requires calorific values. The emission calculations are based on net calorific values. In the following table the applied net calorific values (NCVs) for conversion to energy units in CRT category *International Bunkers - International Navigation* are provided.

Table 3-20 Net calorific values (NCVs) and Conversion factors applied for conversion to energy units in CRT category *International Bunkers - International Navigation*

Fuel	Fuel type	Net calorific value (NCV)					
		NCV	unit	type	NCV	unit	type
Gas/Diesel Oil (Non-bio gas/diesel oil)	liquid	43.292	TJ/Gg	CS	47.3	TJ/Gg	D
					for comparison		
Source		Eurostat (2023): Complete energy balances (Code: nrg_bal_c)			2006 IPCC guidelines, Vol. 2, Chapter 1, Table 1.2		
Note:							
D Default		CS Country specific			PS Plant specific		

[48] Source: 2006 IPCC Guidelines, Volume 2: Energy, Chapter 3: Mobile Combustion - 3.5.1.1 Methodological issues - Choice of method

3.2.2.2.1.3 Choice of emission factors

Default emission factors for CO_2, CH_4 and N_2O for Natural gas were taken from IPCC 2006 Guidelines and are presented in the following table.

Table 3-21 GHG Emission factor TIER 1 for CRT category *International Bunkers - International Navigation*

Fuel type	Fuel	CO_2 (kg/TJ)		CH_4 (kg/TJ)		N_2O (kg/TJ)	
		EF	type	EF	type	EF	type
liquid	Gas/diesel oil	74,100	D	7	D	2	D
Source	2006 IPCC Guidelines Vol. 2, Chap. 3 (3.5.1.2) Table 3.5.2 CO_2 EF and Table 3.5.3 NON-CO_2 EF						
Note:							
D Default	CS Country specific	PS Plant specific	IEF Implied emission factor				

3.2.2.2.2 Uncertainty assessment and time-series consistency

The uncertainties for activity data and emission factors used for CRT category *International Bunkers - International Navigation* are presented in the following table.

Table 3-22 Uncertainty for CRT category *International Bunkers - International Navigation.*

Uncertainty	Gas/Diesel Oil			Reference
	CO_2	CH_4	N_2O	
Activity data (AD)	15%	15%	15%	2006 IPCC GL, Vol. 2, Chap. 3.5.1.7
Emission factor (EF)	1.5%	+/-50%	-40% to 140%	
Combined Uncertainty (U)	15%	50%	101%	$U_{total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

The time-series are considered to be consistent as the same methodology is applied to the whole period.

3.2.2.2.3 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed out:

⇒ Checked of calculations by spreadsheets
- consistent use of energy balance data (preparation of a time series),
- documented sources,
- use of units and conversion factors,
- strictly defined interfaces between spreadsheets/calculation modules,
- unique structure of sheets which do the same,
- record keeping, use of write protection,
- unique use of formulas, special cases are documented/highlighted,
- quick-control checks for data consistency through all steps of calculation.

⇒ cross-checked from different sources:
- National statistic published by INSTAT and
- Energy statistics of UN statistics[49] and data published by International Energy Agency (IEA)[50]

⇒ time series consistency - plausibility checks of dips and jumps.

[49] United Nations - Department of Economic and Social Affairs - Statistics Division Statistics - Energy Statistics https://unstats.un.org/unsd/energystats/

[50] Data and statistics - Data tools - Data tables Energy data by category, indicator, country or region https://www.iea.org/data-and-statistics/data-browser?country=WORLD&fuel=Energy%20supply&indicator=TESbySource

3.2.2.2.4 Category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category *International Bunkers - International Navigation*.

Table 3-23 Recalculations done in CRT category *International Bunkers - International Navigation*

GHG source & sink category	Revisions of data	Type of revision	Type of improvement
1.A.3.d.i	Revision of fuel consumption data	AD	Accuracy
1.A.3.d.i	use of CS NCV	AD	Accuracy

3.2.2.2.5 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 3-24 Planned improvements for CRT category *International Bunkers - International Navigation*

GHG source & sink category	Planned improvement	Type of improvement		Priority
1.A.3.d.i 1.A.3.d.ii	Revision of the energy balance (1990-2022) and improvement of time series completeness and consistency ○ for all navigation related fuels: motor gasoline, gas/diesel oil, fuel oil ○ NCV, carbon content	AD	Accuracy Comparability Transparency Consistency	high
1.A.3.d.i 1.A.3.d. ii	Application of *good practice* approach to separate the activity data (fuel consumption) consistent with the definition of Table 3.6 of the 2006 IPCC Guidelines, Vol. 2, Chapter 3: Mobile Combustion, 3.5.1.3 Choice of activity data.	AD	Accuracy Comparability Transparency Consistency	high
1.A.3.d.i 1.A.3.d.ii	Data on fuel consumption by fuel type and engine type • Surveys of shipping companies (including ferry and freight) • Surveys of individual port and marine authorities	AD	Accuracy Transparency	medium
1.A.3.d.i 1.A.3.d.ii	Investigation on • Ship movement data and standard passenger and freight ferry schedules • Fishery boot movements	AD	Transparency	medium
1.A.3.d.i 1.A.3.d.ii	Application of Tier 2 methodology • Estimate fuel consumption for hotelling & movements and cruise for navigation. • Estimate emissions from for hotelling & movements and cruise for navigation.	M EF	Accuracy	medium

GHG source & sink category	Planned improvement	Type of improvement		Priority
1.A.3.d.ii	Investigation regarding fuel consumption from military navigation.	AD	Completeness	medium

3.2.3 Feedstocks and non-energy use of fuels

As presented in Chapter 1 of Volume 3 of the 2006 IPCC Guidelines, feedstocks are fossil fuels that are used as raw materials in chemical conversion processes in order to produce primarily organic chemicals and, to a lesser extent, inorganic chemicals (especially ammonia) and their derivatives (OECD/IEA/Eurostat, 2004). In most cases, part of the carbon remains embodied in the product manufactured. The use of hydrocarbon feedstocks in chemical conversion processes is almost entirely confined to the chemical and petrochemical industries.

An overview on fuel used as feedstock, reductant and/or non-energy products in Albania is provided in the Table 3-7 and Table 3-8 in Chapter 3.2.1.2.3 *Excluded carbon*.

3.2.3.1 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 3-25 Planned improvements for CRT category feedstock

GHG source & sink category	Planned improvement	Type of improvement		Priority
1.A	Preparation of a consistent timeseries of activity data - National Energy balance - for the period 1990 – 2022 for all fuels with focus on Non-energy use	AD	Accuracy Transparency Consistency	high
1.A	Identification of fuel used as feedstock, reductant and/or non-energy products	AD	Accuracy Transparency Completeness	high

3.2.4 Energy Industries (CRT category 1.A.1)

Energy industries are defined as consisting of economic units whose principal activity is primary energy production, transformation of energy or distribution[51]. This section describes GHG emissions resulting from fuel combustion activities (fuel extraction or energy-producing industries) in energy industries, which, originate from

• public electricity and heat production plants (CRT category 1.A.1.a)	Occurring
• petroleum refining (CRT category 1.A.1.b)	Occurring
• manufacturing of solid fuels (CRT category 1.A.1.c) e.g. charcoal production	Occurring

An overview of the emissions from fuel combustion in CRT category 1.A.1 Energy Industries is provided in the following figures and tables:

- annual GHG, CO2, CH4 and N2O emissions
- Trend of the periods 1990 – 2022, 2005 – 2022, 2021 – 2022.

Fluctuation of emissions are due to stopped/shut-down industrial production …..
Please provide reasons

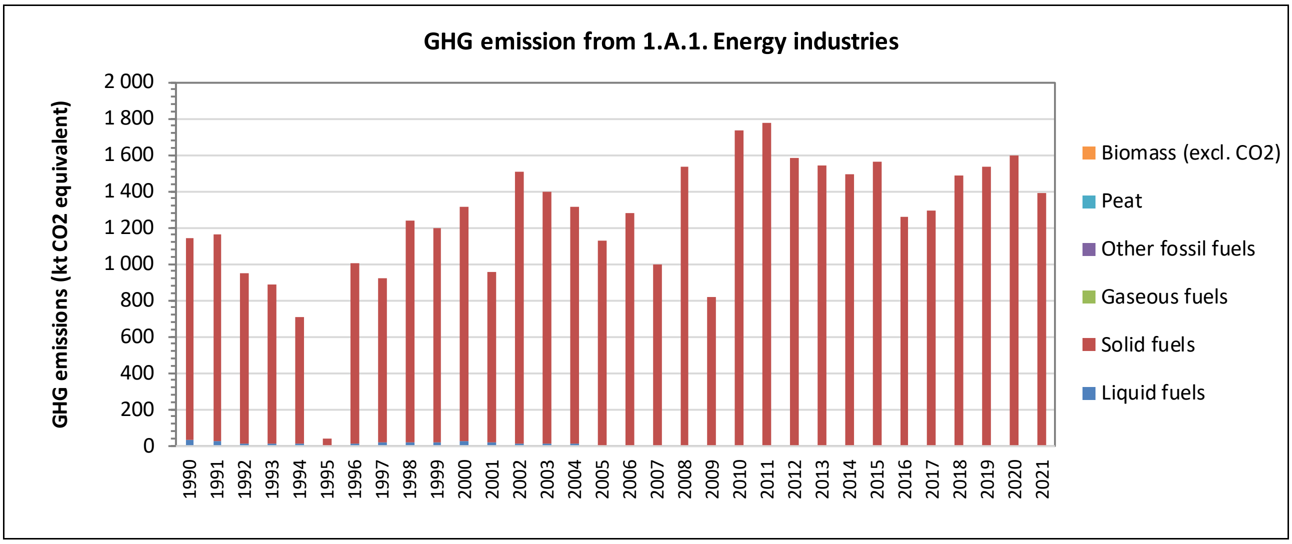


Figure 3-14 Emissions from CRT category 1.A.1 Energy Industries

[51] For more information see https://unstats.un.org/unsd/energy/ires/IRES-web.pdf

Table 3-26 Emissions from CRT category 1.A.1 Energy Industries

GHG emissions	TOTAL GHG	CO_2 (excluding biomass)	N_2O (including biomass)	CH_4 (including biomass)	CO_2 (biomass)
	kt CO2 equivalent	Gg	Gg	Gg	Gg
1990	1 142.70	1 137.43	0.012	0.017	NO
1991	1 161.08	1 155.72	0.012	0.017	NO
1992	950.15	945.75	0.010	0.014	NO
1993	886.60	882.49	0.009	0.013	NO
1994	707.79	704.51	0.007	0.010	NO
1995	41.12	40.93	0.000	0.001	NO
1996	1 004.67	1 000.01	0.010	0.015	NO
1997	923.37	919.10	0.010	0.014	NO
1998	1 238.01	1 232.28	0.013	0.018	NO
1999	1 197.52	1 191.97	0.012	0.018	NO
2000	1 314.34	1 308.26	0.014	0.019	NO
2001	952.97	948.55	0.010	0.014	NO
2002	1 504.34	1 497.35	0.015	0.022	NO
2003	1 396.87	1 390.39	0.014	0.021	NO
2004	1 314.63	1 308.52	0.013	0.019	NO
2005	1 125.21	1 119.97	0.011	0.017	NO
2006	1 277.54	1 271.60	0.013	0.019	NO
2007	999.04	994.39	0.010	0.015	NO
2008	1 532.67	1 525.54	0.015	0.023	NO
2009	819.61	815.79	0.008	0.012	NO
2010	1 736.41	1 728.33	0.017	0.026	NO
2011	1 775.66	1 767.40	0.017	0.026	NO
2012	1 584.07	1 576.71	0.016	0.023	NO
2013	1 540.15	1 532.99	0.015	0.023	NO
2014	1 492.49	1 485.55	0.015	0.022	NO
2015	1 558.84	1 551.59	0.015	0.023	NO
2016	1 256.84	1 251.00	0.012	0.019	NO
2017	1 293.39	1 287.37	0.013	0.019	NO
2018	1 486.22	1 479.31	0.015	0.022	NO
2019	1 533.10	1 525.97	0.015	0.023	NO
2020	1 599.77	1 592.32	0.016	0.024	NO
2021	1 390.53	1 384.06	0.014	0.021	NO
2022					
Trend					
1990 - 2022	*21.7%*	*21.7%*	*13.4%*	*13.4%*	*NA*
2005 - 2022	*23.6%*	*23.6%*	*23.6%*	*23.6%*	*NA*
2021 - 2022	*-13.1%*	*-13.1%*	*-13.1%*	*-13.1%*	*NA*

3.2.4.1 Main Activity Electricity and Heat Production (CRT category 1.A.1.a)

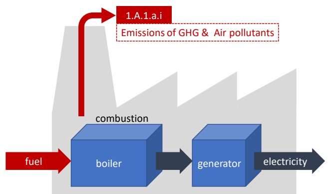
GHG emissions/ removals	CO_2						CH_4						N_2O					
Estimated	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass
1.A.1.a.i	*✓	✓	NO	NO	NO	NO	*✓	✓	NO	NO	NO	NO	*✓	✓	NO	NO	NO	NO
1.A.1.a.ii	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.a.iii	**✓	*** ✓	NO	NO	NO	NO	**✓	*** ✓	NO	NO	NO	NO	**✓	*** ✓	NO	NO	NO	NO
Key Category	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential																		
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF																		
* Until 2012 **until 2004 ***until 2011																		

This section describes GHG emissions resulting from fuel combustion activities in energy industries which, originate from public electricity and heat production plants can be distinguished: Main activity producer and auto-producer. According to 2006 IPCC Guidelines main activity producers are defined as those undertakings whose primary activity is to supply the public.

Type of producer	Electricity plant	Heat plant	Remark
Main activity producer	• units that produce electricity or heat as their principal activity;		They may be in public or private ownership. Emissions from own on-site use of fuel are also included.
Auto-producer	• units that produce electricity but for which the production is not their principal activity;	• units that produce heat for sale but for which the production is not their principal activity;	

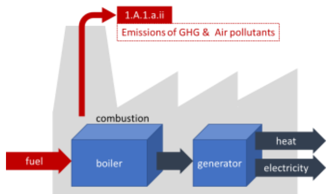
The following sub-categories are defined in the 2006 IPCC Guidelines:

1.A.1.a.i Electricity Generation



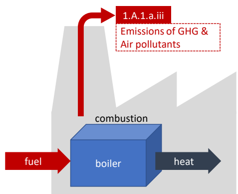
Comprises emissions from all fuel use for electricity generation from main activity producers except those from combined heat and power plants.

1.A.1.a.ii Combined Heat and Power Generation (CHP)



Emissions from production of both heat and electrical power from main activity producers for sale to the public, at a single CHP facility.

1.A.1.a.iii Heat Plants



Production of heat from main activity producers for sale by pipe network.

The majority of electricity in Albania is produced by hydropower. Whereas in the period 1990 -2012 still certain amount of fossil fuels were used, in 2017 the use of solar photovoltaic for electricity started. In Albania bioenergy, geothermal energy or wind was used either for electricity and heat production nor for final consumption in industry or in 'other sector' (household, commercial/institutional).

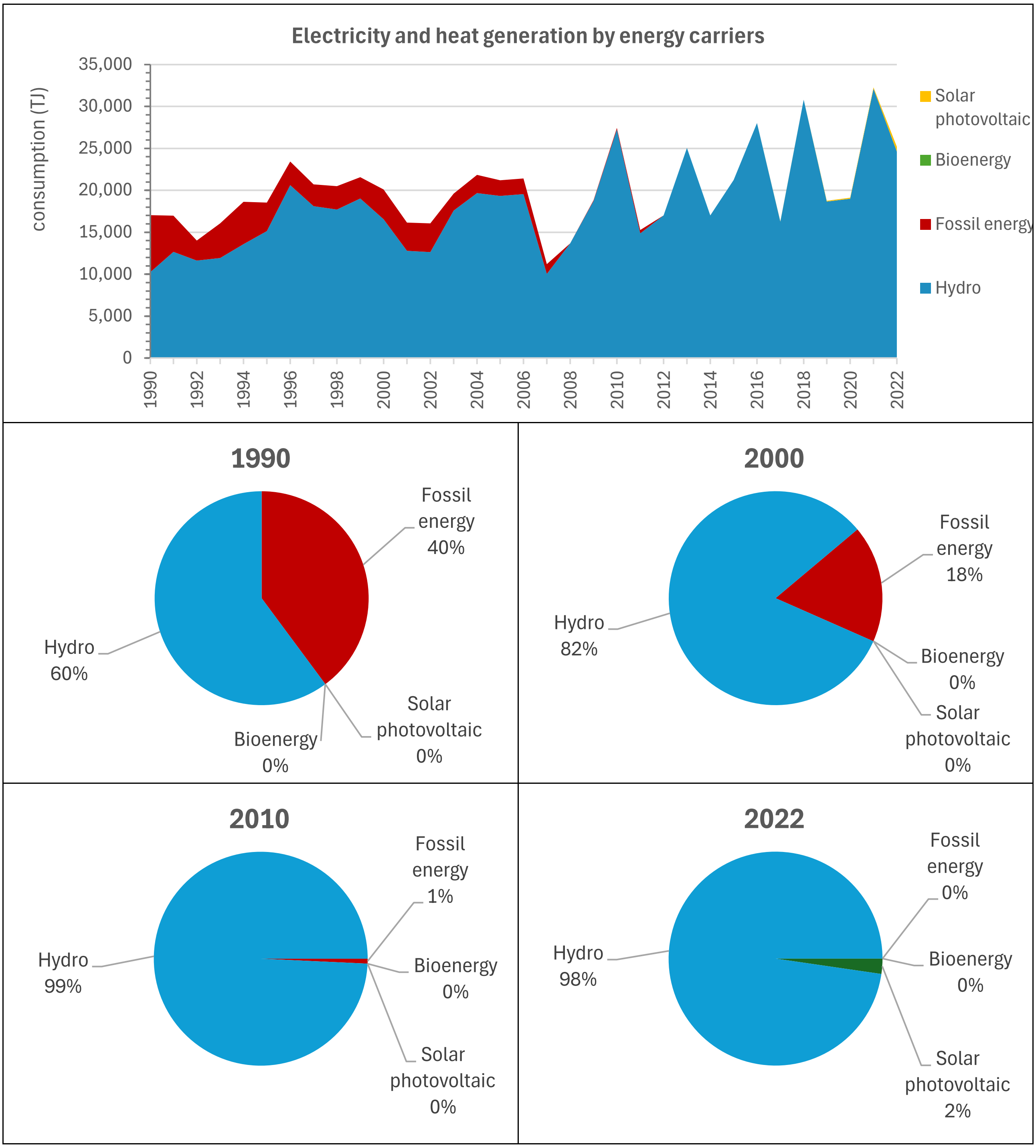


Figure 3-15 Electricity and heat generation by energy type for the period 1990-2022.

3.2.4.1.1 Electricity Generation (CRT category 1.A.1.a.i)

3.2.4.1.1.1 Category description

GHG emissions/ removals	CO_2						CH_4						N_2O					
Estimated	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass
1.A.1.a.i	✓	NO	NO	NO	NO	NO	✓	NO	NO	NO	NO	NO	✓	NO	NO	NO	NO	NO
Key Category	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential																		
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF																		

An overview of the GHG emission from fuel combustion in Sub-category 1.A.1.a.i *Electricity Generation* is provided in the following figures and tables:

- annual GHG emissions;
- Trend of the periods 1990 – 2022, 2005 – 2022.

The main fuel used for electricity production was Residual Fuel Oil and Gas/Diesel Oil.
Since 2012, Albania is producing electricity only by hydropower. In 2017, also solar photovoltaic for electricity production started.
Fluctuation of emissions are due to stopped/shut-down industrial production and limited public life during the time of please check reasons and provide more reasons

- overall economic downturn in the country after 1994;
- world-wide economic crisis in 2007/2008;
- increased electricity production by hydropower and solar photovoltaic.

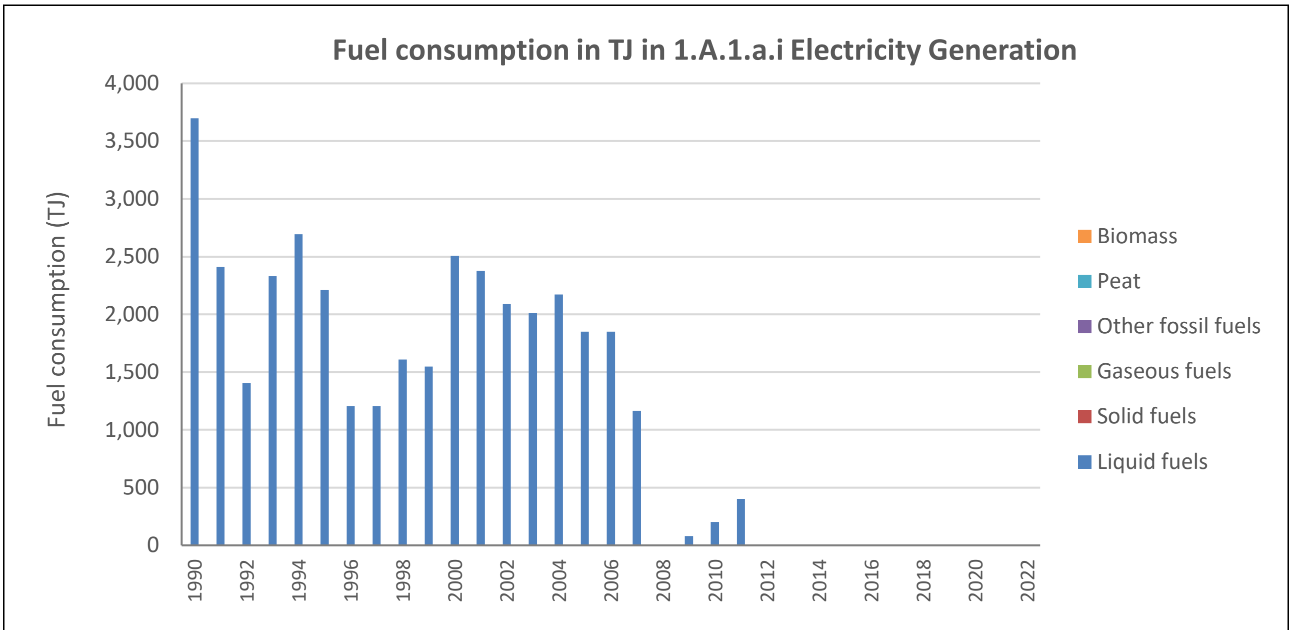


Figure 3-16 Emissions from CRT category 1.A.1.a.i *Electricity Generation* for the period 1990-2022

Table 3-27 Emissions from CRT category 1.A.1.a.i *Electricity Generation* for the period 1990-2022

GHG emissions	TOTAL GHG (excluding biomass)	CO_2 (excluding biomass)	N_2O (including biomass)	CH_4 (including biomass)	CO_2 (biomass)
	kt CO2 equivalent	kt	kt CO2 equivalent	kt CO2 equivalent	kt CO2 equivalent
1990	287.10	286.21	0.59	0.31	NO
1991	187.24	186.66	0.38	0.20	NO
1992	109.22	108.88	0.22	0.12	NO
1993	181.00	180.43	0.37	0.20	NO
1994	209.09	208.43	0.43	0.23	NO
1995	171.64	171.10	0.35	0.19	NO
1996	93.62	93.33	0.19	0.10	NO
1997	93.62	93.33	0.19	0.10	NO
1998	124.83	124.44	0.26	0.14	NO
1999	119.08	118.70	0.25	0.13	NO
2000	191.65	191.04	0.40	0.21	NO
2001	182.10	181.52	0.38	0.20	NO
2002	162.28	161.77	0.33	0.18	NO
2003	156.04	155.55	0.32	0.17	NO
2004	168.52	167.99	0.35	0.18	NO
2005	143.55	143.10	0.29	0.16	NO
2006	143.55	143.10	0.29	0.16	NO
2007	90.50	90.22	0.19	0.10	NO
2008	NO	NO	NO	NO	NO
2009	6.24	6.22	0.01	0.01	NO
2010	15.60	15.55	0.03	0.02	NO
2011	31.21	31.11	0.06	0.03	NO
2012	NO	NO	NO	NO	NO
⋮	NO	NO	NO	NO	NO
2022	NO	NO	NO	NO	NO
Trend					
1990 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*
2005 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*
2021-- 2022	*NA*	*NA*	*NA*	*NA*	*NA*

Note: (1) Amounts of biomass used as fuel are included in the national energy consumption, but the corresponding CO2 emissions are not included in the national total as it is assumed that the biomass is produced in a sustainable manner. If the biomass is harvested at an unsustainable rate, net CO2 emissions are accounted for as a loss of biomass stocks in the Land Use, Land-use Change and Forestry sector. Therefore, emissions from combustion of biofuels are reported as **information items** but **not included in the sectoral or national totals** to avoid double counting.

3.2.4.1.1.2 Methodological issues

3.2.4.1.1.2.1 Choice of methods

For estimating the GHG emissions (CO_2, CH_4, N_2O) the 2006 IPCC Guidelines Tier 1 approach[52] has been applied:

Equation 2.1: GHG emissions from stationary combustion (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Emissions_{GHG,\,fuel}[kt] = Fuel\ Consumption_{fuel}[TJ] \times Emission\ Factor_{GHG,\,fuel}\left[\frac{\mathrm{kg}}{\mathrm{TJ}}\right] * 10^{-6}}$$

Equation 2.2: Total emissions by greenhouse gas (2006 IPCC GL, Vol. 2, Chap. 2)

$$\begin{aligned}\boldsymbol{Emissions_{GHG}[kt_{CO2\ equivalent}]} = & \sum_{fuel} \boldsymbol{emissions_{\mathrm{CO2,\,fuel}}\ [kt]} \\ & + \sum_{fuel} \boldsymbol{emissions_{\mathrm{CH4,\,fuel}}[kt] \times GWP_{CH4}} \\ & + \sum_{fuel} \boldsymbol{emissions_{\mathrm{N2O,\,fuel}}[kt] \times GWP_{N2O}}\end{aligned}$$

Where:

Emissions $_{GHG}$	= emissions of GHG (kt $_{CO2\ equivalent}$)
Emissions $_{GHG,\ fuel}$	= emissions of a given GHG by type of fuel (kt GHG)
Fuel consumption $_{fuel}$	= amount of fuel combusted (TJ)
Emission factor $_{GHG,\ fuel}$	= default emission factor of a given GHG by type of fuel (kg gas/TJ) For CO_2, it includes the carbon oxidation factor, assumed to be 1.
10^{-6}	= conversion from kg to kt (≡ divided by 1.000.000)
GHG	= CO_2, CH_4, N_2O
GWP	= Global warming potential for CO_2, CH_4, N_2O according to the IPCC 5AR
Fuel	= liquid fuels, solid fuels, gaseous fuels, other fossil fuel, biomass, peat

The method is in line with the decision tree, as the category 1.A.1.a.i *Electricity Generation* is not a key category.

3.2.4.1.1.2.2 Choice of activity data

The following fuels are used for electricity production:

Liquid fuels:
- Residual fuel oil
- Gas/Diesel Oil (Non-bio gas/diesel oil)

Fuel consumption used for estimating the GHG emissions for the years 1990 - 2022 were taken from EUROSTAT but were prepared by Albanian Institute of Statistics (INSTAT). The fuel consumption is presented in the following table.

Total fuel consumption has decreased because since 2013 electricity has been generated exclusively from hydropower and solar photovoltaics. Explanation for fluctuations is provided in chapter 'Category description' above.

[52] Source: 2006 IPCC Guidelines, Volume 2: Energy, Chapter 2: Stationary Combustion - 2.3.1 Methodological issues - Choice of method

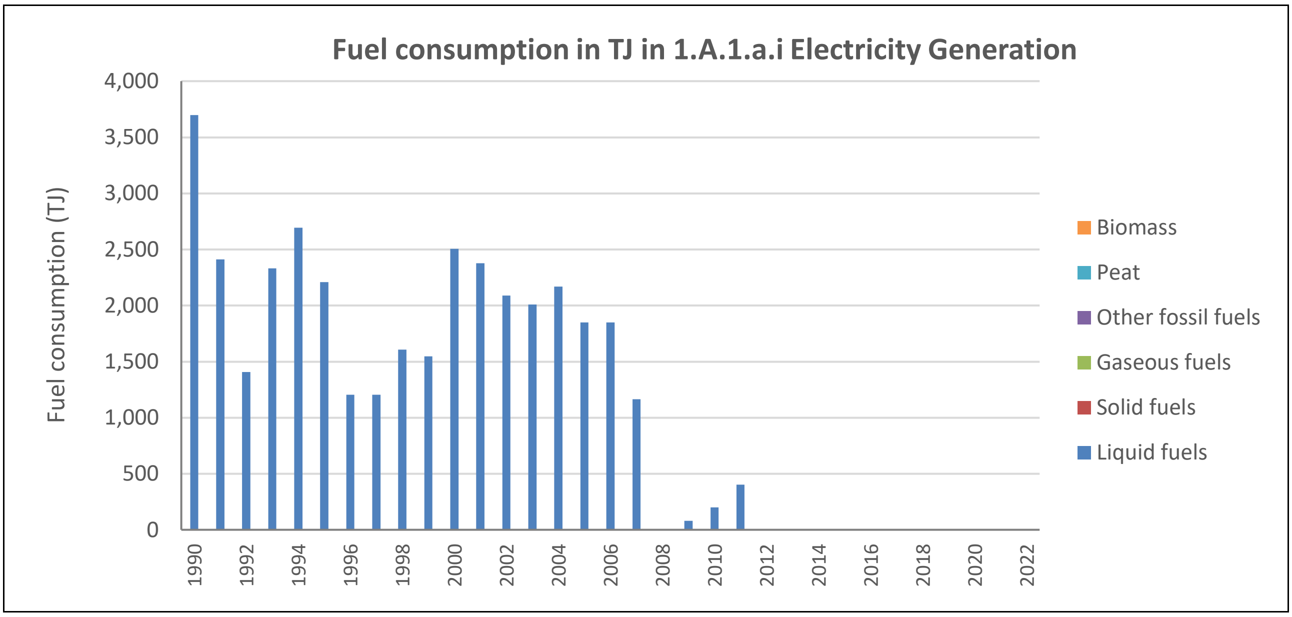


Figure 3-17 Activity data for CRT category 1.A.1.a.i *Electricity Generation* for the period 1990-2022

Table 3-28 Activity data for CRT category 1.A.1.a.i *Electricity Generation* for the period 1990-2022

Activity data 1.A.1.a.i	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
1990	3,697.76	3,697.76	NO	NO	NO	NO	NO
1991	2,411.58	2,411.58	NO	NO	NO	NO	NO
1992	1,406.76	1,406.76	NO	NO	NO	NO	NO
1993	2,331.19	2,331.19	NO	NO	NO	NO	NO
1994	2,692.93	2,692.93	NO	NO	NO	NO	NO
1995	2,210.62	2,210.62	NO	NO	NO	NO	NO
1996	1,205.79	1,205.79	NO	NO	NO	NO	NO
1997	1,205.79	1,205.79	NO	NO	NO	NO	NO
1998	1,607.72	1,607.72	NO	NO	NO	NO	NO
1999	1,548.19	1,548.19	NO	NO	NO	NO	NO
2000	2,506.52	2,506.52	NO	NO	NO	NO	NO
2001	2,378.12	2,378.12	NO	NO	NO	NO	NO
2002	2,090.04	2,090.04	NO	NO	NO	NO	NO
2003	2,009.65	2,009.65	NO	NO	NO	NO	NO
2004	2,170.42	2,170.42	NO	NO	NO	NO	NO
2005	1,848.88	1,848.88	NO	NO	NO	NO	NO
2006	1,848.88	1,848.88	NO	NO	NO	NO	NO
2007	1,165.60	1,165.60	NO	NO	NO	NO	NO
2008	NO	NO	NO	NO	NO	NO	NO
2009	80.39	80.39	NO	NO	NO	NO	NO
2010	200.97	200.97	NO	NO	NO	NO	NO
2011	401.93	401.93	NO	NO	NO	NO	NO

Activity data 1.A.1.a.i	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
2012	NO	NO	NO	NO	NO	NO	NO
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
2022	NO	NO	NO	NO	NO	NO	NO
Trend							
1990 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
2005 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
2021 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*

In energy statistics, production, transformation and consumption of solid, liquid, gaseous and renewable fuels are specified in physical units, e.g. in tonnes or cubic meters. To convert these data to energy units, in this case terajoules, requires calorific values. The emission calculations are bases on net calorific values. In the following table the applied net calorific values (NCVs) for conversion to energy units in CRT category 1.A.1.a.i Electricity Generation.

Table 3-29 Net calorific values (NCVs) applied for conversion to energy units in CRT category 1.A.1.a.i *Electricity Generation*

Fuel	Fuel type	Net calorific value (NCV)					
		NCV	unit	type	NCV	unit	type
Gas/Diesel Oil (Non-bio)	liquid	43.292	TJ/Gg	CS	47.3	TJ/Gg	D
Residual fuel oil	liquid	40.193	TJ/Gg	CS	40.40	TJ/Gg	D
		applied NCV			*for comparison*		
Source		Eurostat (2023): Complete energy balances (Code: nrg_bal_c)			2006 IPCC guidelines, Vol. 2, Chapter 1, Table 1.2		
Note:							
D Default		CS Country specific			PS Plant specific		

3.2.4.1.1.2.3 Choice of emission factors

Default emission factors for greenhouse gases were taken from IPCC 2006 Guidelines and are presented in the following table.

Oxidation factor: For CO2, the emission factor includes the carbon oxidation factor. The oxidation factor is assumed to be 1, which implies a complete oxidation of carbon in the fuel during combustion.

Table 3-30 GHG Emission factor TIER 1 for CRT category 1.A.1.a.i *Electricity Generation*

Fuel	Fuel type	CO_2 (kg/TJ)		CH_4 (kg/TJ)		N_2O (kg/TJ)		Source
		EF	type	EF	type	EF	type	**2006 IPCC Guidelines Vol. 2, Chap. 2 (2.3.2.1)**
Gas/Diesel Oil (Non-bio gas/diesel oil)	solid	74 100	D	3	D	0.6	D	Table 2.2 Default emission factors for stationary combustion in the energy industries (page 2.16)
Residual fuel oil	liquid	77 400	D	3	D	0.6	D	
Note:								
D Default		CS Country specific		PS Plant specific		IEF Implied emission factor		

3.2.4.1.1.3 Uncertainties and time-series consistency

The uncertainties for activity data and emission factors used for CRT category 1.A.1.a.i *Electricity Generation* are presented in the following table.

Table 3-31 Uncertainty for CRT category 1.A.1.a.i *Electricity Generation.*

Uncertainty	Liquid fuels			Reference
	CO_2	CH_4	N_2O	2006 IPCC GL, Vol. 2, Chap. 2 (2.4.2)
Activity data (AD)	5%			Table 2.15 and Table 3.1
Emission factor (EF)	3%			Table 2.13
		100%		Table 2.12
			150%	Table 2.12
Combined Uncertainty (U)	6%	100%	150%	$U_{total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

The time-series are considered to be consistent as the same methodology is applied to the whole period. Activity data are considered to be consistent as national and international data were compared.

3.2.4.1.1.4 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed out:

⇒ Checked of calculations by spreadsheets
- consistent use of energy balance data (energy statistic questionnaires),
- documented sources,
- use of units,
- unique structure of sheets which do the same,
- record keeping, use of write protection,
- unique use of formulas, special cases are documented/highlighted,
- quick-control checks for data consistency through all steps of calculation.

⇒ cross-checked from different sources:
- National statistic published by INSTAT and
- Energy statistics of UN statistics[53] and data published by International Energy Agency (IEA)[54]

⇒ time series consistency - plausibility checks of dips and jumps.

3.2.4.1.1.5 Category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category *1.A.1.a.i Electricity Generation*.

[53] United Nations - Department of Economic and Social Affairs - Statistics Division Statistics - Energy Statistics https://unstats.un.org/unsd/energystats/

[54] Data and statistics - Data tools - Data tables Energy data by category, indicator, country or region https://www.iea.org/data-and-statistics/data-browser?country=WORLD&fuel=Energy%20supply&indicator=TESbySource

Table 3-32 Recalculations done since NC & BUR in CRT category 1.A.1.a.i *Electricity Generation*

source category	Revisions of data	Type of revision	Type of improvement
1.A.1.a.i	Fuel consumption data (activity data) was revised; Eurostat data set (submitted by INSTAT) were used	AD	Accuracy
1.A.1.a.i	Revision of NCV	AD	Accuracy

3.2.4.1.1.6 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 3-33 Planned improvements for CRT category 1.A.1.a.i *Electricity Generation*

GHG source & sink category	Planned improvement	Type of improvement		Priority
1.A.1.a.i	No improvements are planned.			

3.2.4.1.2 Combined Heat and Power Generation (CHP) (CRT category 1.A.1.a.ii)

3.2.4.1.2.1 Category description

GHG emissions/ removals	CO_2						CH_4						N_2O					
Estimated	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass
1.A.1.a.ii	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Key Category	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential																		
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF																		

An overview of the GHG emission from fuel combustion in category 1.A.1.a.ii *Combined Heat and Power Generation* is provided in the following figures and tables:

- annual GHG emissions;
- Trend of the periods 1990 – 2022.

The main fuel used for electricity production was fuel oil.
Fluctuation of emissions are due to stopped/shut-down industrial production and limited public life during the time of please check reasons and provide more reasons

- overall economic downturn in the country;
- increased electricity and heat production by hydropower.

Since 2003, Albania was not using combined heat and power plants.

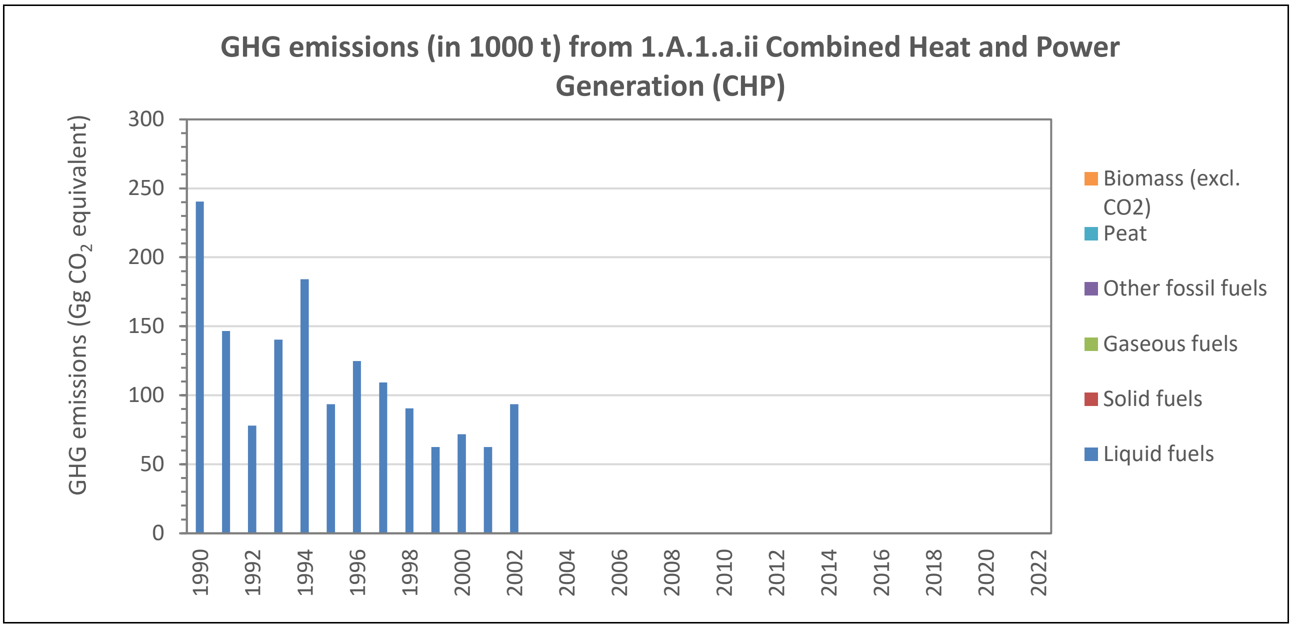


Figure 3-18 Emissions from CRT category 1.A.1.a.ii *Combined Heat and Power Generation* for the period 1990-2022

Table 3-34 Emissions from CRT category 1.A.1.a.ii *Combined Heat and Power Generation* for the period 1990-2022

GHG emissions	TOTAL GHG (excluding biomass)	CO_2 (excluding biomass)	N_2O (including biomass)	CH_4 (including biomass)	CO_2 (biomass)
	kt CO2 equivalent	kt CO2 equivalent	kt CO2 equivalent	kt CO2 equivalent	kt CO2 equivalent
1990	240.29	239.54	0.49	0.26	NO
1991	146.67	146.21	0.30	0.16	NO
1992	78.02	77.77	0.16	0.08	NO
1993	140.43	139.99	0.29	0.15	NO
1994	184.12	183.55	0.38	0.20	NO
1995	93.62	93.33	0.19	0.10	NO
1996	124.83	124.44	0.26	0.14	NO
1997	109.22	108.88	0.22	0.12	NO
1998	90.50	90.22	0.19	0.10	NO
1999	62.41	62.22	0.13	0.07	NO
2000	71.78	71.55	0.15	0.08	NO
2001	62.41	62.22	0.13	0.07	NO
2002	93.62	93.33	0.19	0.10	NO
2003	NO	NO	NO	NO	NO
⋮	NO	NO	NO	NO	NO
2022	NO	NO	NO	NO	NO
Trend					
1990 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*
2005 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*
2021-- 2022	*NA*	*NA*	*NA*	*NA*	*NA*

Note: (1) Amounts of biomass used as fuel are included in the national energy consumption, but the corresponding CO2 emissions are not included in the national total as it is assumed that the biomass is produced in a sustainable manner. If the biomass is harvested at an unsustainable rate, net CO2 emissions are accounted for as a loss of biomass stocks in the Land Use, Land-use Change and Forestry sector. Therefore, emissions from combustion of biofuels are reported as **information items** but **not included in the sectoral or national totals** to avoid double counting.

3.2.4.1.2.2 Methodological issues

3.2.4.1.2.2.1 Choice of methods

For estimating the GHG emissions (CO_2, CH_4, N_2O) the 2006 IPCC Guidelines Tier 1 approach[55] has been applied:

Equation 2.1: GHG emissions from stationary combustion (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Emissions_{GHG,\,fuel}[kt] = Fuel\ Consumption_{fuel}[TJ] \times Emission\ Factor_{GHG,\,fuel}\left[\frac{\mathrm{kg}}{\mathrm{TJ}}\right] * 10^{-6}}$$

Equation 2.2: Total emissions by greenhouse gas (2006 IPCC GL, Vol. 2, Chap. 2)

$$\begin{aligned}\boldsymbol{Emissions_{GHG}[kt_{CO2\ equivalent}]} =& \sum_{fuel} \boldsymbol{emissions_{\mathbf{CO2,\,fuel}}\ [kt]} \\ &+ \sum_{fuel} \boldsymbol{emissions_{\mathbf{CH4,\,fuel}}[kt] \times GWP_{CH4}} \\ &+ \sum_{fuel} \boldsymbol{emissions_{\mathbf{N2O,\,fuel}}[kt] \times GWP_{N2O}}\end{aligned}$$

Where:

Emissions $_{GHG}$	= emissions of GHG (kt $_{CO2\ equivalent}$)
Emissions $_{GHG,\ fuel}$	= emissions of a given GHG by type of fuel (kt GHG)
Fuel consumption $_{fuel}$	= amount of fuel combusted (TJ)
Emission factor $_{GHG,\ fuel}$	= default emission factor of a given GHG by type of fuel (kg gas/TJ) For CO_2, it includes the carbon oxidation factor, assumed to be 1.
10^{-6}	= conversion from kg to kt (≡ divided by 1.000.000)
GHG	= CO_2, CH_4, N_2O
GWP	= Global warming potential for CO_2, CH_4, N_2O according to the IPCC 5AR
Fuel	= liquid fuels, solid fuels, gaseous fuels, other fossil fuel, biomass, peat

The method is in line with the decision tree, as the category 1.A.1.a.ii *Combined Heat and Power Generation* is not a key category.

3.2.4.1.2.2.2 Choice of activity data

The following fuels are used for electricity production:

Liquid fuels:
- Residual fuel oil

Fuel consumption used for estimating the GHG emissions for the years 1990 - 2022 were taken from EUROSTAT but were prepared by Albanian Institute of Statistics (INSTAT). The fuel consumption is presented in the following table.

Total fuel consumption has decreased because since 2003 electricity has been generated exclusively from hydropower and solar photovoltaics. Explanation for fluctuations is provided in chapter 'Category description' above.

[55] Source: 2006 IPCC Guidelines, Volume 2: Energy, Chapter 2: Stationary Combustion - 2.3.1 Methodological issues - Choice of method

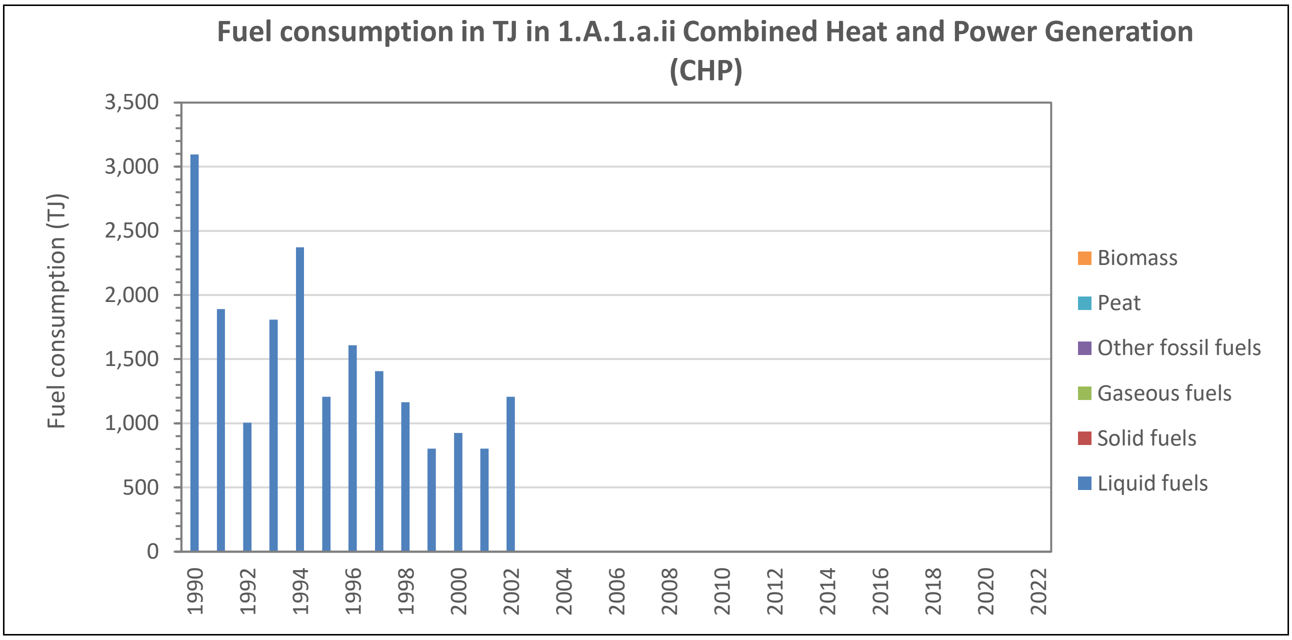


Figure 3-19 Activity data for CRT category 1.A.1.a.ii *Combined Heat and Power Generation* for the period 1990-2022

Table 3-35 Activity data for CRT category 1.A.1.a.ii *Combined Heat and Power Generation* for the period 1990-2022

Activity data 1.A.1.a.ii	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
1990	3,094.86	3,094.86	NO	NO	NO	NO	NO
1991	1,889.07	1,889.07	NO	NO	NO	NO	NO
1992	1,004.83	1,004.83	NO	NO	NO	NO	NO
1993	1,808.69	1,808.69	NO	NO	NO	NO	NO
1994	2,371.39	2,371.39	NO	NO	NO	NO	NO
1995	1,205.79	1,205.79	NO	NO	NO	NO	NO
1996	1,607.72	1,607.72	NO	NO	NO	NO	NO
1997	1,406.76	1,406.76	NO	NO	NO	NO	NO
1998	1,165.60	1,165.60	NO	NO	NO	NO	NO
1999	803.86	803.86	NO	NO	NO	NO	NO
2000	924.44	924.44	NO	NO	NO	NO	NO
2001	803.86	803.86	NO	NO	NO	NO	NO
2002	1,205.79	1,205.79	NO	NO	NO	NO	NO
2003	NO	NO	NO	NO	NO	NO	NO
⋮	NO	NO	NO	NO	NO	NO	NO
2022	NO	NO	NO	NO	NO	NO	NO
Trend							
1990 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
2005 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
2021 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*

In energy statistics, production, transformation and consumption of solid, liquid, gaseous and renewable fuels are specified in physical units, e.g. in tonnes or cubic meters. To convert these data to energy units, in this case terajoules, requires calorific values. The emission calculations are bases on net calorific values. In the following table the applied net calorific values (NCVs) for conversion to energy units in CRT category 1.A.1.a.i Electricity Generation.

Table 3-36 Net calorific values (NCVs) applied for conversion to energy units in CRT category 1.A.1.a.ii *Combined Heat and Power Generation*

Fuel	Fuel type	Net calorific value (NCV)					
		NCV	unit	type	NCV	unit	type
Residual fuel oil	liquid	40.193	TJ/Gg	CS	40.40	TJ/Gg	D
					for comparison		
Source		Eurostat (2023): Complete energy balances (Code: nrg_bal_c)			2006 IPCC guidelines, Vol. 2, Chapter 1, Table 1.2		
Note:							
D Default		CS Country specific			PS Plant specific		

3.2.4.1.2.2.3 *Choice of emission factors*

Default emission factors for greenhouse gases were taken from IPCC 2006 Guidelines and are presented in the following table.

Oxidation factor: For CO2, the emission factor includes the carbon oxidation factor. The oxidation factor is assumed to be 1, which implies a complete oxidation of carbon in the fuel during combustion.

Table 3-37 GHG Emission factor TIER 1 for CRT category 1.A.1.a.ii *Combined Heat and Power Generation*

Fuel	Fuel type	CO_2 (kg/TJ)		CH_4 (kg/TJ)		N_2O (kg/TJ)		Source
		EF	type	EF	type	EF	type	2006 IPCC Guidelines Vol. 2, Chap. 2 (2.3.2.1)
Residual fuel oil	liquid	77 400	D	3	D	0.6	D	Table 2.2 Default emission factors for stationary combustion in the energy industries (page 2.16)
Note:								
D Default		CS Country specific		PS Plant specific		IEF Implied emission factor		

3.2.4.1.2.3 Uncertainties and time-series consistency

The uncertainties for activity data and emission factors used for CRT category 1.A.1.a.ii *Combined Heat and Power Generation* are presented in the following table.

Table 3-38 Uncertainty for CRT category 1.A.1.a.ii *Combined Heat and Power Generation.*

Uncertainty	Liquid fuels			Reference
	CO_2	CH_4	N_2O	2006 IPCC GL, Vol. 2, Chap. 2 (2.4.2)
Activity data (AD)	5%			Table 2.15 and Table 3.1
Emission factor (EF)	3%			Table 2.13
		100%		Table 2.12
			150%	Table 2.12
Combined Uncertainty (U)	6%	100%	150%	$U_{total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

The time-series are considered to be consistent as the same methodology is applied to the whole period. Activity data are considered to be consistent as national and international data were compared.

3.2.4.1.2.4 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed out:

⇒ Checked of calculations by spreadsheets
  - consistent use of energy balance data (energy statistic questionnaires),
  - documented sources,
  - use of units,
  - unique structure of sheets which do the same,
  - record keeping, use of write protection,
  - unique use of formulas, special cases are documented/highlighted,
  - quick-control checks for data consistency through all steps of calculation.

⇒ cross-checked from different sources:
- National statistic published by INSTAT and
- Energy statistics of UN statistics[56] and data published by International Energy Agency (IEA)[57]

⇒ time series consistency - plausibility checks of dips and jumps.

3.2.4.1.2.5 Category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category 1.A.1.a.ii *Combined Heat and Power Generation*.

Table 3-39 Recalculations done since NC & BUR in CRT category 1.A.1.a.ii *Combined Heat and Power Generation*

source category	Revisions of data	Type of revision	Type of improvement
1.A.1.a.ii	Fuel consumption data (activity data) was revised; Eurostat data set (submitted by INSTAT) were used	AD	Accuracy
1.A.1.a.ii	Revision of NCV	AD	Accuracy

3.2.4.1.2.6 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

[56] United Nations - Department of Economic and Social Affairs - Statistics Division Statistics - Energy Statistics https://unstats.un.org/unsd/energystats/

[57] Data and statistics - Data tools - Data tables Energy data by category, indicator, country or region https://www.iea.org/data-and-statistics/data-browser?country=WORLD&fuel=Energy%20supply&indicator=TESbySource

Table 3-40 Planned improvements for CRT category 1.A.1.a.ii *Combined Heat and Power Generation*

GHG source & sink category	Planned improvement	Type of improvement		Priority
1.A.1.a.ii	No improvements are planned.			

3.2.4.1.3 Heat plants (CRT category 1.A.1.a.iii)

3.2.4.1.3.1 Category description

GHG emissions/ removals	CO_2						CH_4						N_2O					
Estimated	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass
1.A.1.a.iii	NO	✓	NO	NO	NO	NO	NO	✓	NO	NO	NO	NO	NO	✓	NO	NO	NO	NO
Key Category			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential																		
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF																		

An overview of the GHG emission from fuel combustion in CRT category 1.A.1.a.iii *Heat plants* is provided in the following figures and tables:

- annual GHG emissions;
- Trend of the periods 1990 – 2022.

The main fuel used for electricity production was lignite.
Fluctuation of emissions are due to stopped/shut-down industrial production and limited public life during the time of please check reasons and provide more reasons

- overall economic downturn in the country;
- world-wide economic crisis.

Since 2003, Albania is producing heat only by hydropower. In 2017, also solar photovoltaic for electricity production started.

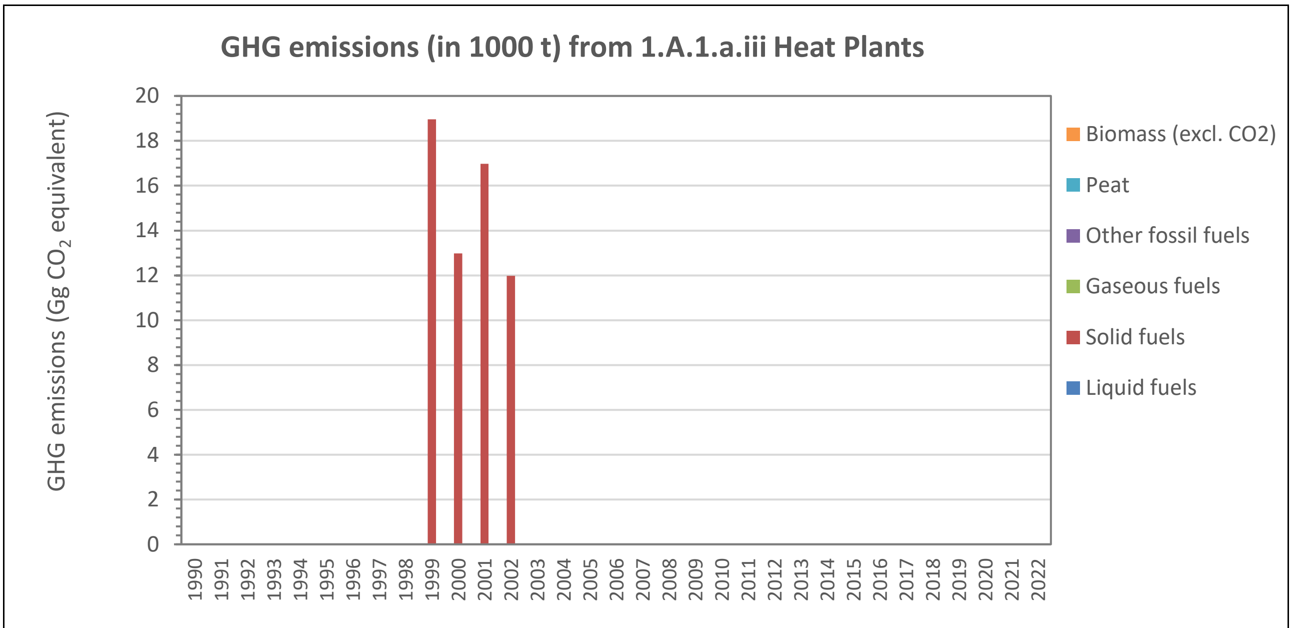


Figure 3-20 Emissions from CRT category 1.A.1.a.iii *Heat plants* for the period 1990-2022

Table 3-41 Emissions from CRT category 1.A.1.a.iii *Heat plants* for the period 1990-2022

GHG emissions	TOTAL GHG	CO_2 (excluding biomass)	N_2O (including biomass)	CH_4 (including biomass)	CO_2 (biomass)
	kt CO2 equivalent	kt CO2 equivalent	kt CO2 equivalent	kt CO2 equivalent	kt CO2 equivalent
1990	NO	NO	NO	NO	NO
⋮	NO	NO	NO	NO	NO
1998	NO	NO	NO	NO	NO
1999	18.97	18.89	0.07	0.005	NO
2000	12.98	12.92	0.05	0.004	NO
2001	16.97	16.90	0.07	0.005	NO
2002	11.98	11.93	0.05	0.003	NO
2003	NO	NO	NO	NO	NO
⋮	NO	NO	NO	NO	NO
2022	NO	NO	NO	NO	NO
Trend					
1990 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*
2005 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*
2021-- 2022	*NA*	*NA*	*NA*	*NA*	*NA*

Note: (1) Amounts of biomass used as fuel are included in the national energy consumption, but the corresponding CO2 emissions are not included in the national total as it is assumed that the biomass is produced in a sustainable manner. If the biomass is harvested at an unsustainable rate, net CO2 emissions are accounted for as a loss of biomass stocks in the Land Use, Land-use Change and Forestry sector. Therefore, emissions from combustion of biofuels are reported as **information items** but **not included in the sectoral or national totals** to avoid double counting.

3.2.4.1.3.2 Methodological issues

3.2.4.1.3.2.1 Choice of methods

For estimating the GHG emissions (CO_2, CH_4, N_2O) the 2006 IPCC Guidelines Tier 1 approach has been applied:

Equation 2.1: GHG emissions from stationary combustion (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Emissions_{GHG,\,fuel}[kt] = Fuel\ Consumption_{fuel}[TJ] \times Emission\ Factor_{GHG,\,fuel}\left[\frac{\mathrm{kg}}{\mathrm{TJ}}\right] * 10^{-6}}$$

Equation 2.2: Total emissions by greenhouse gas (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Emissions_{GHG}\left[kt_{CO2\ equivalent}\right] = \sum_{fuel} emissions_{\mathrm{CO2,\,fuel}}\ [kt] + \sum_{fuel} emissions_{\mathrm{CH4,\,fuel}}[kt] \times GWP_{CH4} + \sum_{fuel} emissions_{\mathrm{N2O,\,fuel}}[kt] \times GWP_{N2O}}$$

Where:

Emissions $_{GHG}$	= emissions of GHG (kt $_{CO2\ equivalent}$)
Emissions $_{GHG,\ fuel}$	= emissions of a given GHG by type of fuel (kt GHG)
Fuel consumption $_{fuel}$	= amount of fuel combusted (TJ)
Emission factor $_{GHG,\ fuel}$	= default emission factor of a given GHG by type of fuel (kg gas/TJ) For CO_2, it includes the carbon oxidation factor, assumed to be 1.
10^{-6}	= conversion from kg to kt (≡ divided by 1.000.000)

GHG = CO_2, CH_4, N_2O
GWP = Global warming potential for CO_2, CH_4, N_2O according to the IPCC 5AR
Fuel = liquid fuels, solid fuels, gaseous fuels, other fossil fuel, biomass, peat

The method is in line with the decision tree, as the CRT category 1.A.1.a.iii *Heat plants* is not a key category.

3.2.4.1.3.2.2 Choice of activity data

The following fuels are used for electricity production:

Solid fuels: • lignite

Fuel consumption used for estimating the GHG emissions for the years 1990 - 2022 were taken from EUROSTAT but were prepared by Albanian Institute of Statistics (INSTAT). The fuel consumption is presented in the following table.

Total fuel consumption has stopped because since 2003 heat has been generated exclusively from hydropower and solar photovoltaics. Explanation for fluctuations is provided in chapter 'Category description' above.

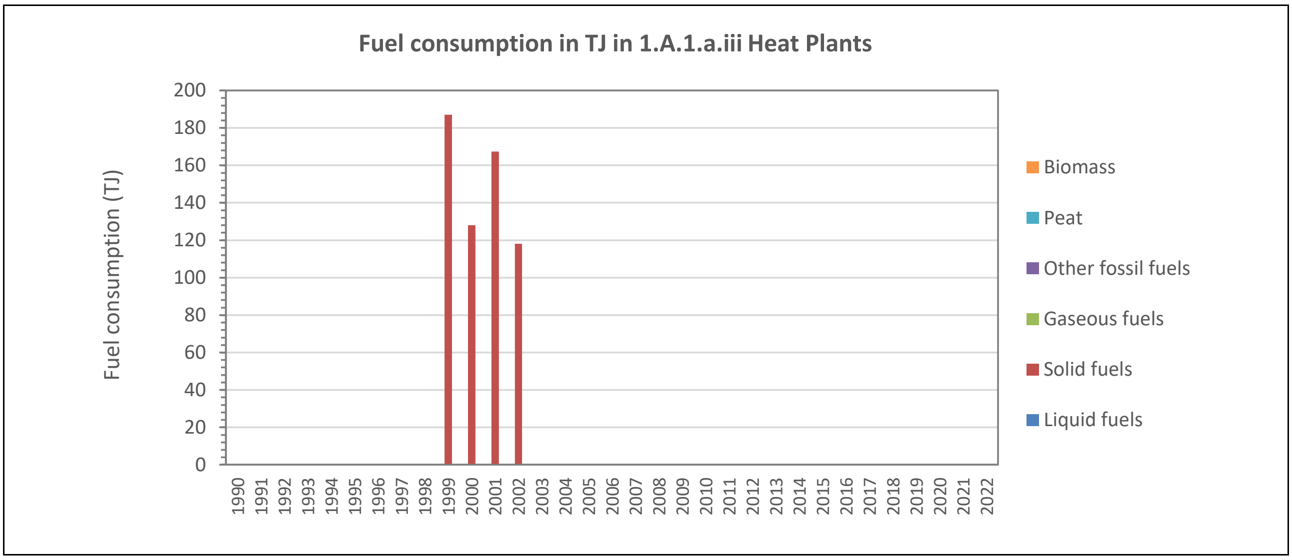


Figure 3-21 Activity data for CRT category 1.A.1.a.iii *Heat plants* for the period 1990-2022

Table 3-42 Activity data for CRT category 1.A.1.a.iii *Heat plants* for the period 1990-2022

Activity data 1.A.1.a.iii	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
1990	NO	NO	NO	NO	NO	NO	NO
⋮	NO	NO	NO	NO	NO	NO	NO
1998	NO	NO	NO	NO	NO	NO	NO
1999	187.02	187.02	NO	NO	NO	NO	NO
2000	127.96	127.96	NO	NO	NO	NO	NO
2001	167.33	167.33	NO	NO	NO	NO	NO
2002	118.12	118.12	NO	NO	NO	NO	NO
2003	NO	NO	NO	NO	NO	NO	NO
⋮	NO	NO	NO	NO	NO	NO	NO

Activity data 1.A.1.a.iii	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
2022	NO	NO	NO	NO	NO	NO	NO
Trend							
1990 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
2005 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
2021 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*

In energy statistics, production, transformation and consumption of solid, liquid, gaseous and renewable fuels are specified in physical units, e.g. in tonnes or cubic meters. To convert these data to energy units, in this case terajoules, requires calorific values. The emission calculations are bases on net calorific values. In the following table the applied net calorific values (NCVs) for conversion to energy units in CRT category 1.A.1.a.i Electricity Generation.

Table 3-43 Net calorific values (NCVs) applied for conversion to energy units in CRT category 1.A.1.a.iii *Heat plants*

Fuel	Fuel type	Net calorific value (NCV)					
		NCV	unit	type	NCV	unit	type
lignite	solid	9.843	TJ/Gg	CS	11.9	TJ/Gg	D
					for comparison		
Source		Eurostat (2023): Complete energy balances (Code: nrg_bal_c)			2006 IPCC guidelines, Vol. 2, Chapter 1, Table 1.2		
Note:							
D Default	CS Country specific			PS Plant specific			

3.2.4.1.3.2.3 *Choice of emission factors*

Default emission factors for greenhouse gases were taken from IPCC 2006 Guidelines and are presented in the following table.

Oxidation factor: For CO2, the emission factor includes the carbon oxidation factor. The oxidation factor is assumed to be 1, which implies a complete oxidation of carbon in the fuel during combustion.

Table 3-44 GHG Emission factor TIER 1 for CRT category 1.A.1.a.iii *Heat plants*

Fuel	Fuel type	CO_2 (kg/TJ)		CH_4 (kg/TJ)		N_2O (kg/TJ)		Source 2006 IPCC Guidelines Vol. 2, Chap. 2 (2.3.2.1)
		EF	type	EF	type	EF	type	
Lignite	solid	101 000	D	1	D	1.5	D	Table 2.2 Default emission factors for stationary combustion in the energy industries (page 2.16)
Note:								
D Default	CS Country specific		PS Plant specific			IEF Implied emission factor		

3.2.4.1.3.3 Uncertainties and time-series consistency

The uncertainties for activity data and emission factors used for CRT category 1.A.1.a.iii *Heat plants* are presented in the following table.

Table 3-45 Uncertainty for CRT category 1.A.1.a.iii *Heat plants.*

Uncertainty	Liquid fuels			Reference
	CO_2	CH_4	N_2O	2006 IPCC GL, Vol. 2, Chap. 2 (2.4.2)
Activity data (AD)	5%			Table 2.15 and Table 3.1
Emission factor (EF)	5%			Table 2.13
		100%		Table 2.12
			150%	Table 2.12
Combined Uncertainty (U)	7%	100%	150%	$U_{total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

The time-series are considered to be consistent as the same methodology is applied to the whole period. Activity data are considered to be consistent as national and international data were compared.

3.2.4.1.3.4 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed out:

⇒ Checked of calculations by spreadsheets
- consistent use of energy balance data (energy statistic questionnaires),
- documented sources,
- use of units,
- unique structure of sheets which do the same,
- record keeping, use of write protection,
- unique use of formulas, special cases are documented/highlighted,
- quick-control checks for data consistency through all steps of calculation.

⇒ cross-checked from different sources:
- National statistic published by INSTAT and
- Energy statistics of UN statistics[58] and data published by International Energy Agency (IEA)[59]

⇒ time series consistency - plausibility checks of dips and jumps.

3.2.4.1.3.5 Category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category 1.A.1.a.iii *Heat plants*.

Table 3-46 Recalculations done since NC & BUR in CRT category 1.A.1.a.iii *Heat plants*

source category	Revisions of data	Type of revision	Type of improvement
1.A.1.a.iii	Fuel consumption data (activity data) was revised; Eurostat data set (submitted by INSTAT) were used	AD	Accuracy

[58] United Nations - Department of Economic and Social Affairs - Statistics Division Statistics - Energy Statistics https://unstats.un.org/unsd/energystats/

[59] Data and statistics - Data tools - Data tables Energy data by category, indicator, country or region https://www.iea.org/data-and-statistics/data-browser?country=WORLD&fuel=Energy%20supply&indicator=TESbySource

source category	Revisions of data	Type of revision	Type of improvement
1.A.1.a.iii	Revision of NCV	AD	Accuracy

3.2.4.1.3.6 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 3-47 Planned improvements for CRT category 1.A.1.a.iii *Heat plants*

GHG source & sink category	Planned improvement	Type of improvement		Priority
1.A.1.a.iii	No improvements are planned.			

3.2.4.2 Petroleum Refining (CRT category 1.A.1.b)

3.2.4.2.1 Category description

GHG emissions/ removals	CO_2						CH_4						N_2O					
Estimated	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass
1.A.1.b	✓	NO	NO	NO	NO	NO	✓	NO	NO	NO	NO	NO	✓	NO	NO	NO	NO	NO
Key Category	LA 1990 2022																	

A '✓' indicates: emissions from this sub-category have been estimated.
Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential

LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF

This section describes GHG emissions resulting from all combustion activities supporting the refining of petroleum products including on-site combustion for the generation of electricity and/or heat for own use. Fugitive emissions (evaporative emissions) occurring at the refinery are not included and should be reported separately under 1.B.2.a. Petroleum Refining is a key source with regards to CO_2 emissions from liquid and gaseous fuels. It is important to specify that oil refining and petrochemical production are physically distinct because they are produced by two different divisions (activities).

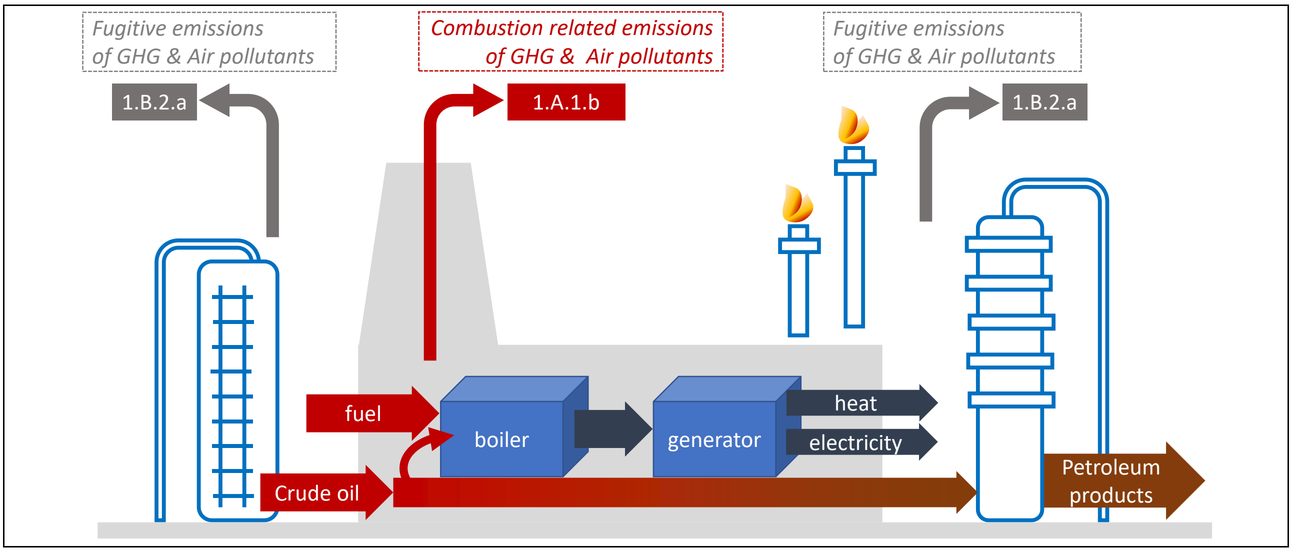


Figure 22 Reporting of emission from refinery: fuel combustion and fugitive emissions

In Albania three refineries are operating and most of crude oil is exported: please check information below

- Ballsh Refinery (ARMO), 20.000 bbl/d, built in 1976
- Fier Refinery (ARMO), 10.000 bbl/d, built in 1968
- Elbasan Refinery (BITEX), 3.750 bbl/d, built in 2016

The greenhouse gas emissions from CRT category 1.A.1.b *Petroleum Refining* amounted to 206.96 kt CO_2 equivalents in 1990, 92.76 kt CO_2 equivalents in 2005 and 36.87 kt CO_2 equivalents in 2022.
The overall trend in GHG emissions from the CRT category 1.A.1.b *Petroleum Refining* shows a overall decrease by -82.2% from 1990 to 2022, a decrease by -60.3% from 2005 to 2022, a decrease by -27.6% from 2021 to 2022.

The overall decreasing trend of emissions is the result of the decrease in petroleum refining capacity and outdated technology. Fluctuation of emissions are due to please check reasons and provide more reasons

- overall economic downturn in the country;
- high export of national crude oil;
- start of operation of the third refinery in 2017.

An overview of the emission from fuel combustion in IPCC category 1.A.1.b Petroleum *Refining* is provided in the following figures and tables.

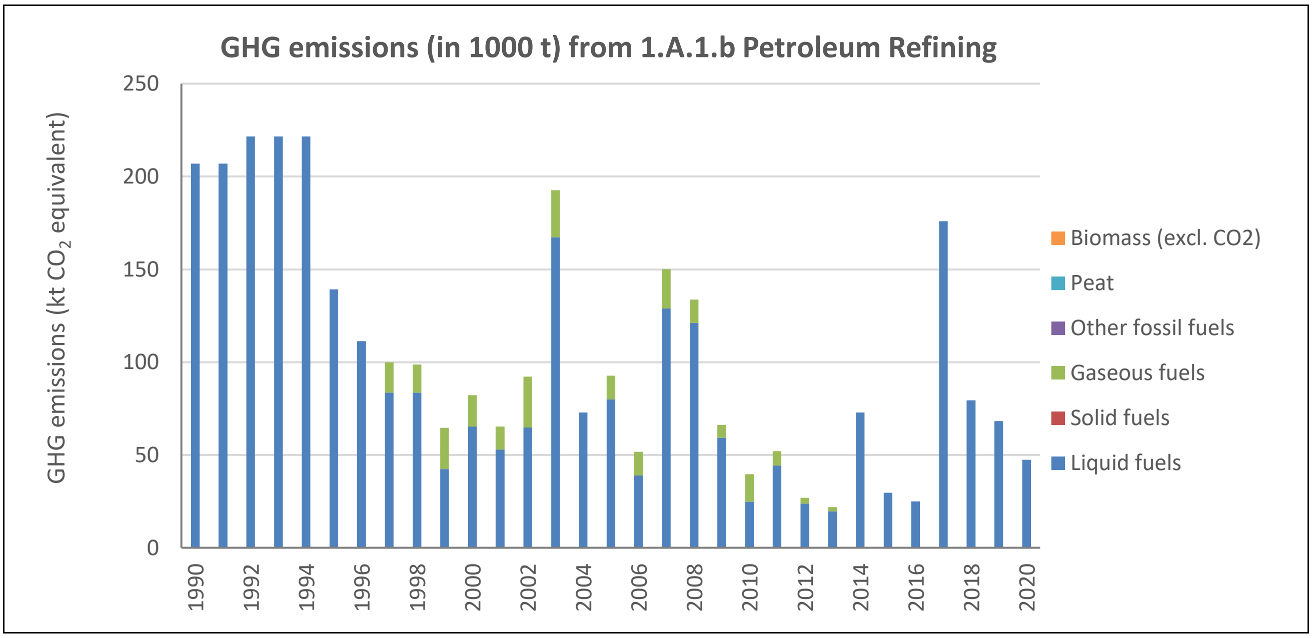


Figure 23 Emissions from IPCC category 1.A.1.b *Petroleum Refining*

Table 48 Emissions from IPCC category 1.A.1.b *Petroleum Refining*

GHG emissions	TOTAL GHG (excluding CO_2 from biomass)	CO_2 (excluding biomass)	N_2O (including biomass)	CH_4 (including biomass)	CO_2 (biomass) (1)
1.A.1.b	**kt CO_2 eq**	**kt**	**kt**	**kt**	**kt**
1990	206.96	205.98	0.0022	0.0124	NO
1991	206.96	205.98	0.0022	0.0124	NO
1992	221.67	220.64	0.0024	0.0130	NO
1993	221.67	220.64	0.0024	0.0130	NO
1994	221.67	220.64	0.0024	0.0130	NO
1995	139.29	138.55	0.0017	0.0096	NO
1996	111.43	110.84	0.0013	0.0077	NO
1997	99.95	99.49	0.0010	0.0061	NO
1998	98.84	98.38	0.0010	0.0060	NO
1999	64.70	64.48	0.0005	0.0028	NO
2000	82.25	81.98	0.0006	0.0035	NO
2001	65.39	65.16	0.0005	0.0030	NO
2002	92.26	91.97	0.0007	0.0038	NO
2003	192.74	192.10	0.0015	0.0079	NO
2004	72.97	72.66	0.0007	0.0039	NO
2005	92.76	92.41	0.0008	0.0044	NO
2006	51.69	51.47	0.0005	0.0029	NO
2007	150.16	149.64	0.0012	0.0066	NO
2008	133.83	133.35	0.0011	0.0058	NO
2009	66.26	65.98	0.0006	0.0036	NO
2010	39.64	39.53	0.0003	0.0015	NO
2011	52.02	51.80	0.0005	0.0027	NO
2012	26.95	26.84	0.0003	0.0014	NO
2013	21.84	21.77	0.0002	0.0008	NO
2014	72.97	72.66	0.0007	0.0039	NO
2015	29.66	29.55	0.0002	0.0012	NO
2016	25.05	24.95	0.0002	0.0012	NO
2017	176.01	175.31	0.0016	0.0087	NO
2018	79.47	79.15	0.0007	0.0039	NO
2019	68.33	68.06	0.0006	0.0034	NO
2020	47.37	47.20	0.0004	0.0022	NO
2021	50.91	50.72	0.0004	0.0023	NO
2022	36.87	36.73	0.0003	0.0017	NO
Trend					
1990 - 2022	-82.2%	-82.2%	-85.6%	-86.6%	*NA*
2005 - 2022	-60.3%	-60.3%	-59.5%	-61.8%	*NA*
2021 - 2022	-27.6%	-27.6%	-28.1%	-28.3%	*NA*

Note: (1) Amounts of biomass used as fuel are included in the national energy consumption, but the corresponding CO2 emissions are not included in the national total as it is assumed that the biomass is produced in a sustainable manner. If the biomass is harvested at an unsustainable rate, net CO2 emissions are accounted for as a loss of biomass stocks in the Land Use, Land-use Change and Forestry sector. Therefore, emissions from combustion of biofuels are reported as **information items** but **not included in the sectoral or national totals** to avoid double counting.

3.2.4.2.2 Methodological issues

3.2.4.2.2.1 Choice of methods

For estimating the GHG emissions (CO_2, CH_4, N_2O) the 2006 IPCC Guidelines Tier 1 approach[60] has been applied:

Equation 2.1: GHG emissions from stationary combustion (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Emissions_{GHG,\,fuel}[kt] = Fuel\ Consumption_{fuel}[TJ] \times Emission\ Factor_{GHG,\,fuel}\left[\frac{\mathrm{kg}}{\mathrm{TJ}}\right] * 10^{-6}}$$

Equation 2.2: Total emissions by greenhouse gas (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Emissions_{GHG}\left[kt_{CO2\ equivalent}\right] = \sum_{fuel} emissions_{\mathrm{CO2,\,fuel}}\,[kt] + \sum_{fuel} emissions_{\mathrm{CH4,\,fuel}}[kt] \times GWP_{CH4} + \sum_{fuel} emissions_{\mathrm{N2O,\,fuel}}[kt] \times GWP_{N2O}}$$

Where:

Emissions $_{GHG}$	= emissions of GHG (kt $_{CO2\ equivalent}$)
Emissions $_{GHG,\ fuel}$	= emissions of a given GHG by type of fuel (kt GHG)
Fuel consumption $_{fuel}$	= amount of fuel combusted (TJ)
Emission factor $_{GHG,\ fuel}$	= default emission factor of a given GHG by type of fuel (kg gas/TJ)
	For CO_2, it includes the carbon oxidation factor, assumed to be 1.
10^{-6}	= conversion from kg to kt (≡ divided by 1.000.000)
GHG	= CO_2, CH_4, N_2O
GWP	= Global warming potential for CO_2, CH_4, N_2O according to the IPCC 5AR
Fuel	= liquid fuels, solid fuels, gaseous fuels, other fossil fuel, biomass, peat

The method applied is not in line with the decision tree, as the category 1.A.1.b *Petroleum Refining* is a key category.

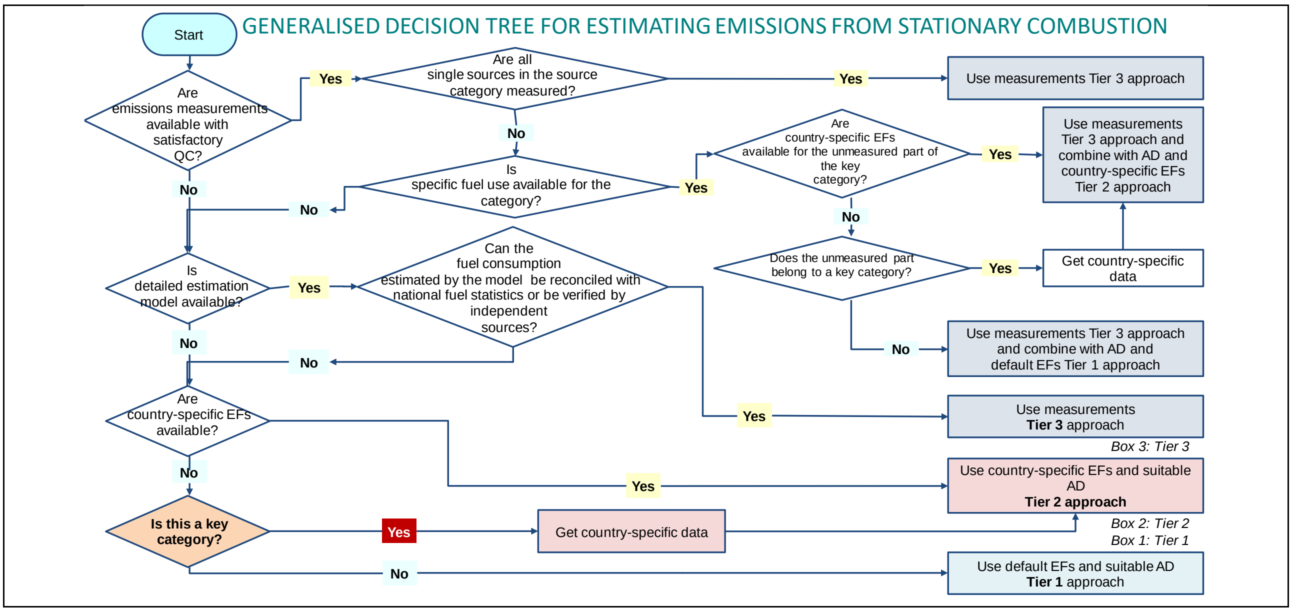


Figure 24 Decision tree for estimating GHG emission from IPCC category 1.A.1.b *Petroleum Refining*

[60] Source: 2006 IPCC Guidelines, Volume 2: Energy, Chapter 2: Stationary Combustion - 2.3.1 Methodological issues - Choice of method

3.2.4.2.2.2 Choice of activity data

The following fuels are used for petroleum refining:

Liquid fuels:
- Refinery gas
- Petroleum Coke
- Gas/Diesel Oil (Non-bio gas/diesel oil)
- Residual fuel oil
- Other oil products n.e.c.

Gaseous fuels:
- Natural gas

Fuel consumption used for estimating the GHG emissions for the years 1990 - 2022 were taken from EUROSTAT but were prepared by Albanian Institute of Statistics (INSTAT). The fuel consumption is presented in the following table

The total fuel consumption decreased by -84.3%in the period 1990 – 2022, increased by -63.5% in the period 2005 – 2022, and decreased by -27.9% during the period 2021 – 2022.

The overall decreasing trend of emissions is the result of the decrease in petroleum refining capacity and outdated technology. Fluctuation of emissions are due to please check reasons and provide more reasons

- overall economic downturn in the country;
- high export of national crude oil;
- start of operation of the third refinery in 2017.

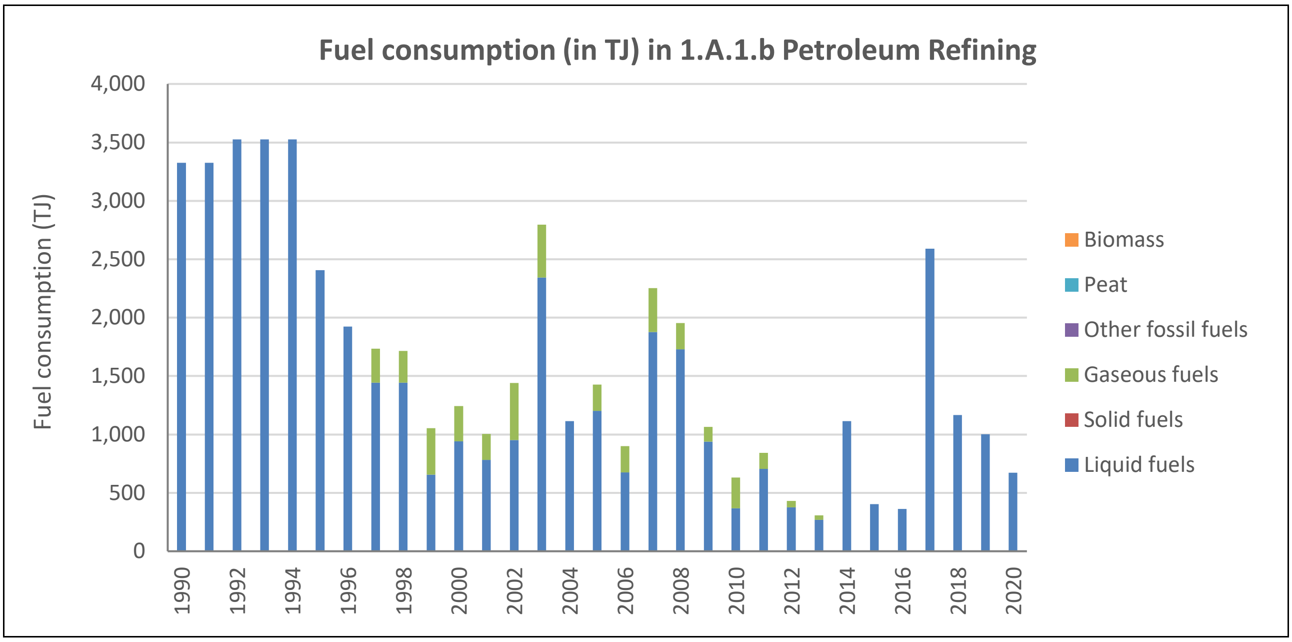


Figure 25 Activity data for IPCC category 1.A.1.b *Petroleum Refining*

Table 49 Activity data for CRT category 1.A.1.b *Petroleum Refining*

Activity data 1. A.1.b	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
1990	3,325.30	3,325.30	NO	NO	NO	NO	NO
1991	3,325.30	3,325.30	NO	NO	NO	NO	NO
1992	3,525.28	3,525.28	NO	NO	NO	NO	NO
1993	3,525.28	3,525.28	NO	NO	NO	NO	NO
1994	3,525.28	3,525.28	NO	NO	NO	NO	NO
1995	2,405.30	2,405.30	NO	NO	NO	NO	NO
1996	1,924.24	1,924.24	NO	NO	NO	NO	NO
1997	1,734.78	1,443.18	NO	291.60	NO	NO	NO
1998	1,714.98	1,443.18	NO	271.80	NO	NO	NO
1999	1,052.86	656.86	NO	396.00	NO	NO	NO
2000	1,242.94	941.44	NO	301.50	NO	NO	NO
2001	1,003.80	781.50	NO	222.30	NO	NO	NO
2002	1,440.80	951.20	NO	489.60	NO	NO	NO
2003	2,794.91	2,343.11	NO	451.80	NO	NO	NO
2004	1,114.86	1,114.86	NO	NO	NO	NO	NO
2005	1,427.05	1,201.15	NO	225.90	NO	NO	NO
2006	899.38	673.48	NO	225.90	NO	NO	NO
2007	2,253.54	1,876.44	NO	377.10	NO	NO	NO
2008	1,954.72	1,728.82	NO	225.90	NO	NO	NO
2009	1,063.17	938.97	NO	124.20	NO	NO	NO
2010	632.01	368.31	NO	263.70	NO	NO	NO
2011	841.86	705.06	NO	136.80	NO	NO	NO
2012	430.73	374.93	NO	55.80	NO	NO	NO
2013	305.69	268.79	NO	36.90	NO	NO	NO
2014	1,114.86	1,114.86	NO	NO	NO	NO	NO
2015	403.19	403.19	NO	NO	NO	NO	NO
2016	360.61	360.61	NO	NO	NO	NO	NO
2017	2,590.49	2,590.49	NO	NO	NO	NO	NO
2018	1,166.75	1,166.75	NO	NO	NO	NO	NO
2019	1,001.33	1,001.33	NO	NO	NO	NO	NO
2020	672.53	672.53	NO	NO	NO	NO	NO
2021	722.46	722.46	NO	NO	NO	NO	NO
2022	521.25	521.25	NO	NO	NO	NO	NO
Trend							
1990 - 2022	-84.3%	-84.3%	NA	NA	NA	NA	NA
2005 - 2022	-63.5%	-56.6%	NA	NA	NA	NA	NA
2021 - 2022	-27.9%	-27.9%	NA	NA	NA	NA	NA

In energy statistics, production, transformation and consumption of solid, liquid, gaseous and renewable fuels are specified in physical units, e.g., in tonnes or cubic metres. To convert these data to energy units, in this case terajoules, requires calorific values. The emission calculations are based on net calorific values. In the following table the applied net calorific values (NCVs) for conversion to energy units in IPCC category 1.A.1.b *Petroleum Refining*.

Table 3-50 Net calorific values (NCVs) applied for conversion to energy units in CRT category 1.A.1.b *Petroleum Refining*

Fuel	Fuel type	Net calorific value (NCV)					
		NCV	unit	type	NCV	unit	type
Gas/Diesel Oil (Non-biol)	liquid	43.292	TJ/Gg	CS	43.0	TJ/Gg	D
Residual fuel oil		40.193	TJ/Gg	CS	40.40	TJ/Gg	D
Refinery gas		48.106	TJ/Gg	CS	49.5	TJ/Gg	D
Petroleum Coke		31.987	TJ/Gg	CS	32.5	TJ/Gg	D
Other oil products n.e.c.		44.799	TJ/Gg	CS	40.2	TJ/Gg	D
Natural gas	gaseous	32.397	**TJ / 10^6 m³**	CS	48.0	TJ/Gg	D
					for comparison		
Source		Eurostat (2023): Complete energy balances (Code: nrg_bal_c)			2006 IPCC guidelines, Vol. 2, Chapter 1, Table 1.2		
Note:							
D Default		CS Country specific			PS Plant specific		

3.2.4.2.2.3 Choice of emission factors

For liquid fuels the default emission factors for CO_2, CH_4 and N_2O were taken from IPCC 2006 Guidelines and are presented in the following table.

Table 51 GHG Emission factor TIER 1 for IPCC category 1.A.1.b *Petroleum Refining*

Fuel	Fuel type	CO_2 (kg/TJ)		CH_4 (kg/TJ)		N_2O (kg/TJ)	
		EF	type	EF	type	EF	type
Natural gas	gaseous	56 100	D	1	D	0.1	D
Gas/Diesel Oil (Non-biol)	liquid	74 100	D	3	D	0.6	D
Residual fuel oil		77 400	D	3	D	0.6	D
Petroleum Coke		97 500	D	3	D	0.6	D
Other oil products n.e.c.		73 300	D	3	D	0.6	D
Refinery Gas		57 600	D	1	D	0.1	D
Source	2006 IPCC Guidelines, Vol. 2. Chap. 2 (2.3.2.1) Table 2.2 Default emission factors for stationary combustion in the energy industries (page 2.16)						
Note:							
D Default	CS Country specific		PS Plant specific		IEF Implied emission factor		

3.2.4.2.3 Uncertainty assessment and time-series consistency

The uncertainties for activity data and emission factors used for IPCC category 1.A.1.b *Petroleum Refining* are presented in the following table.

Table 52 Uncertainty for IPCC category 1.A.1.b *Petroleum Refining.*

Uncertainty	Gaseous fuels			Liquid fuels			Reference
	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	2006 IPCC GL. Vol. 2. Chap. 2
Activity data (AD)	5%			5%			based Table 2.15 and Chap. 2.4.2
Emission factor (EF)	7%			7%			and Chap. 2.4.1
		100%			100%		based Table 2.12
			150%			150%	based Table 2.14
Combined Uncertainty (U)	9%	100%	187%	9%	100%	187%	$U_{total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

The time-series are considered to be consistent as the same methodology is applied to the whole period. Activity data were taken from the same source and are considered to be consistent as national and international data were compared.

3.2.4.2.4 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed out:

⇒ Checked of calculations by spreadsheets
- consistent use of energy balance data (preparation of a time series),
- documented sources,
- use of units and conversion factors,
- unique structure of sheets which do the same,
- record keeping, use of write protection,
- quick-control checks for data consistency through all steps of calculation.

⇒ cross-checked from different sources:
- National statistic published by INSTAT and
- Energy statistics of UN statistics[61] and data published by International Energy Agency (IEA)[62]

⇒ time series consistency - plausibility checks of dips and jumps.

3.2.4.2.5 Category-specific recalculations including explanatory information and justifications

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category 1.A.1.b *Petroleum Refining*.

Table 53 Recalculations done since NC in IPCC category 1.A.1.b *Petroleum Refining*

GHG source & sink category	Revisions of data	Type of revision	Type of improvement
1.A.1.b	Fuel consumption data (activity data) was revised; Eurostat data set (submitted by INSTAT) were used	AD	Accuracy Transparency

[61] United Nations - Department of Economic and Social Affairs - Statistics Division Statistics - Energy Statistics https://unstats.un.org/unsd/energystats/

[62] Data and statistics - Data tools - Data tables Energy data by category, indicator, country or region https://www.iea.org/data-and-statistics/data-browser?country=WORLD&fuel=Energy%20supply&indicator=TESbySource

GHG source & sink category	Revisions of data	Type of revision	Type of improvement
1.A.1.b	Revision of NCV	AD	Accuracy

3.2.4.2.6 Category-specific planned improvements

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 54 Planned improvements for IPCC category 1.A.1.b *Petroleum Refining*

GHG source & sink category	Planned improvement	Type of improvement		Priority
1.A.1.b	Application of higher TIER methodology due to key category	AD	Accuracy	high
1.A.1.b	Further analysis of energy balance as national and international data sets was not always were consistent	AD	Transparency	high
1.A.1.b	• Preparation of the country specific CO_2 emission factor (CS EF) for natural gas, refinery gas, petroleum coke based on plant specific data for each year • Carbon content (%) of natural gas, refinery gas, petroleum coke, gas/diesel oil, residual fuel oil and natural gas etc. for preparing country specific emission factor (CS EF)	EF	Accuracy	high
1.A.1.b	Preparation of a carbon mass balance	AD	Accuracy	high
1.A.1.b	Investigation of carbon oxidation factor and destruction efficiency (completeness of combustion of the fuel): carbon oxidation factor is intended to reflect carbon that is emitted as soot or ash	EF	Accuracy	high
1.A.1.b	Information about fitted/non-fitted equipment for flue gas cleaning, improvement in combustion	EF non-GHG	Accuracy Transparency	Medium
1.A.1.b	Preparation of an overview of national refinery sector - processes and functional units including related emissions[63] • fundamental processes. • separation processes. • conversion processes • refining processes • extractions • other processes	AD	Transparency Completeness	high

[63] For e.g. according to Table 3.1: Environmental accounts of refinery processes, Best Available Techniques (BAT) Reference Document for the Refining of Mineral Oil and Gas (2015); available on 22.09-2022 on https://eippcb.jrc.ec.europa.eu/sites/default/files/2019-11/REF_BREF_2015.pdf

3.2.4.3 Manufacture of Solid Fuels and Other Energy Industries (CRT category 1.A.1.c)

The CRT category 1.A.1.c *Manufacture of Solid Fuels and Other Energy Industries* is divided in two sub-categories:

1.A.1.c.i *Manufacture of Solid Fuels*
1.A.1.c.ii *Other Energy Industries*

3.2.4.3.1.1 Source category description

GHG emissions/ removals	CO_2						CH_4						N_2O					
Estimated	liquid	solid	gaseous	Other fossil fuel	Peat	Biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass
1.A.1.c.i	NO	NO	NO	NO	NO	NE	NO	NO	NO	NO	NO	NE	NO	NO	NO	NO	NO	NE
1.A.1.c.ii	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential																		
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF																		

The emissions from charcoal production were not estimated as the activity data were not consistent as different sources provided various activity data.

3.2.4.3.1.2 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 3-55 Planned improvements for CRT category 1.A.1.c.i Manufacture of Solid Fuels

source	Planned improvement	Type of improvement		Priority
1.A.1.c.i	Cross-check of national and international data sources on charcoal production	AD	Consistency Transparency	high
1.A.1.c.i	Analysis of charcoal production (1) Raw materials for carbonization. • Fuelwood & wood fuel: type of wood and wood waste • Agricultural residues • bark waste (2) charcoal making technologies (3) efficiencies of various types of kiln			high
1.A.1.c.i	Country specific Net Caloric Value (NCV) for fuels of national production: charcoal ⇒ conversion from mass unit to energy unit (unit EF is kg /TJ)	AD EF	Accuracy Transparency	medium
1.A.1.c.i	Estimation of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O)		Completness	high
1.A.1.c.i	Carbon content (%) of charcoal for preparing country specific emission factor (CS EF)	EF	Accuracy Transparency	medium

source	Planned improvement	Type of improvement		Priority
	⇒ **CS EF_{CO2}** [t/TJ] = (C [%] • 44 • Ox)/(NCV [TJ/t] • 12• 100)			

3.2.5 Manufacturing Industries and Construction (CRT category 1.A.2)

This section describes GHG emissions resulting from fuel combustion activities in manufacturing industries and construction, which originate from the following sources:

IPCC/NFR code	Description	Occurrent		Not occurrent (NO)
		Estimated	Not estimated (NE)	
1.A.2.a	Iron and Steel	✓		
1.A.2.b	Non-Ferrous Metals	✓		
1.A.2.c	Chemicals	✓		
1.A.2.d	Pulp, Paper and Print	✓		
1.A.2.e	Food Processing, Beverages and Tobacco	✓		
1.A.2.f	Non-Metallic Minerals	✓		
1.A.2.g	Manufacturing of transport equipment	✓		
1.A.2.h	Manufacturing of machinery			✓
1.A.2.i	Mining (excluding fuels) and Quarrying	✓		
1.A.2.j	Wood and wood products	✓		
1.A.2.k	Construction	✓		
1.A.2.l	Textile and Leather	✓		
1.A.2.m	Other	✓		
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential				

An overview of the emissions from fuel combustion in CRT category 1.A.2 *Manufacturing Industries and Construction* is provided in the following figures and tables:

- annual GHG, CO2, CH4 and N2O emissions
- Trend of the periods 1990 – 2022, 2005 – 2022, 2021 – 2022
- by sub-category.

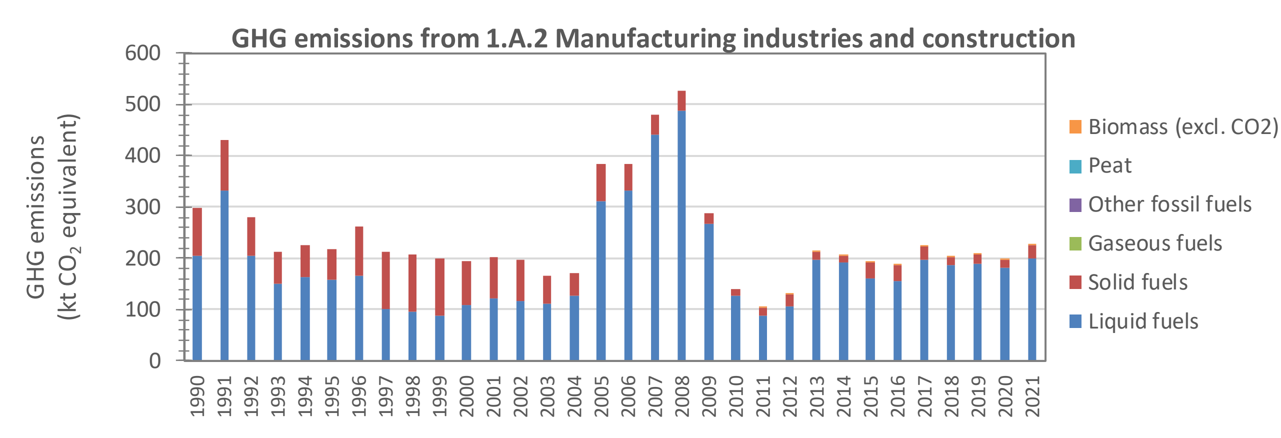


Figure 3-26 Emissions from CRT category 1.A.2 Manufacturing Industries and Construction

The main fuels used in 1.A.2 were liquid fuel, such as Gas/diesel oil and fuel oil. The fuel was used mainly in 1.A.2.b Non-ferrous metals.

For the period 1990-2009, the energy balance does not provide detailed data per sub-category. In the last decade, share of emissions changed due to energy balance refinements and change in the fuels mix used. Important sources of emissions were 1.A.2.e Food processing, beverages and tobacco, 1.A.2.i Mining (excluding fuels) and quarrying and 1.A.2.j Wood and wood products. The share of emissions from the sub-category 1.A.2.a Iron and steel became smaller due to fuels mix ((change from fuel oil to natural gas liquids) and use of electricity.

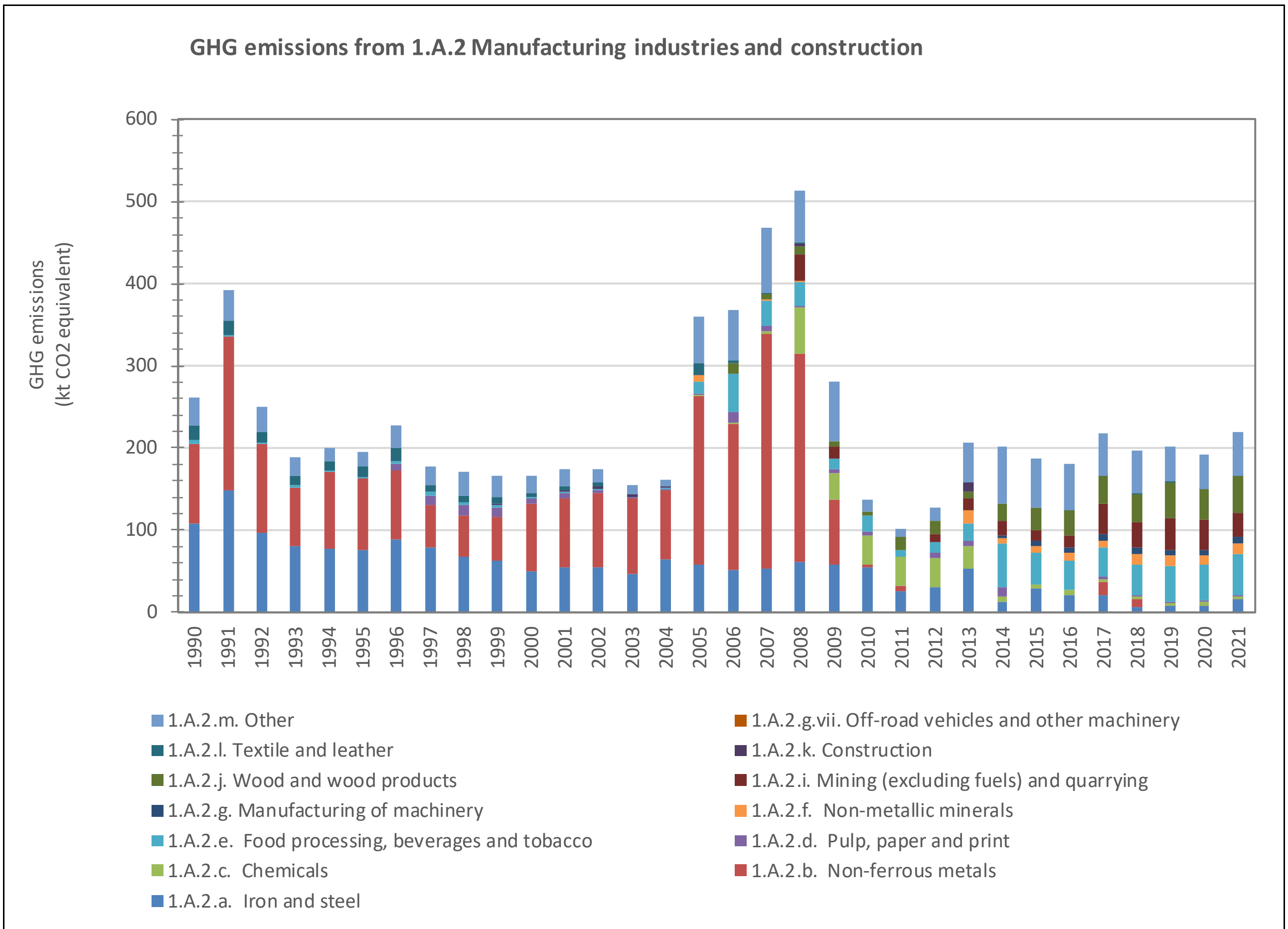


Figure 3-27 Emissions from CRT category 1.A.2 Manufacturing Industries and Construction by subcategory

Table 3-56 Emissions from CRT category 1.A.2 Manufacturing Industries and Construction

GHG emissions	TOTAL GHG	CO_2 (excluding biomass)	N_2O (including biomass)	CH_4 (including biomass)	CO_2 (biomass)
	kt CO_2 equivalent	kt	kt	kt	kt
1990	295.00	293.948	0.0024	0.0135	IE
1991	427.10	425.611	0.0034	0.0187	IE
1992	276.67	275.682	0.0023	0.0124	IE
1993	211.47	210.708	0.0017	0.0097	IE
1994	222.08	221.290	0.0018	0.0100	IE
1995	216.78	215.999	0.0018	0.0099	IE
1996	257.92	256.958	0.0022	0.0125	IE
1997	209.51	208.664	0.0019	0.0113	IE
1998	204.81	203.992	0.0018	0.0110	IE
1999	198.27	197.460	0.0018	0.0109	IE
2000	192.86	192.110	0.0017	0.0099	IE
2001	199.24	198.495	0.0017	0.0098	IE
2002	194.28	193.521	0.0017	0.0100	IE
2003	163.63	162.975	0.0015	0.0085	IE
2004	168.94	168.290	0.0015	0.0084	IE
2005	379.09	377.798	0.0030	0.0163	IE
2006	381.06	379.800	0.0029	0.0158	IE
2007	477.10	475.559	0.0036	0.0191	IE
2008	521.98	520.285	0.0039	0.0209	IE
2009	285.77	284.859	0.0021	0.0113	IE
2010	138.83	138.442	0.0009	0.0051	IE
2011	101.89	101.624	0.0006	0.0038	0.0234
2012	127.66	127.252	0.0009	0.0054	0.0250
2013	210.78	210.082	0.0016	0.0086	0.0234
2014	202.19	201.472	0.0017	0.0089	0.0419
2015	189.70	188.997	0.0016	0.0090	0.0444
2016	184.17	183.470	0.0016	0.0088	0.0439
2017	221.25	220.432	0.0019	0.0102	0.0389
2018	199.37	198.668	0.0016	0.0086	0.0390
2019	205.05	204.313	0.0017	0.0090	0.0428
2020	194.83	194.148	0.0016	0.0084	0.0423
2021	222.91	222.099	0.0019	0.0101	0.0448
2022					
Trend					
1990 - 2022	*-24.4%*	*-24.4%*	*-21.5%*	*-25.1%*	*NA*
2005 - 2022	*-41.2%*	*-41.2%*	*-36.7%*	*-38.1%*	*NA*
2021 - 2022	*14.4%*	*14.4%*	*18.6%*	*20.3%*	*5.8%*

3.2.5.1 Iron and Steel (CRT category 1.A.2.a)

The CRT category 1.A.2.a *Iron and Steel* includes GHG emissions resulting from fuel combustion activities in

Activities	Occurring in Albania
▪ Manufacture of basic iron and steel (ISIC Class 2410)	✓
▪ Casting of iron and steel (ISIC Class 2431)	✓

3.2.5.1.1 Source category description

GHG emissions/ removals	CO_2						CH_4						N_2O					
Estimated	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass
1.A.2.a	✓*	✓	NO	NO	NO	NO	✓	✓	NO	NO	NO	NO	✓	✓	NO	NO	NO	NO
Key Category	LA2022 TA 1990-2022	LA1990 TA 1990-2022	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

A '✓' indicates: emissions from this sub-category have been estimated.
Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential

Use of notation key			
IE	* 1993 - 1998	1.A.2.b (liquid)	The energy statistics is still under development; a split of the fuel combustion for this subcategory has to be reviewed for the entire timeseries. Emissions are currently allocated in CRT category 1.A.2.m Other.

LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF

An overview of the emissions from fuel combustion in CRT category *1.A.2.a Iron and Steel* is provided in the following figures and tables:

- annual GHG emissions
- Trend of the periods 1990 – 2022, 2005 – 2022, 2021 – 2022.

The main fuels used in 1.A.2.a were in the first tree years solid fuels for the blast furnace and then liquid fuels for the post-treatment such as heating of the steel produced in the electric arc furnace (EA).

The emissions from the CRT category 1.A.2.a *Iron and steel* decreased due to shut down of the blast furnace in 1993 and fuels mix change due to change of technology in steel making post-treatment processes.

No CO2 emissions were captured.

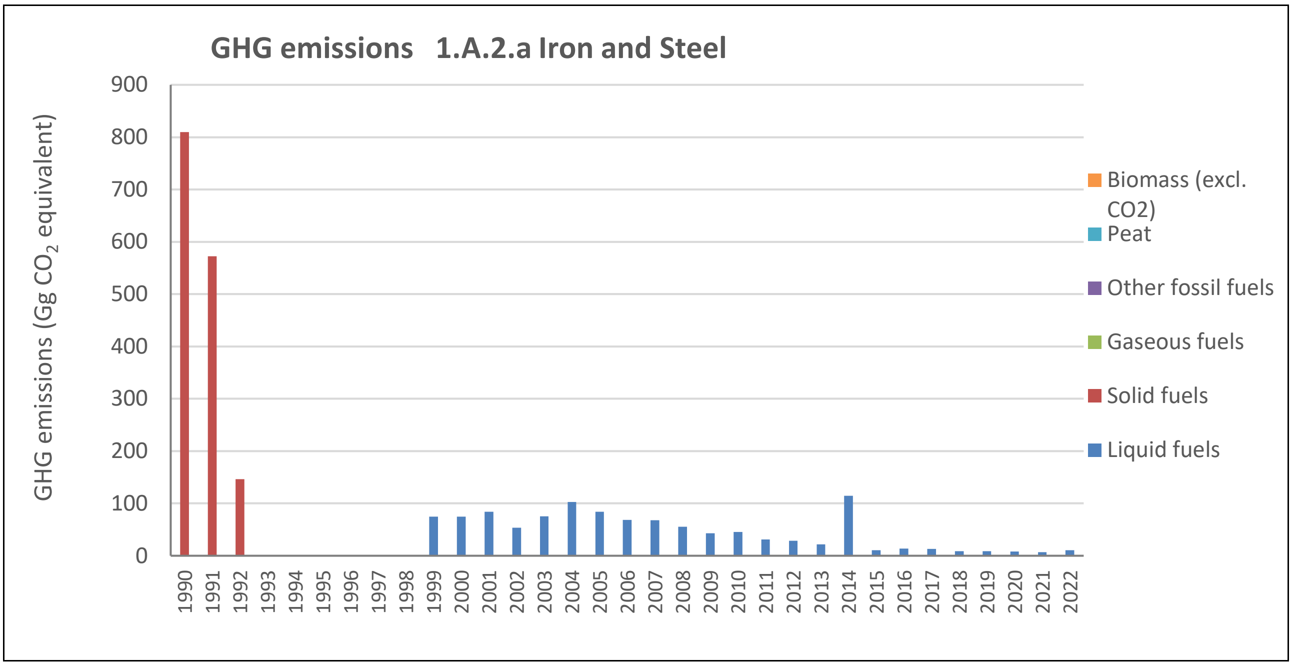


Figure 3-28 Emissions from CRT category 1.A.2.a Iron and Steel

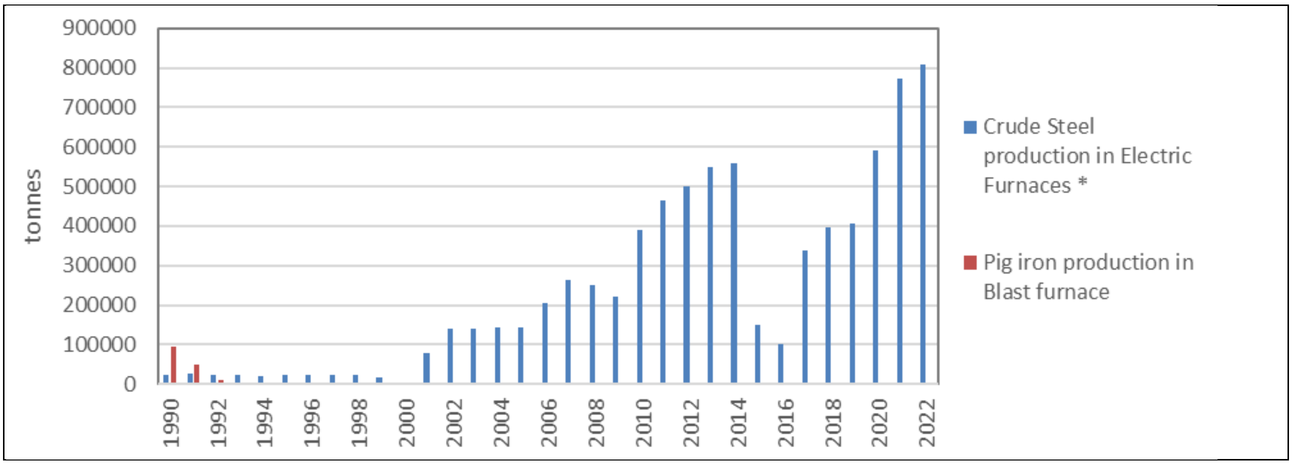


Figure 3-29 Main products in category 1.A.2.a Iron and Steel in the period 2000-2021; Source: INSTAT, BGS and USGS)

Table 3-57 Emissions from CRT category 1.A.2.a Main Activity Iron and Steel

GHG emissions	TOTAL GHG	CO_2 (excluding biomass)	N_2O (including biomass)	CH_4 (including biomass)	CO_2 (biomass)
	kt CO2 equivalent	kt	kt CO2 equivalent	kt CO2 equivalent	kt
1990	809.75	805.15	2.69	1.90	NO
1991	572.29	569.19	1.82	1.28	NO
1992	146.52	145.59	0.54	0.38	NO
1993	IE	IE	IE	IE	NO
1994	IE	IE	IE	IE	NO
1995	IE	IE	IE	IE	NO
1996	IE	IE	IE	IE	NO
1997	IE	IE	IE	IE	NO
1998	IE	IE	IE	IE	NO
1999	74.41	74.17	0.16	0.08	NO
2000	74.52	74.28	0.16	0.08	NO
2001	83.95	83.67	0.18	0.10	NO
2002	53.41	53.24	0.12	0.06	NO
2003	75.19	74.95	0.16	0.09	NO
2004	102.57	102.24	0.22	0.12	NO
2005	83.75	83.48	0.18	0.09	NO
2006	68.15	67.93	0.15	0.08	NO
2007	67.87	67.65	0.14	0.08	NO
2008	55.21	55.03	0.12	0.06	NO
2009	42.73	42.59	0.09	0.05	NO
2010	45.55	45.40	0.10	0.05	NO
2011	31.30	31.20	0.07	0.04	NO
2012	28.27	28.18	0.06	0.03	NO
2013	22.00	21.93	0.05	0.03	NO
2014	114.58	114.20	0.25	0.13	NO
2015	10.24	10.21	0.02	0.01	NO
2016	13.53	13.49	0.03	0.02	NO
2017	12.99	12.95	0.03	0.01	NO
2018	8.58	8.55	0.02	0.01	NO
2019	8.58	8.55	0.02	0.01	NO
2020	7.79	7.77	0.02	0.01	NO
2021	6.75	6.73	0.01	0.01	NO
2022	10.44	10.41	0.02	0.01	NO
Trend					
1990 - 2022	*-98.7%*	*-98.7%*	*-99.4%*	*-99.4%*	*NA*
2005 - 2022	*-87.5%*	*-87.5%*	*-87.4%*	*-87.4%*	*NA*
2021 - 2022	*54.7%*	*54.7%*	*54.8%*	*54.8%*	*NA*

3.2.5.1.2 Methodological issues

3.2.5.1.2.1 Choice of methods

For estimating the GHG emissions (CO_2, CH_4, N_2O) the 2006 IPCC Guidelines Tier 1 approach[64] has been applied:

Equation 2.1: GHG emissions from stationary combustion (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Emissions_{GHG,\,fuel}[kt] = Fuel\ Consumption_{fuel}[TJ] \times Emission\ Factor_{GHG,\,fuel}\left[\frac{\mathrm{kg}}{\mathrm{TJ}}\right] * 10^{-6}}$$

Equation 2.2: Total emissions by greenhouse gas (2006 IPCC GL, Vol. 2, Chap. 2)

$$\begin{aligned}\boldsymbol{Emissions_{GHG}[kt_{CO2\ equivalent}]} = &\sum_{fuel} \boldsymbol{emissions_{\mathrm{CO2,\,fuel}}\ [kt]} \\ &+ \sum_{fuel} \boldsymbol{emissions_{\mathrm{CH4,\,fuel}}[kt] \times GWP_{CH4}} \\ &+ \sum_{fuel} \boldsymbol{emissions_{\mathrm{N2O,\,fuel}}[kt] \times GWP_{N2O}}\end{aligned}$$

Where:

Emissions $_{GHG}$	= emissions of GHG (kt $_{CO2\ equivalent}$)
Emissions $_{GHG,\ fuel}$	= emissions of a given GHG by type of fuel (kt GHG)
Fuel consumption $_{fuel}$	= amount of fuel combusted (TJ)
Emission factor $_{GHG,\ fuel}$	= default emission factor of a given GHG by type of fuel (kg gas/TJ) For CO_2, it includes the carbon oxidation factor, assumed to be 1.
10^{-6}	= conversion from kg to kt (≡ divided by 1.000.000)
GHG	= CO_2, CH_4, N_2O
GWP	= Global warming potential for CO_2, CH_4, N_2O according to the IPCC 5AR
Fuel	= liquid fuels, solid fuels, gaseous fuels, other fossil fuel, biomass, peat

The method applied is not in line with the decision tree, as the category 1.A.2.a *Main Activity Iron and Steel* is a key category. See here the chapter planned improvements.

3.2.5.1.2.2 Choice of activity data

The following fuels are used for petroleum refining:

Solid fuels
- Blast furnace gas
- Coke Oven Coke
- Other bituminous coal

Liquid fuels:
- Petroleum Coke
- Gas/Diesel Oil (Non-bio gas/diesel oil)
- Residual fuel oil
- Other oil products n.e.c.

The emissions for the years 1992-1998 are included in 1.A.2.m.

Fuel consumption used for estimating the GHG emissions for the years 1990 - 2022 were taken from EUROSTAT but were prepared by Albanian Institute of Statistics (INSTAT). The fuel consumption is presented

[64] Source: 2006 IPCC Guidelines, Volume 2: Energy, Chapter 2: Stationary Combustion - 2.3.1 Methodological issues - Choice of method

in the following table.

The total fuel consumption decreased by -98.0% in the period 1990 – 2022, decreased by -87.4% in the period 2005 – 2022, and increased by 54.8% during the period 2021 – 2022.

The overall decreasing trend of emissions is the result of the switch of iron and stell production from blast furnace, which was shutdown, to Electric arc furnace. Industrial production almost came to a standstill and resulted in the closure of many major industries after at the end of the Hoxha era. The consumption of liquid fuels in the iron and steel industry is a result of changed and improved technology and please check reasons and provide more reasons (i.e. for 2014).

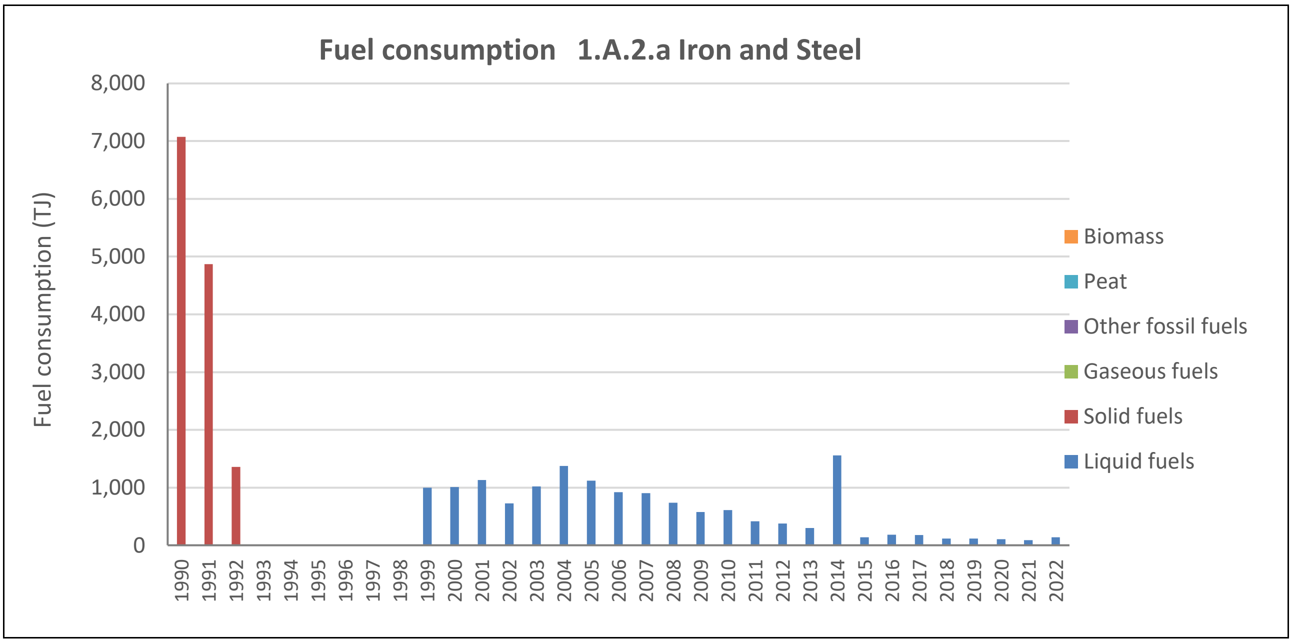


Figure 3-30 Activity data for category 1.A.2.a Iron and Steel

Table 3-58 Activity data for category 1.A.2.a Iron and Steel

Activity data 1.A.2.a	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
1990	7,072.96	IE	7,072.96	NO	NO	NO	NO
1991	4,867.64	IE	4,867.64	NO	NO	NO	NO
1992	1,360.70	IE	1,360.70	NO	NO	NO	NO
1993	IE	IE	NO	NO	NO	NO	NO
1994	IE	IE	NO	NO	NO	NO	NO
1995	IE	IE	NO	NO	NO	NO	NO
1996	IE	IE	NO	NO	NO	NO	NO
1997	IE	IE	NO	NO	NO	NO	NO
1998	IE	IE	NO	NO	NO	NO	NO
1999	1,000.64	1,000.64	NO	NO	NO	NO	NO
2000	1,010.62	1,010.62	NO	NO	NO	NO	NO
2001	1,133.80	1,133.80	NO	NO	NO	NO	NO
2002	725.34	725.34	NO	NO	NO	NO	NO

Activity data 1.A.2.a	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
2003	1,020.12	1,020.12	NO	NO	NO	NO	NO
2004	1,376.26	1,376.26	NO	NO	NO	NO	NO
2005	1,120.37	1,120.37	NO	NO	NO	NO	NO
2006	919.40	919.40	NO	NO	NO	NO	NO
2007	904.82	904.82	NO	NO	NO	NO	NO
2008	739.44	739.44	NO	NO	NO	NO	NO
2009	578.67	578.67	NO	NO	NO	NO	NO
2010	609.04	609.04	NO	NO	NO	NO	NO
2011	416.67	416.67	NO	NO	NO	NO	NO
2012	379.50	379.50	NO	NO	NO	NO	NO
2013	298.70	298.70	NO	NO	NO	NO	NO
2014	1,557.00	1,557.00	NO	NO	NO	NO	1.00
2015	138.76	138.76	NO	NO	NO	NO	1.00
2016	183.56	183.56	NO	NO	NO	NO	NO
2017	176.21	176.21	NO	NO	NO	NO	NO
2018	116.01	116.01	NO	NO	NO	NO	NO
2019	116.01	116.01	NO	NO	NO	NO	NO
2020	105.33	105.33	NO	NO	NO	NO	NO
2021	91.16	91.16	NO	NO	NO	NO	NO
2022	141.09	141.09	NO	NO	NO	NO	NO
Trend							
1990 - 2022	*-98.0%*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
2005 - 2022	*-87.4%*	*-87.4%*	*NA*	*NA*	*NA*	*NA*	*NA*
2021 - 2022	*54.8%*	*54.8%*	*NA*	*NA*	*NA*	*NA*	*NA*

In energy statistics, production, transformation and consumption of solid, liquid, gaseous and renewable fuels are specified in physical units, e.g. in tonnes or cubic meters. To convert these data to energy units, in this case terajoules, requires calorific values. The emission calculations are bases on net calorific values. In the following table the applied net calorific values (NCVs) for conversion to energy units in IPCC/NFR sub-category 1.A.2.a Iron and Steel.

Table 3-59 Net calorific values (NCVs) applied for conversion to energy units in category 1.A.2.a Iron and Steel

Fuel	Fuel type	Net calorific value (NCV)					
		NCV	unit	type	NCV	unit	type
Other Bituminous Coal	solid	27.214	TJ/Gg	CS	11.9	TJ/Gg	D
Coke Oven Coke	solid	28.2	TJ/Gg	CS	28.2	TJ/Gg	D
Blast furnace gas	solid		TJ/Gg	CS	2.5	TJ/Gg	D
Gas/Diesel Oil (Non-bio)	liquid	43.292	TJ/Gg	CS	47.3	TJ/Gg	D
Residual fuel oil	liquid	40.193	TJ/Gg	CS	40.40	TJ/Gg	D

Fuel	Fuel type	Net calorific value (NCV)					
		NCV	unit	type	NCV	unit	type
Petroleum Coke	liquid	31.987	TJ/Gg	CS	32.5	TJ/Gg	D
Other oil products n.e.c.	liquid	44.799	TJ/Gg	CS	40.2	TJ/Gg	D
					for comparison		
Source		Eurostat (2023): Complete energy balances (Code: nrg_bal_c)			2006 IPCC guidelines, Vol. 2, Chapter 1, Table 1.2		
Note:							
D Default		CS Country specific			PS Plant specific		

3.2.5.1.2.3 Choice of emission factors

Default emission factors for greenhouse gases were taken from IPCC 2006 Guidelines and are presented in the following table.

Table 3-60 GHG Emission factor TIER 1 for CRT category 1.A.2.a Iron and Steel

Fuel	Fuel type	CO_2 (kg/TJ)		CH_4 (kg/TJ)		N_2O (kg/TJ)		Source
								2006 IPCC Guidelines Vol. 2, Chap. 2 (2.3.2.1)
		EF	type	EF	type	EF	type	
Other Bituminous Coal	solid	94 600	D	1	D	1.5	D	**Table 2.3** Default emission factors for stationary combustion in manufacturing industries and construction (page 2.18)
Coke Oven Coke	solid	107 000	D	1	D	1.5	D	
Blast furnace gas	solid	260 000	D	1	D	0.1	D	
Gas/Diesel Oil (Non-bio)	liquid	74 100	D	3	D	0.6	D	
Residual fuel oil	liquid	77 400	D	3	D	0.6	D	
Petroleum Coke	liquid	97 500	D	3	D	0.6	D	
Other oil products n.e.c.	liquid	73 300	D	3	D	0.6	D	
Note:								
D Default		CS Country specific		PS Plant specific		IEF Implied emission factor		

3.2.5.1.3 Uncertainties and time-series consistency

The uncertainties for activity data and emission factors used for CRT category 1.A.1.a Main Activity Electricity and Heat Production are presented in the following table.

Table 3-61 Uncertainty for CRT category 1.A.2.a Iron and Steel.

Uncertainty	Solid fuels			Liquid fuels			Reference
	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	2006 IPCC GL, Vol. 2, Chap. 2 (2.4.2); Based on
Activity data (AD)	3%			5%			Table 2.15 and Table 3.1
Emission factor (EF)	2%	100%	200%	5%	100%	150%	Table 2.13 Table 2.12 Table 2.14
Combined Uncertainty (U)	4%	100%	200%	7%	100%	150%	$U_{total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

The time-series are considered to be consistent as the same methodology is applied to the whole period. Activity data are considered to be consistent as national and international data were always compared.

3.2.5.1.4 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed out:

⇒ Checked of calculations by spreadsheets
- consistent use of energy balance data (energy statistic questionnaires),
- documented sources,
- use of units,
- strictly defined interfaces between spreadsheets/calculation modules,
- unique structure of sheets which do the same,
- record keeping, use of write protection,
- unique use of formulas, special cases are documented/highlighted,
- quick-control checks for data consistency through all steps of calculation.

⇒ cross-checked from different sources:
- National statistic published by INSTAT and
- Energy statistics of UN statistics[65] and data published by International Energy Agency (IEA)[66]

⇒ time series consistency - plausibility checks of dips and jumps..

3.2.5.1.5 Category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category 1.A.2.a Iron and Steel .

Table 3-62 Recalculations done in category 1.A.2.a Iron and Steel

GHG source & sink category	Revisions of data	Type of revision	Type of improvement
1.A.2.a	Fuel consumption data (activity data) was revised; Eurostat data set (submitted by INSTAT) were used	AD	Accuracy Transparency
1.A.2.a	Revision of NCV	AD	Accuracy

[65] United Nations - Department of Economic and Social Affairs - Statistics Division Statistics - Energy Statistics https://unstats.un.org/unsd/energystats/

[66] Data and statistics - Data tools - Data tables Energy data by category, indicator, country or region https://www.iea.org/data-and-statistics/data-browser?country=WORLD&fuel=Energy%20supply&indicator=TESbySource

3.2.5.1.6 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 3-63 Planned improvements for category 1.A.2.a Iron and Steel

source category	Planned improvement	Type of improvement		Priority
1.A.2.a	Application of higher TIER methodology due to key category	AD	Accuracy	high
1.A.2.a	Further analysis of energy balance as national and international data sets was not always were consistent	AD	Transparency	high
1.A.2.a	• Preparation of the country specific CO_2 emission factor (CS EF) for natural gas, refinery gas, petroleum coke based on plant specific data for each year • Carbon content (%) of natural gas, refinery gas, petroleum coke, gas/diesel oil, residual fuel oil and natural gas etc. for preparing country specific emission factor (CS EF)	EF	Accuracy	high
1.A.2.a	Cross-check of national and international data sources (Eurostat and UNSD)	AD	Consistency Transparency	Medium
1.A.2.a	Investigation of carbon oxidation factor and destruction efficiency (completeness of combustion of the fuel): carbon oxidation factor is intended to reflect carbon that is emitted as soot or ash	EF	Accuracy	high
1.A.2.a	Information about fitted/non-fitted equipment for flue gas cleaning, improvement in combustion	EF non-GHG	Accuracy Transparency	Medium
1.A.2.a	Investigation of production process in blast furnaces	EF	Accuracy	high

3.2.5.2 Non-Ferrous Metals (CRT category 1.A.2.b)

The CRT category 1.A.2.b *Non-Ferrous Metals* includes GHG emissions resulting from fuel combustion activities in

Activities	Occurring in Albania
▪ Manufacture of basic precious and other non-ferrous metals (ISIC Class 2420)	✓
▪ Casting of non-ferrous metals (ISIC Class 2432)	✓

3.2.5.2.1 Source category description

GHG emissions/ removals	CO_2						CH_4						N_2O					
Estimated	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass
1.A.2.b	✓*	✓	NO	NO	NO	NO	✓	✓	NO	NO	NO	NO	✓	✓	NO	NO	NO	NO
Key Category	LA2022 TA 1990-2022		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

A '✓' indicates: emissions from this sub-category have been estimated.
Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential

Use of notation key

IE	* 1993 - 1998	1.A.2.b (liquid)	The energy statistics is still under development; a split of the fuel combustion for this subcategory has to be reviewed for the entire timeseries. Emissions are currently allocated in CRT category 1.A.2.m Other.

LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF

An overview of the emissions from fuel combustion in CRT category *1.A.2.b Non-Ferrous Metals* is provided in the following figures and tables:

- annual emissions of GHGs;
- Trend of the periods 1990 – 2022, 2005 – 2022, 2021 – 2022.

The main fuels used in CRT category *1.A.2.b Non-Ferrous Metals* were liquid fuel, such as gas/diesel oil and fuel oil but also petroleum coke.

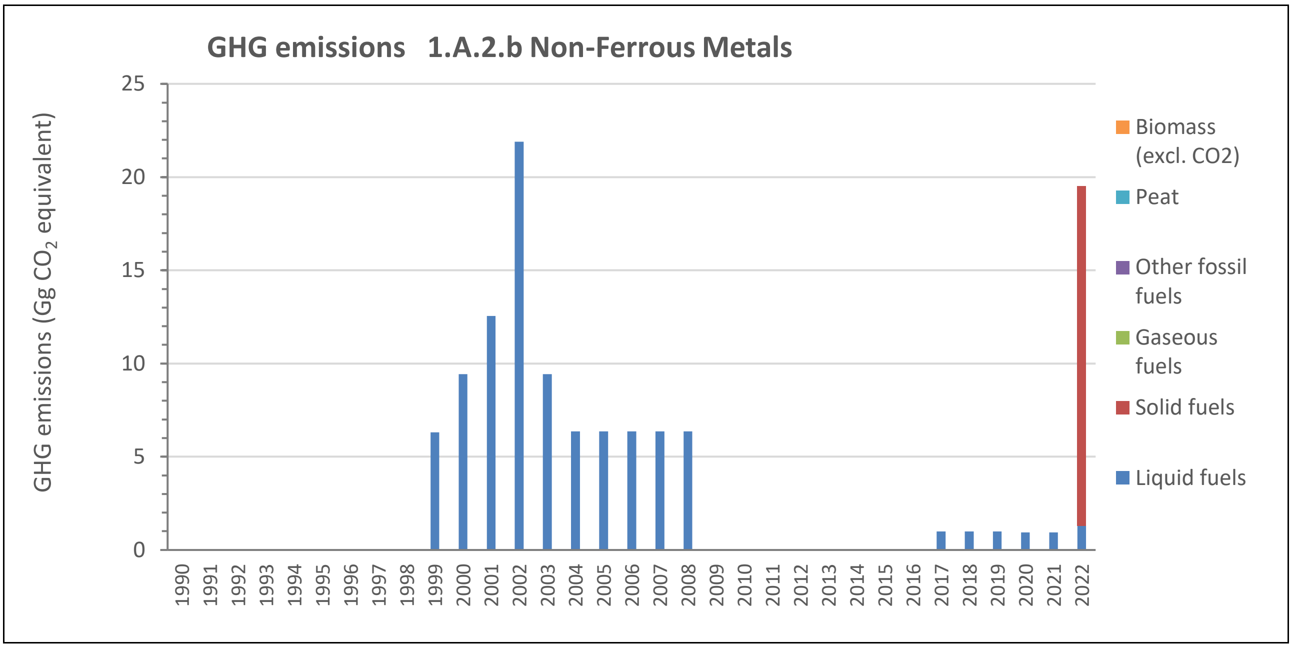


Figure 3-31 Emissions from CRT category 1.A.2.b Non-Ferrous Metals

Table 3-64 Emissions from CRT category 1.A.2.b Non-Ferrous Metals

GHG emissions	TOTAL GHG	CO_2 (excluding biomass)	N_2O (including biomass)	CH_4 (including biomass)	CO_2 (biomass)
	kt CO2 equivalent	kt	kt CO2 equivalent	kt CO2 equivalent	kt
1990	IE	IE	IE	IE	NO
1991	IE	IE	IE	IE	NO
1992	IE	IE	IE	IE	NO
1993	IE	IE	IE	IE	NO
1994	IE	IE	IE	IE	NO
1995	IE	IE	IE	IE	NO
1996	IE	IE	IE	IE	NO
1997	IE	IE	IE	IE	NO
1998	IE	IE	IE	IE	NO
1999	6.30	6.28	0.013	0.007	NO
2000	9.42	9.39	0.020	0.010	NO
2001	12.54	12.50	0.026	0.014	NO
2002	21.91	21.84	0.045	0.024	NO
2003	9.42	9.39	0.020	0.010	NO
2004	6.36	6.34	0.014	0.007	NO
2005	6.36	6.34	0.014	0.007	NO
2006	6.36	6.34	0.014	0.007	NO
2007	6.36	6.34	0.014	0.007	NO
2008	6.36	6.34	0.014	0.007	NO
2009	IE	IE	IE	IE	NO
2010	IE	IE	IE	IE	NO
2011	IE	IE	IE	IE	NO
2012	IE	IE	IE	IE	NO
2013	IE	IE	IE	IE	NO
2014	IE	IE	IE	IE	NO
2015	IE	IE	IE	IE	NO
2016	IE	IE	IE	IE	NO
2017	0.99	0.98	0.002	0.001	NO
2018	0.99	0.98	0.002	0.001	NO
2019	0.99	0.98	0.002	0.001	NO
2020	0.94	0.93	0.002	0.001	NO
2021	0.94	0.93	0.002	0.001	NO
2022	19.53	19.40	0.079	0.055	NO
Trend					
1990 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*
2005 - 2022	*206.9%*	*205.78%*	*479.2%*	*665.4%*	*NA*
2021 - 2022	*1987.7%*	*1980.17%*	*3840.2%*	*5107.2%*	*NA*

3.2.5.2.2 Methodological issues

3.2.5.2.2.1 Choice of methods

For estimating the GHG emissions (CO_2, CH_4, N_2O) the 2006 IPCC Guidelines Tier 1 approach[67] has been applied:

Equation 2.1: GHG emissions from stationary combustion (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Emissions_{GHG,\,fuel}[kt] = Fuel\ Consumption_{fuel}[TJ] \times Emission\ Factor_{GHG,\,fuel}\left[\frac{\mathrm{kg}}{\mathrm{TJ}}\right] * 10^{-6}}$$

Equation 2.2: Total emissions by greenhouse gas (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Emissions_{GHG}\left[kt_{CO2\ equivalent}\right] = \sum_{fuel} emissions_{\mathrm{CO2,\,fuel}}\ [kt] + \sum_{fuel} emissions_{\mathrm{CH4,\,fuel}}[kt] \times GWP_{CH4} + \sum_{fuel} emissions_{\mathrm{N2O,\,fuel}}[kt] \times GWP_{N2O}}$$

Where:

Emissions $_{GHG}$	= emissions of GHG (kt $_{CO2\ equivalent}$)
Emissions $_{GHG,\ fuel}$	= emissions of a given GHG by type of fuel (kt GHG)
Fuel consumption $_{fuel}$	= amount of fuel combusted (TJ)
Emission factor $_{GHG,\ fuel}$	= default emission factor of a given GHG by type of fuel (kg gas/TJ) For CO_2, it includes the carbon oxidation factor, assumed to be 1.
10^{-6}	= conversion from kg to kt (≡ divided by 1.000.000)
GHG	= CO_2, CH_4, N_2O
GWP	= Global warming potential for CO_2, CH_4, N_2O according to the IPCC 5AR
Fuel	= liquid fuels, solid fuels, gaseous fuels, other fossil fuel, biomass, peat

The method applied is not in line with the decision tree, as the category 1.A.2.a *Main Activity Iron and Steel* is a key category. See here the chapter planned improvements.

3.2.5.2.2.2 Choice of activity data

Fuel consumption used for estimating the GHG and non-GHG emissions for the years 1990 - 2022 were taken from Statistical Office of Albania (INSTAT).

Figure 3-32 Activity data for CRT category 1.A.2.b Non-Ferrous

Table 3-65 Activity data for sub-category 1.A.2.b Non-Ferrous Metals

Activity data 1.A.1.b	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
1990	IE	IE	NO	NO	NO	NO	NO
1991	IE	IE	NO	NO	NO	NO	NO
1992	IE	IE	NO	NO	NO	NO	NO
1993	IE	IE	NO	NO	NO	NO	NO

[67] Source: 2006 IPCC Guidelines, Volume 2: Energy, Chapter 2: Stationary Combustion - 2.3.1 Methodological issues - Choice of method

Activity data 1.A.1.b	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
1994	IE	IE	NO	NO	NO	NO	NO
1995	IE	IE	NO	NO	NO	NO	NO
1996	IE	IE	NO	NO	NO	NO	NO
1997	IE	IE	NO	NO	NO	NO	NO
1998	IE	IE	NO	NO	NO	NO	NO
1999	82.99	82.99	NO	NO	NO	NO	NO
2000	123.19	123.19	NO	NO	NO	NO	NO
2001	163.38	163.38	NO	NO	NO	NO	NO
2002	283.96	283.96	NO	NO	NO	NO	NO
2003	123.19	123.19	NO	NO	NO	NO	NO
2004	85.60	85.60	NO	NO	NO	NO	NO
2005	85.60	85.60	NO	NO	NO	NO	NO
2006	85.60	85.60	NO	NO	NO	NO	NO
2007	85.60	85.60	NO	NO	NO	NO	NO
2008	85.60	85.60	NO	NO	NO	NO	NO
2009	IE	IE	NO	NO	NO	NO	NO
2010	IE	IE	NO	NO	NO	NO	NO
2011	IE	IE	NO	NO	NO	NO	NO
2012	IE	IE	NO	NO	NO	NO	NO
2013	IE	IE	NO	NO	NO	NO	NO
2014	IE	IE	NO	NO	NO	NO	1.00
2015	IE	IE	NO	NO	NO	NO	NO
2016	IE	IE	NO	NO	NO	NO	NO
2017	13.27	13.27	NO	NO	NO	NO	NO
2018	13.27	13.27	NO	NO	NO	NO	NO
2019	13.27	13.27	NO	NO	NO	NO	NO
2020	12.58	12.58	NO	NO	NO	NO	NO
2021	12.58	12.58	NO	NO	NO	NO	NO
2022	208.82	17.51	191.32	NO	NO	NO	NO
Trend							
1990 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
2005 - 2022	*143.9%*	*-79.6%*	*NA*	*NA*	*NA*	*NA*	*NA*
2021 - 2022	*1559.5%*	*39.1%*	*NA*	*NA*	*NA*	*NA*	*NA*

In energy statistics, production, transformation and consumption of solid, liquid, gaseous and renewable fuels are specified in physical units, e.g. in tonnes or cubic meters. To convert these data to energy units, in this case terajoules, requires calorific values. The emission calculations are bases on net calorific values. In the following table the applied net calorific values (NCVs) for conversion to energy units in IPCC/NFR sub-category 1.A.2.b Non-Ferrous Metals.

Table 3-66 Net calorific values (NCVs) applied for conversion to energy units in category 1.A.2.b Non-Ferrous Metals

Fuel	Fuel type	Net calorific value (NCV) (TJ/Gg) or *(TJ/m3)		Source
		NCV	type	
Gas/Diesel Oil	liquid	42.71	CS	Statistical Office of Albania (INSTAT)
Residual fuel oil	liquid	41.20	CS	
Petroleum Coke	liquid	40.19	CS	
Natural Gas	gaseous	46.00	CS	
Wood / Fuelwood	biomass	9.18*	CS	
Wood pellets	biomass	16.85	CS	
Note: D Default CS Country specific PS Plant specific				

3.2.5.2.2.3 Choice of emission factors

Default emission factors for greenhouse gases were taken from IPCC 2006 Guidelines and are presented in the following table.

Table 3-67 GHG Emission factor TIER 1 for CRT category 1.A.2.b Non-Ferrous Metals

Fuel	Fuel type	CO_2 (kg/TJ)		CH_4 (kg/TJ)		N_2O (kg/TJ)		Source 2006 IPCC Guidelines Vol. 2, Chap. 2 (2.3.2.1)
		EF	type	EF	type	EF	type	
Gas/Diesel Oil	liquid	74 100	D	3	D	0.6	D	**Table 2.3** Default emission factors for stationary combustion in manufacturing industries and construction (page 2.18)
Residual Fuel Oil / Total fuel oil	liquid	77 400	D	3	D	0.6	D	
Lignite	solid	101 000	D	10	D	1.5	D	
LPG	gaseous	63 100	D	1	D	0.1	D	
Natural gas	gaseous	56 100	D	1	D	0.1	D	
Wood pellets	biomass	112 000	D	30	D	4	D	
Note: D Default CS Country specific PS Plant specific IEF Implied emission factor								

3.2.5.2.3 Uncertainties and time-series consistency

The uncertainties for activity data and emission factors used for CRT category 1.A.1.a Main Activity Electricity and Heat Production are presented in the following table.

Table 3-68 Uncertainty for CRT category 1.A.2.b Non-Ferrous Metals.

Uncertainty	Liquid fuels			Reference
	CO_2	CH_4	N_2O	2006 IPCC GL, Vol. 2, Chap. 2 (2.4.2)
Activity data (AD)	2%	2%	2%	Table 2.15 and Table 3.1
Emission factor (EF)	2%			Table 2.13
		100%		Table 2.12
			20%	Table 2.14
Combined Uncertainty (U)	2%	100%	20%	$U_{total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

The time-series are considered to be consistent as the same methodology is applied to the whole period. Activity data are considered to be consistent as national and international data were always compared.

3.2.5.2.4 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed out:

⇒ Checked of calculations by spreadsheets
- consistent use of energy balance data (energy statistic questionnaires),
- documented sources,
- use of units,
- strictly defined interfaces between spreadsheets/calculation modules,
- unique structure of sheets which do the same,
- record keeping, use of write protection,
- unique use of formulas, special cases are documented/highlighted,
- quick-control checks for data consistency through all steps of calculation.

⇒ cross-checked from different sources:
- National statistic published by INSTAT and
- Energy statistics of UN statistics[68] and data published by International Energy Agency (IEA)[69]

⇒ time series consistency - plausibility checks of dips and jumps..

3.2.5.2.5 Category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category 1.A.2.b Non-Ferrous Metals.

Table 3-69 Recalculations done in category 1.A.2.b Non-Ferrous Metals

source category	Revisions of data	Type of revision	Type of improvement
1.A.2.b	Revision of NCV	AD	Accuracy

3.2.5.2.6 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

[68] United Nations - Department of Economic and Social Affairs - Statistics Division Statistics - Energy Statistics https://unstats.un.org/unsd/energystats/

[69] Data and statistics - Data tools - Data tables Energy data by category, indicator, country or region https://www.iea.org/data-and-statistics/data-browser?country=WORLD&fuel=Energy%20supply&indicator=TESbySource

Table 3-70 Planned improvements for category 1.A.2.b Non-Ferrous Metals

source category	Planned improvement	Type of improvement		Priority
1.A.2.b	Carbon content (%) of lignite, gas/diesel oil, residual fuel oil, etc. for preparing country specific emission factor (CS EF) ⇒ **CS EF_{CO2}** [t/TJ] = (C [%] • 44 • Ox)/(NCV [TJ/t] • 12• 100)	EF	Accuracy Transparency	Medium
1.A.2.b	Information about fitted/non-fitted equipment for flue gas cleaning, improvement in combustion	EF	Accuracy Transparency	Medium
1.A.2.b	Improvement of time series consistency and split of fuels: the energy statistics is still under development; a split of the fuel combustion for this subcategory has to be reviewed for the entire time series. Emissions are allocated in IPCC/NFR subcategory 1.A.2.m Other.	AD	Accuracy Transparency	High
1.A.2.b	Cross-check of national and international data sources (Eurostat and UNSD)	AD	Consistency Transparency	Medium

3.2.5.3 Chemical industry (CRT category 1.A.2.c)

The CRT category 1.A.2.c *Chemical industry* includes GHG emissions resulting from fuel combustion activities in

Activities	Occurring in ALB
▪ Manufacture of chemicals and chemical products (ISIC division 20)	✓
▪ Manufacture of pharmaceuticals, medicinal chemical & botanical products (ISIC Class 21)	✓

3.2.5.3.1 Source category description

GHG emissions/ removals	CO_2						CH_4						N_2O					
Estimated	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass
1.A.2.c	✓	✓*	NO	NO	NO	✓	✓	✓*	NO	NO	NO	✓	✓	✓*	NO	NO	NO	✓
Key category	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

A '✓' indicates: emissions from this sub-category have been estimated.
Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential

LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF

* data provided only from 2005 onwards, all other years IE

Use of notation key

IE	1.A.2.c (liquid, solid)	The energy statistics is still under development; a split of the fuel combustion for this subcategory has to be reviewed for the entire timeseries. Emissions are currently allocated in CRT category 1.A.2.m *Other*.

An overview of the emissions from fuel combustion in CRT category *1.A.2.c Chemical industry* is provided in the following figures and tables:

- annual emissions of GHGs;
- Trend of the periods 1990 – 2022, 2005 – 2022, 2021 – 2022.

The main fuels used in 1.A.2.c were liquid fuel, such as gas/diesel oil and fuel oil.

For the period 1990-2009, the emissions from this sub-category are included in 1.A.2.m Other.

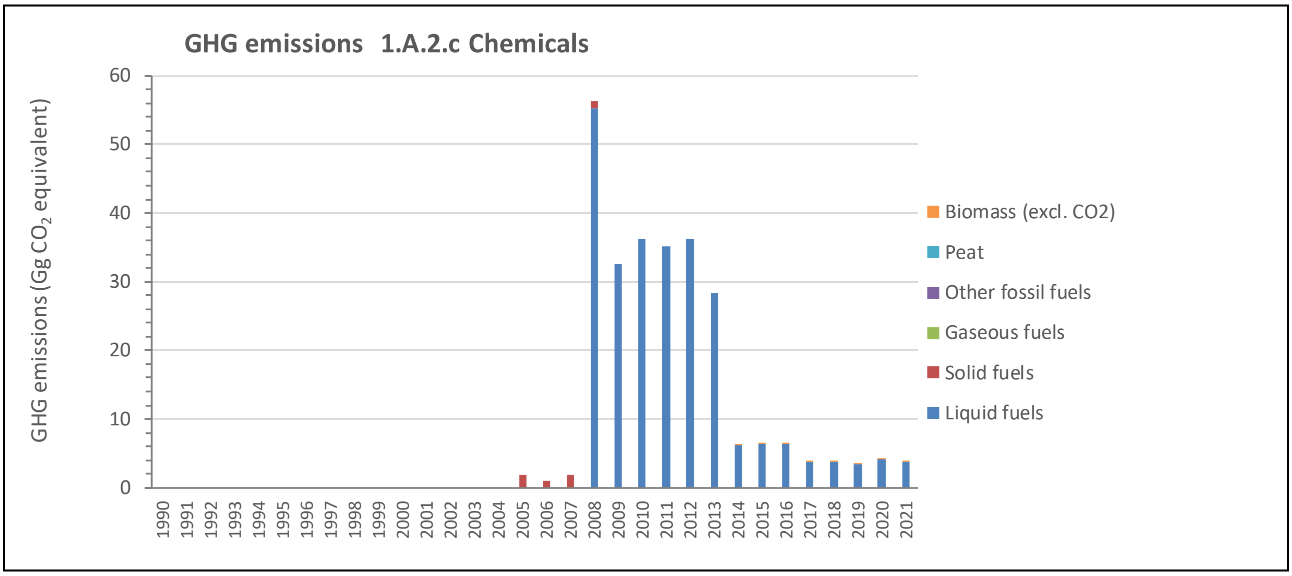


Figure 3-33 Emissions from CRT category 1.A.2.c Chemical industry

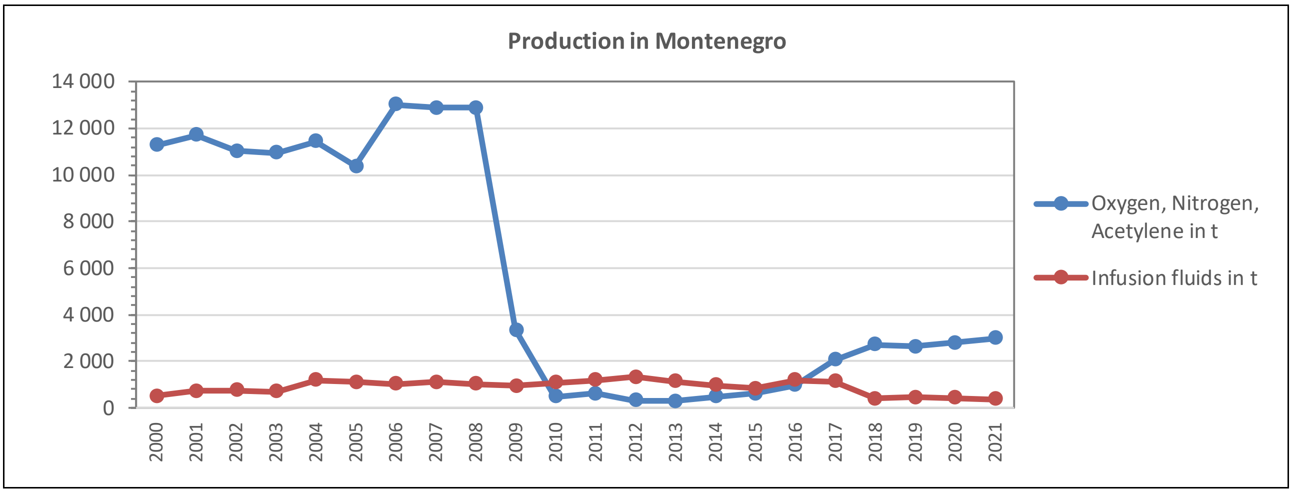


Figure 3-34 Main products in category 1.A.2.j Chemical industry in the period 2000-2022; Source: INSTAT

Table 3-71 Emissions from CRT category 1.A.2.c Chemical industry

GHG emissions	TOTAL GHG	CO_2 (excluding biomass)	N_2O (including biomass)	CH_4 (including biomass)	CO_2 (biomass)
	kt CO2 equivalent	kt	kt CO2 equivalent	kt CO2 equivalent	kt
1990	IE	IE	IE	IE	NO
1991	IE	IE	IE	IE	NO
1992	IE	IE	IE	IE	NO
1993	IE	IE	IE	IE	NO
1994	IE	IE	IE	IE	NO
1995	IE	IE	IE	IE	NO
1996	IE	IE	IE	IE	NO
1997	IE	IE	IE	IE	NO
1998	IE	IE	IE	IE	NO
1999	IE	IE	IE	IE	NO
2000	IE	IE	IE	IE	NO
2001	IE	IE	IE	IE	NO
2002	IE	IE	IE	IE	NO
2003	IE	IE	IE	IE	NO
2004	IE	IE	IE	IE	NO
2005	1.873	1.860	0.008	0.005	NO
2006	0.937	0.930	0.004	0.002	NO
2007	1.873	1.860	0.008	0.005	NO
2008	56.232	56.171	0.033	0.027	NO
2009	32.570	32.523	0.029	0.018	NO
2010	36.176	36.110	0.043	0.023	NO
2011	35.206	35.157	0.030	0.019	NO
2012	36.233	36.168	0.042	0.023	NO
2013	28.356	28.260	0.068	0.029	NO
2014	6.244	6.218	0.015	0.006	0.004
2015	6.308	6.276	0.015	0.006	0.012
2016	6.307	6.276	0.015	0.006	0.011
2017	3.769	3.748	0.009	0.004	0.008
2018	3.768	3.748	0.009	0.004	0.007
2019	3.449	3.432	0.008	0.003	0.006
2020	4.080	4.059	0.010	0.004	0.007
2021	3.767	3.748	0.009	0.004	0.006
2022					
Trend					
1990 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*
2005 - 2022	*101.1%*	*101.5%*	*7.9%*	*-18.2%*	*NA*
2021 - 2022	*-7.7%*	*-7.7%*	*-7.5%*	*-7.6%*	*-15.9%*

3.2.5.3.2 Methodological issues

3.2.5.3.2.1 Choice of methods

For estimating the GHG emissions (CO_2, CH_4, N_2O) the 2006 IPCC Guidelines Tier 1 approach[70] has been applied:

Equation 2.1: GHG emissions from stationary combustion (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Emissions_{GHG,\,fuel}[kt] = Fuel\ Consumption_{fuel}[TJ] \times Emission\ Factor_{GHG,\,fuel}\left[\frac{\mathrm{kg}}{\mathrm{TJ}}\right] * 10^{-6}}$$

Equation 2.2: Total emissions by greenhouse gas (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Emissions_{GHG}\left[kt_{CO2\ equivalent}\right] = \sum_{fuel} emissions_{\mathrm{CO2,\,fuel}}\ [kt] + \sum_{fuel} emissions_{\mathrm{CH4,\,fuel}}[kt] \times GWP_{CH4} + \sum_{fuel} emissions_{\mathrm{N2O,\,fuel}}[kt] \times GWP_{N2O}}$$

Where:

Emissions $_{GHG}$	= emissions of GHG (kt $_{CO2\ equivalent}$)
Emissions $_{GHG,\ fuel}$	= emissions of a given GHG by type of fuel (kt GHG)
Fuel consumption $_{fuel}$	= amount of fuel combusted (TJ)
Emission factor $_{GHG,\ fuel}$	= default emission factor of a given GHG by type of fuel (kg gas/TJ) For CO_2, it includes the carbon oxidation factor, assumed to be 1.
10^{-6}	= conversion from kg to kt (≡ divided by 1.000.000)
GHG	= CO_2, CH_4, N_2O
GWP	= Global warming potential for CO_2, CH_4, N_2O according to the IPCC 5AR
Fuel	= liquid fuels, solid fuels, gaseous fuels, other fossil fuel, biomass, peat

The method applied is not in line with the decision tree, as the category 1.A.2.a *Main Activity Iron and Steel* is a key category. See here the chapter planned improvements.

3.2.5.3.2.2 Choice of activity data

Fuel consumption used for estimating the GHG and non-GHG emissions for the years 1990 - 2022 were taken from Statistical Office of Albania (INSTAT).

[70] Source: 2006 IPCC Guidelines, Volume 2: Energy, Chapter 2: Stationary Combustion - 2.3.1 Methodological issues - Choice of method

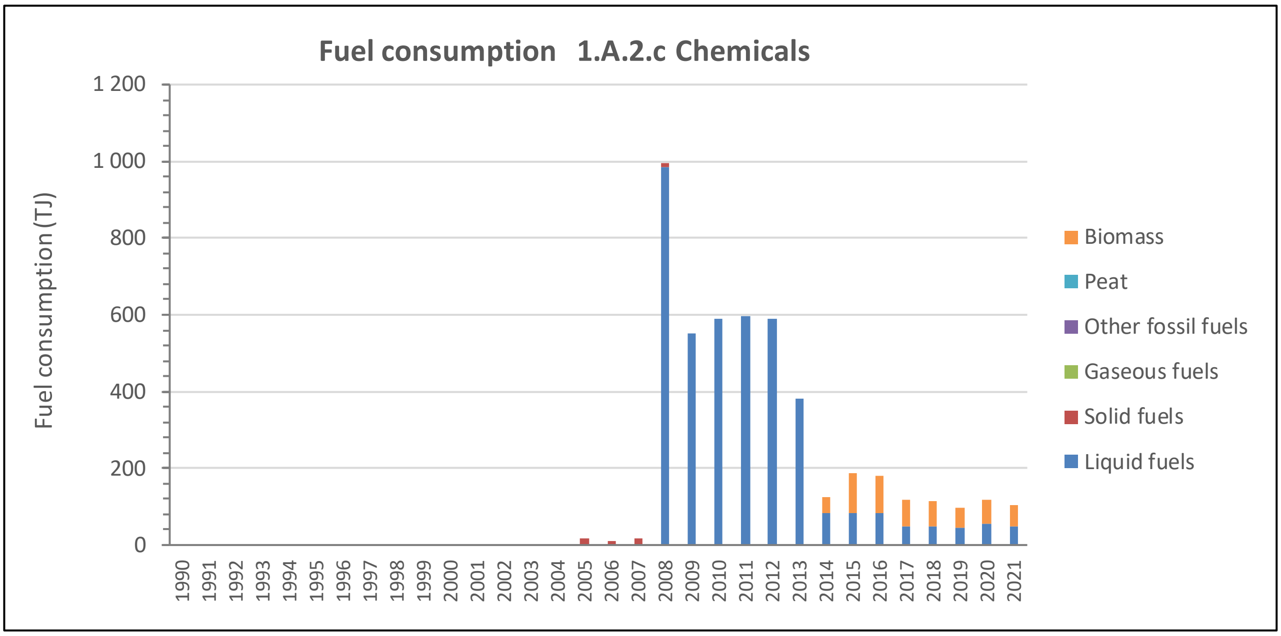


Figure 3-35 Activity data for CRT category 1.A.2.c Chemical industry

Use of notation key

IE	1.A.2.c liquid, solid	The energy statistics is still under development; a split of the fuel combustion for this subcategory has to be reviewed for the entire timeseries. Emissions are currently allocated in CRT category 1.A.2.m *Other*.

Table 3-72 Activity data for CRT category 1.A.2.c Chemical industry

Activity data 1.A.1.c	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
1990	IE	IE	IE	NO	NO	NO	NO
1991	IE	IE	IE	NO	NO	NO	NO
1992	IE	IE	IE	NO	NO	NO	NO
1993	IE	IE	IE	NO	NO	NO	NO
1994	IE	IE	IE	NO	NO	NO	NO
1995	IE	IE	IE	NO	NO	NO	NO
1996	IE	IE	IE	NO	NO	NO	NO
1997	IE	IE	IE	NO	NO	NO	NO
1998	IE	IE	IE	NO	NO	NO	NO
1999	IE	IE	IE	NO	NO	NO	NO
2000	IE	IE	IE	NO	NO	NO	NO
2001	IE	IE	IE	NO	NO	NO	NO
2002	IE	IE	IE	NO	NO	NO	NO
2003	IE	IE	IE	NO	NO	NO	NO
2004	IE	IE	IE	NO	NO	NO	NO
2005	18.42	IE	18.42	NO	NO	NO	NO
2006	9.21	IE	9.21	NO	NO	NO	NO
2007	18.42	IE	18.42	NO	NO	NO	NO
2008	993.90	984.69	9.21	NO	NO	NO	NO
2009	552.81	552.81	NO	NO	NO	NO	NO

Activity data 1.A.1.c	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
2010	589.83	589.83	NO	NO	NO	NO	NO
2011	596.17	596.17	NO	NO	NO	NO	NO
2012	588.82	588.82	NO	NO	NO	NO	NO
2013	381.37	381.37	NO	NO	NO	NO	NO
2014	123.91	83.91	NO	NO	NO	NO	40.00
2015	186.90	82.90	NO	NO	NO	NO	104.00
2016	178.90	82.90	NO	NO	NO	NO	96.00
2017	116.69	49.69	NO	NO	NO	NO	67.00
2018	115.69	49.69	NO	NO	NO	NO	66.00
2019	95.42	45.42	NO	NO	NO	NO	50.00
2020	116.71	53.71	NO	NO	NO	NO	63.00
2021	102.69	49.69	NO	NO	NO	NO	53.00
2022							
Trend							
1990 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
2005 - 2022	*457.5%*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
2021 - 2022	*-12.0%*	*-7.5%*	*NA*	*NA*	*NA*	*NA*	*-15.9%*

In energy statistics, production, transformation and consumption of solid, liquid, gaseous and renewable fuels are specified in physical units, e.g. in tons or cubic meters. To convert these data to energy units, in this case terajoules, requires calorific values. The emission calculations are bases on net calorific values. In the following table the applied net calorific values (NCVs) for conversion to energy units in CRT category 1.A.2.c Chemical industry.

Table 3-73 Net calorific values (NCVs) applied for conversion to energy units in sub-category 1.A.2.c Chemicals

Fuel	Fuel type	Net calorific value (NCV) (TJ/Gg) or *(TJ/m3)		Source
		NCV	type	
Gas/Diesel Oil	liquid	42.71	CS	Statistical Office of Albania (INSTAT)
Residual fuel oil	liquid	41.20	CS	
Liquefied Petroleum Gases (LPG)	liquid	46.89	CS	
Sub-Bituminous Coal	solid	16.75	CS	
Wood / Fuelwood	biomass	9.18*	CS	

Note:
D Default CS Country specific PS Plant specific

3.2.5.3.2.3 Choice of emission factors

Default emission factors for greenhouse gases were taken from IPCC 2006 Guidelines and are presented in the following table.

Table 3-74 GHG Emission factor TIER 1 for CRT category 1.A.2 Main Activity Manufacturing Industries and Construction

Fuel	Fuel type	CO_2 (kg/TJ)		CH_4 (kg/TJ)		N_2O (kg/TJ)		Source
		EF	type	EF	type	EF	type	**2006 IPCC Guidelines Vol. 2, Chap. 2 (2.3.2.1)**
Residual Fuel Oil	liquid	77 400	D	3	D	0.6	D	**Table 2.3** Default emission factors for stationary combustion in manu-facturing industries and construction (page 2.18)
Lignite	solid	101 000	D	10	D	1.5	D	
Wood pellets	biomass	112 000	D	30	D	4	D	

Note:
D Default CS Country specific PS Plant specific IEF Implied emission factor

3.2.5.3.3 Uncertainties and time-series consistency

The uncertainties for activity data and emission factors used for CRT category 1.A.1.a Main Activity Electricity and Heat Production are presented in the following table.

Table 3-75 Uncertainty for CRT category 1.A.2.b Non-Ferrous Metals

Uncertainty	Liquid fuels			Reference
	CO_2	CH_4	N_2O	2006 IPCC GL, Vol. 2, Chap. 2 (2.4.2)
Activity data (AD)	2%	2%	2%	Table 2.15 and Table 3.1
Emission factor (EF)	2%			Table 2.13
		100%		Table 2.12
			20%	Table 2.14
Combined Uncertainty (U)	2%	100%	20%	$U_{total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

The time-series are considered to be consistent as the same methodology is applied to the whole period. Activity data are considered to be consistent as national and international data were always compared.

3.2.5.3.4 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed out:

⇒ consistent use of energy balance data (energy statistic questionnaires),
  - documented sources,
  - use of units,
  - strictly defined interfaces between spreadsheets/calculation modules,
  - unique structure of sheets which do the same,
  - record keeping, use of write protection,
  - unique use of formulas, special cases are documented/highlighted,
  - quick-control checks for data consistency through all steps of calculation.

⇒ cross-checked from different sources:
  - National statistic published by INSTAT and
  - Energy statistics of UN statistics[71] and data published by International Energy Agency (IEA)[72]

⇒ time series consistency - plausibility checks of dips and jumps.

[71] United Nations - Department of Economic and Social Affairs - Statistics Division Statistics - Energy Statistics https://unstats.un.org/unsd/energystats/

[72] Data and statistics - Data tools - Data tables Energy data by category, indicator, country or region https://www.iea.org/data-and-statistics/data-browser?country=WORLD&fuel=Energy%20supply&indicator=TESbySource

3.2.5.3.5 Category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category 1.A.2.c *Chemicals*.

Table 3-76 Recalculations done in sub-category 1.A.2.c Chemicals

source category	Revisions of data	Type of revision	Type of improvement
1.A.2.c	Revision of NCV	AD	Accuracy

3.2.5.3.6 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 3-77 Planned improvements for sub-category 1.A.2.c Chemicals

source category	Planned improvement	Type of improvement		Priority
1.A.2.c	Carbon content (%) of lignite, gas/diesel oil, residual fuel oil, etc. for preparing country specific emission factor (CS EF) ⇒ **CS EF$_{CO2}$** [t/TJ] = (C [%] • 44 • Ox)/(NCV [TJ/t] • 12• 100)	EF	Accuracy Transparency	Medium
1.A.2.c	Information about fitted/non-fitted equipment for flue gas cleaning, improvement in combustion	EF	Accuracy Transparency	Medium
1.A.2.c	Improvement of time series consistency and split of fuels: the energy statistics is still under development; a split of the fuel combustion for this subcategory has to be reviewed for the entire time series. Emissions are allocated in IPCC/NFR subcategory 1.A.2.m Other.	AD	Accuracy Transparency	High
1.A.2.c	Cross-check of national and international data sources (Eurostat and UNSD)	AD	Consistency Transparency	Medium

3.2.5.4 Pulp, Paper and Print (CRT category 1.A.2.d)

The CRT category 1.A.2.d *Pulp, Paper and Printing* includes GHG emissions resulting from fuel combustion activities in

Activities	Occurring in ALB
▪ Manufacture of paper and paper products (ISIC Division 17)	✓
○ ISIC Group 1701 Manufacture of pulp, paper and paperboard	
○ ISIC Group 1702 Manufacture of corrugated paper and paperboard and of containers of paper and paperboard	
○ ISIC Group 1709 Manufacture of other articles of paper and paperboard	
▪ Printing and reproduction of recorded media (ISIC Division 18)	✓
○ ISIC Group 181 Printing and service activities related to printing	
○ ISIC Group 182 Reproduction of recorded media	

3.2.5.4.1 Source category description

GHG emissions/ removals	CO_2						CH_4						N_2O					
Estimated	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass
1.A.2.d	✓*	✓*	NO	NO	NO	NO	✓*	✓*	NO	NO	NO	NO	✓*	✓*	NO	NO	NO	NO
Key category	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

A '✓' indicates: emissions from this sub-category have been estimated.
Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential

LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF

* data provided only from 1995 onwards, all other years IE

Use of notation key

IE	1.A.2.d (liquid, solid)	The energy statistics is still under development; a split of the fuel combustion for this subcategory has to be reviewed for the entire timeseries. Emissions are currently allocated in CRT category 1.A.2.m *Other*.

An overview of the emissions from fuel combustion in CRT category *1.A.2.d Pulp, Paper and Print* is provided in the following figures and tables:

- annual emissions of GHGs;
- Trend of the periods 1990 – 2022, 2005 – 2022, 2021 – 2022.

GHG emissions decreased significantly to change in fuel mix. Whereas until 2005 the main fuel used was lignite which come from the Pljevija basin, the fuel mix changed to liquid fuel, such as gas/diesel oil and fuel oil.

For the period 1990-1995, 2011 and 2015-2016 the emissions from this sub-category are included in 1.A.2.m Other.

Figure 3-36 GHG emissions from CRT category 1.A.2.d Pulp, Paper and Printing

Figure 3-37 Main products in category 1.A.2.d Pulp, Paper and Print in the period 2000-2022; Source: INSTAT

Table 3-78 GHG Emissions from CRT category 1.A.2.d Pulp, Paper and Print

GHG emissions	TOTAL GHG	CO_2 (excluding biomass)	N_2O (including biomass)	CH_4 (including biomass)	CO_2 (biomass)
	kt CO2 equivalent	kt	kt CO2 equivalent	kt CO2 equivalent	kt
1990	IE	IE	IE	IE	NO
1991	IE	IE	IE	IE	NO
1992	IE	IE	IE	IE	NO
1993	IE	IE	IE	IE	NO
1994	IE	IE	IE	IE	NO
1995	IE	IE	IE	IE	NO
1996	8.43	8.37	0.037	0.021	NO
1997	11.24	11.16	0.049	0.028	NO
1998	14.05	13.95	0.062	0.035	NO
1999	11.24	11.16	0.049	0.028	NO
2000	6.56	6.51	0.029	0.016	NO
2001	5.62	5.58	0.025	0.014	NO
2002	2.81	2.79	0.012	0.007	NO
2003	1.87	1.86	0.008	0.005	NO
2004	1.87	1.86	0.008	0.005	NO
2005	1.87	1.86	0.008	0.005	NO
2006	13.41	13.37	0.034	0.015	NO
2007	7.18	7.15	0.019	0.009	NO
2008	1.87	1.86	0.008	0.005	NO
2009	6.24	6.22	0.015	0.006	NO
2010	6.24	6.22	0.015	0.006	NO
2011	NO	NO	NO	NO	NO
2012	6.24	6.22	0.015	0.006	NO
2013	6.24	6.22	0.015	0.006	NO
2014	12.48	12.44	0.030	0.013	NO
2015	NO	NO	NO	NO	NO
2016	NO	NO	NO	NO	NO
2017	3.12	3.11	0.008	0.003	NO
2018	1.87	1.87	0.005	0.002	NO
2019	1.87	1.87	0.005	0.002	NO
2020	1.87	1.87	0.005	0.002	NO
2021	2.50	2.49	0.006	0.003	NO
2022					
Trend					
1990 - 2022	NA	NA	NA	NA	NA
2005 - 2022	33.2%	33.7%	-27.1%	-45.3%	NA
2021 - 2022	33.3%	33.3%	33.3%	33.3%	NA

3.2.5.4.2 Methodological issues

3.2.5.4.2.1 Choice of methods

For estimating the GHG emissions (CO_2, CH_4, N_2O) the 2006 IPCC Guidelines Tier 1 approach[73] has been applied:

Equation 2.1: GHG emissions from stationary combustion (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Emissions_{GHG,\,fuel}[kt] = Fuel\ Consumption_{fuel}[TJ] \times Emission\ Factor_{GHG,\,fuel}\left[\frac{\mathrm{kg}}{\mathrm{TJ}}\right] * 10^{-6}}$$

Equation 2.2: Total emissions by greenhouse gas (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Emissions_{GHG}\left[kt_{CO2\ equivalent}\right] = \sum_{fuel} emissions_{\mathrm{CO2,\,fuel}}\ [kt] + \sum_{fuel} emissions_{\mathrm{CH4,\,fuel}}[kt] \times GWP_{CH4} + \sum_{fuel} emissions_{\mathrm{N2O,\,fuel}}[kt] \times GWP_{N2O}}$$

Where:

Emissions $_{GHG}$	= emissions of GHG (kt $_{CO2\ equivalent}$)
Emissions $_{GHG,\ fuel}$	= emissions of a given GHG by type of fuel (kt GHG)
Fuel consumption $_{fuel}$	= amount of fuel combusted (TJ)
Emission factor $_{GHG,\ fuel}$	= default emission factor of a given GHG by type of fuel (kg gas/TJ) For CO_2, it includes the carbon oxidation factor, assumed to be 1.
10^{-6}	= conversion from kg to kt (≡ divided by 1.000.000)
GHG	= CO_2, CH_4, N_2O
GWP	= Global warming potential for CO_2, CH_4, N_2O according to the IPCC 5AR
Fuel	= liquid fuels, solid fuels, gaseous fuels, other fossil fuel, biomass, peat

The method applied is not in line with the decision tree, as the category 1.A.2.a *Main Activity Iron and Steel* is a key category. See here the chapter planned improvements.

3.2.5.4.2.2 Choice of activity data

Fuel consumption used for estimating the GHG and non-GHG emissions for the years 1990 - 2022 were taken from Statistical Office of Albania (INSTAT).

[73] Source: 2006 IPCC Guidelines, Volume 2: Energy, Chapter 2: Stationary Combustion - 2.3.1 Methodological issues - Choice of method

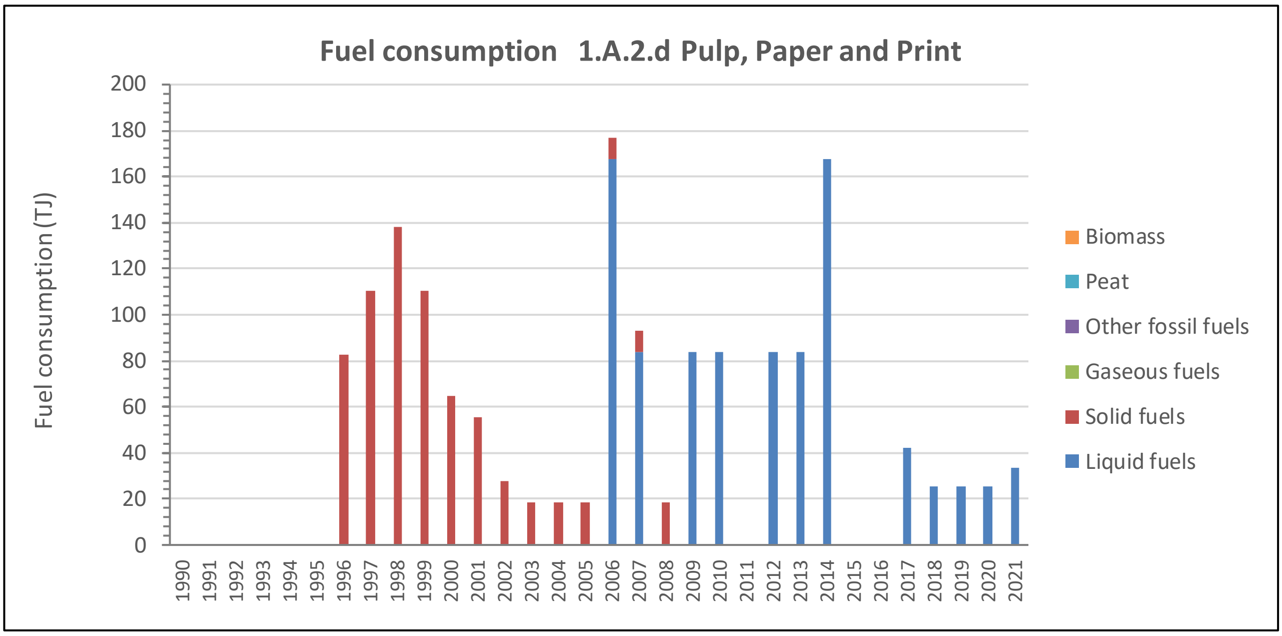


Figure 3-38 Activity data for sub-category 1.A.2.d Pulp, Paper and Print

Use of notation key

IE	1.A.2.d liquid, solid	The energy statistics is still under development; a split of the fuel combustion for this subcategory has to be reviewed for the entire timeseries. Emissions are currently allocated in CRT category 1.A.2.m *Other*.

Table 3-79 Activity data for sub-category 1.A.2.d Pulp, Paper and Print

Activity data 1.A.1.d	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
1990	IE	IE	IE	NO	NO	NO	NO
1991	IE	IE	IE	NO	NO	NO	NO
1992	IE	IE	IE	NO	NO	NO	NO
1993	IE	IE	IE	NO	NO	NO	NO
1994	IE	IE	IE	NO	NO	NO	NO
1995	IE	IE	IE	NO	NO	NO	NO
1996	82.89	IE	82.89	NO	NO	NO	NO
1997	110.52	IE	110.52	NO	NO	NO	NO
1998	138.15	IE	138.15	NO	NO	NO	NO
1999	110.52	IE	110.52	NO	NO	NO	NO
2000	64.47	IE	64.47	NO	NO	NO	NO
2001	55.26	IE	55.26	NO	NO	NO	NO
2002	27.63	IE	27.63	NO	NO	NO	NO
2003	18.42	IE	18.42	NO	NO	NO	NO
2004	18.42	IE	18.42	NO	NO	NO	NO
2005	18.42	IE	18.42	NO	NO	NO	NO
2006	177.03	167.82	9.21	NO	NO	NO	NO
2007	93.12	83.91	9.21	NO	NO	NO	NO
2008	18.42	NO	18.42	NO	NO	NO	NO
2009	83.91	83.91	NO	NO	NO	NO	NO

Activity data 1.A.1.d	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
2010	83.91	83.91	NO	NO	NO	NO	NO
2011	IE	IE	NO	NO	NO	NO	NO
2012	83.91	83.91	NO	NO	NO	NO	NO
2013	83.91	83.91	NO	NO	NO	NO	NO
2014	167.82	167.82	NO	NO	NO	NO	NO
2015	IE	IE	NO	NO	NO	NO	NO
2016	IE	IE	NO	NO	NO	NO	NO
2017	41.96	41.96	NO	NO	NO	NO	NO
2018	25.17	25.17	NO	NO	NO	NO	NO
2019	25.17	25.17	NO	NO	NO	NO	NO
2020	25.17	25.17	NO	NO	NO	NO	NO
2021	33.56	33.56	NO	NO	NO	NO	NO
2022							
Trend							
1990 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
2005 - 2022	*82.2%*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
2021 - 2022	*33.3%*	*33.3%*	*NA*	*NA*	*NA*	*NA*	*NA*

In energy statistics, production, transformation and consumption of solid, liquid, gaseous and renewable fuels are specified in physical units, e.g. in tons or cubic meters. To convert these data to energy units, in this case terajoules, requires calorific values. The emission calculations are bases on net calorific values. In the following table the applied net calorific values (NCVs) for conversion to energy units in CRT category 1.A.2.d Pulp, Paper and Print.

Table 3-80 Net calorific values (NCVs) applied for conversion to energy units in sub-category 1.A.2.d Pulp, Paper and Print

Fuel	Fuel type	Net calorific value (NCV) (TJ/Gg)		Source
		NCV	type	
Gas/Diesel Oil	liquid	42.71	CS	Statistical Office of Albania (INSTAT)
Residual fuel oil	liquid	41.20	CS	
Liquefied Petroleum Gases (LPG)	liquid	46.89	CS	
Sub-Bituminous Coal	solid	16.75	CS	
Lignite	solid	9.21	CS	

Note:
D Default CS Country specific PS Plant specific

3.2.5.4.2.3 Choice of emission factors

Default emission factors for greenhouse gases were taken from IPCC 2006 Guidelines and are presented in the following table.

Table 3-81 GHG Emission factor TIER 1 for CRT category 1.A.2 Manufacturing Industries and Construction

Fuel	Fuel type	CO_2 (kg/TJ)		CH_4 (kg/TJ)		N_2O (kg/TJ)		Source
		EF	type	EF	type	EF	type	2006 IPCC Guidelines Vol. 2, Chap. 2 (2.3.2.1)
Residual Fuel Oil	liquid	77 400	D	3	D	0.6	D	**Table 2.3** Default emission factors for stationary combustion in manufacturing industries and construction (page 2.18)
Lignite	solid	101 000	D	10	D	1.5	D	
Wood pellets	biomass	112 000	D	30	D	4	D	

Note:
D Default CS Country specific PS Plant specific IEF Implied emission factor

3.2.5.4.3 Uncertainties and time-series consistency

The uncertainties for activity data and emission factors used for CRT category 1.A.1.a Main Activity Electricity and Heat Production are presented in the following table.

Table 3-82 Uncertainty for CRT category 1.A.2.b Non-Ferrous Metals

Uncertainty	Liquid fuels			Reference
	CO_2	CH_4	N_2O	2006 IPCC GL, Vol. 2, Chap. 2 (2.4.2)
Activity data (AD)	2%	2%	2%	Table 2.15 and Table 3.1
Emission factor (EF)	2%			Table 2.13
		100%		Table 2.12
			20%	Table 2.14
Combined Uncertainty (U)	2%	100%	20%	$U_{total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

The time-series are considered to be consistent as the same methodology is applied to the whole period. Activity data are considered to be consistent as national and international data were always compared.

3.2.5.4.4 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed out:

⇒ consistent use of energy balance data (energy statistic questionnaires),
- documented sources,
- use of units,
- strictly defined interfaces between spreadsheets/calculation modules,
- unique structure of sheets which do the same,
- record keeping, use of write protection,
- unique use of formulas, special cases are documented/highlighted,
- quick-control checks for data consistency through all steps of calculation.

⇒ cross-checked from different sources:
- National statistic published by INSTAT and
- Energy statistics of UN statistics[74] and data published by International Energy Agency (IEA)[75]

[74] United Nations - Department of Economic and Social Affairs - Statistics Division Statistics - Energy Statistics https://unstats.un.org/unsd/energystats/

[75] Data and statistics - Data tools - Data tables Energy data by category, indicator, country or region https://www.iea.org/data-and-statistics/data-browser?country=WORLD&fuel=Energy%20supply&indicator=TESbySource

⇒ time series consistency - plausibility checks of dips and jumps.

3.2.5.4.5 Category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category 1.A.2.d *Pulp, Paper and Print*.

Table 3-83 Recalculations done in sub-category 1.A.2.d Pulp, Paper and Print

source category	Revisions of data	Type of revision	Type of improvement
1.A.2.d	Revision of NCV	AD	Accuracy

3.2.5.4.6 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 3-84 Planned improvements for sub-category 1.A.2.d Pulp, Paper and Print

source category	Planned improvement	Type of improvement		Priority
1.A.2.d	Carbon content (%) of lignite, gas/diesel oil, residual fuel oil, etc. for preparing country specific emission factor (CS EF) ⇒ **CS EF$_{CO2}$** [t/TJ] = (C [%] • 44 • Ox)/(NCV [TJ/t] • 12• 100)	EF	Accuracy Transparency	Medium
1.A.2.d	Information about fitted/non-fitted equipment for flue gas cleaning, improvement in combustion	EF	Accuracy Transparency	Medium
1.A.2.d	Improvement of time series consistency and split of fuels: the energy statistics is still under development; a split of the fuel combustion for this subcategory has to be reviewed for the entire time series. Emissions are allocated in IPCC/NFR subcategory 1.A.2.m Other.	AD	Accuracy Transparency	High
1.A.2.d	Cross-check of national and international data sources (Eurostat and UNSD)	AD	Consistency Transparency	Medium

3.2.5.5 Food Processing, Beverages and Tobacco (CRT category 1.A.2.e)

The CRT category 1.A.2.d *Pulp, Paper and Printing* includes GHG emissions resulting from fuel combustion activities in

Activities	Occurring in Albania
▪ ISIC Divisions 10 Manufacture of food products	✓

○ Processing and preserving of meat, fish, crustaceans and molluscs, fruit and vegetables	
○ Manufacture of vegetable and animal oils and fats, dairy products, grain mill products, starches and starch products and of other food products	
▪ ISIC Divisions 11 Manufacture of beverages	
○ Distilling, rectifying and blending	✓
○ Manufacture of wines, malt liquors and malt, soft drinks; production of mineral waters and other bottled waters	
▪ ISIC Divisions 12 Manufacture of tobacco products.	NO

3.2.5.5.1 Source category description

GHG emissions/ removals	CO_2						CH_4						N_2O					
Estimated	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass
1.A.2.e	✓*	✓**	NO	NO	NO	✓	✓*	✓**	NO	NO	NO	✓	✓*	✓**	NO	NO	NO	✓
Key Category	LA 2020						-	-	-	-	-	-	-	-	-	-	-	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential																		
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF																		
* data provided only for 1990, 1995 and after 2004, all other years IE; ** data provided for all years except f2009 and 2010, for which IE is used																		

Use of notation key

IE 1.A.2.e (liquid) The energy statistics is still under development; a split of the fuel combustion for this subcategory has to be reviewed for the entire timeseries. Emissions are currently allocated in CRT category 1.A.2.m *Other*.

An overview of the emissions from fuel combustion in CRT category *1.A.2.e Food Processing, Beverages and Tobacco* is provided in the following figures and tables:

- annual emissions of GHGs;
- Trend of the periods 1990 – 2022, 2005 – 2022, 2021 – 2022.

The main fuels used in 1.A.2.e were liquid fuel, such as gas/diesel oil and fuel oil.

In the last decade the GHG emissions increased significantly to change in fuel mix but also due to increased processing of food and beverages. Whereas until 2005 the main fuel used was lignite which come from the Pljevija basin, the fuel mix changed to liquid fuel, such as gas/diesel oil and fuel oil.

For 1990-2005, , the emissions from liquid fuels combusted in CRT category 1.A.2.e Food Processing, Beverages and Tobacco is included in CRT category 1.A.2.m Other.

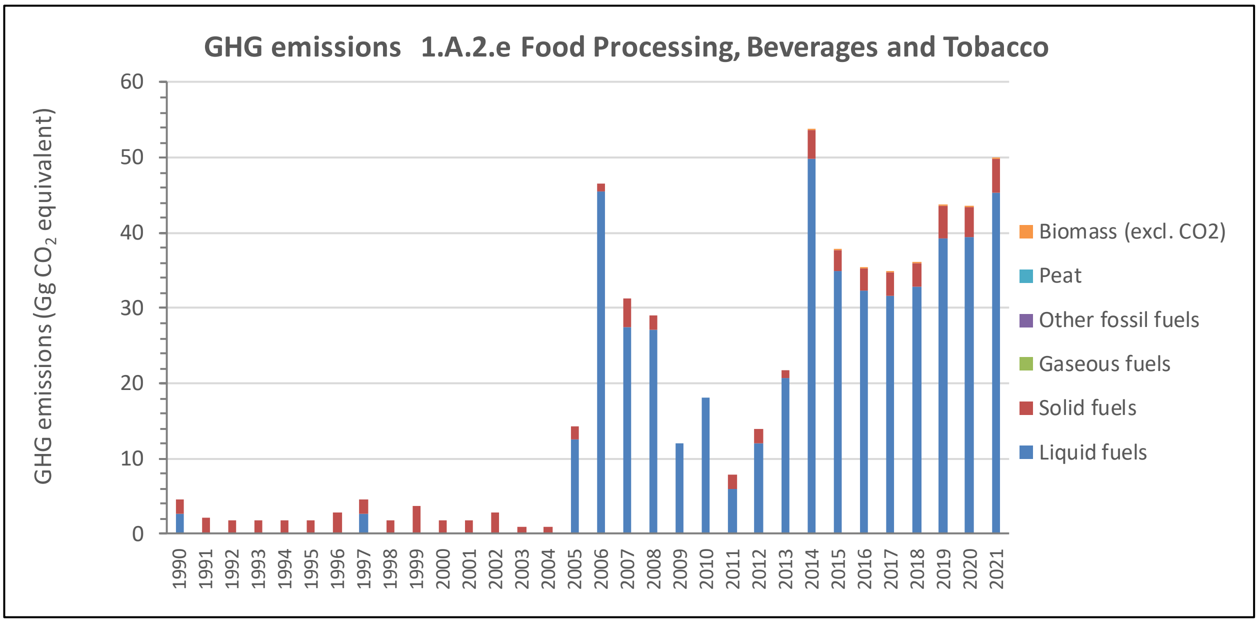


Figure 3-39: GHG Emissions from sub-category 1.A.2.e Food Processing, Beverages and Tobacco

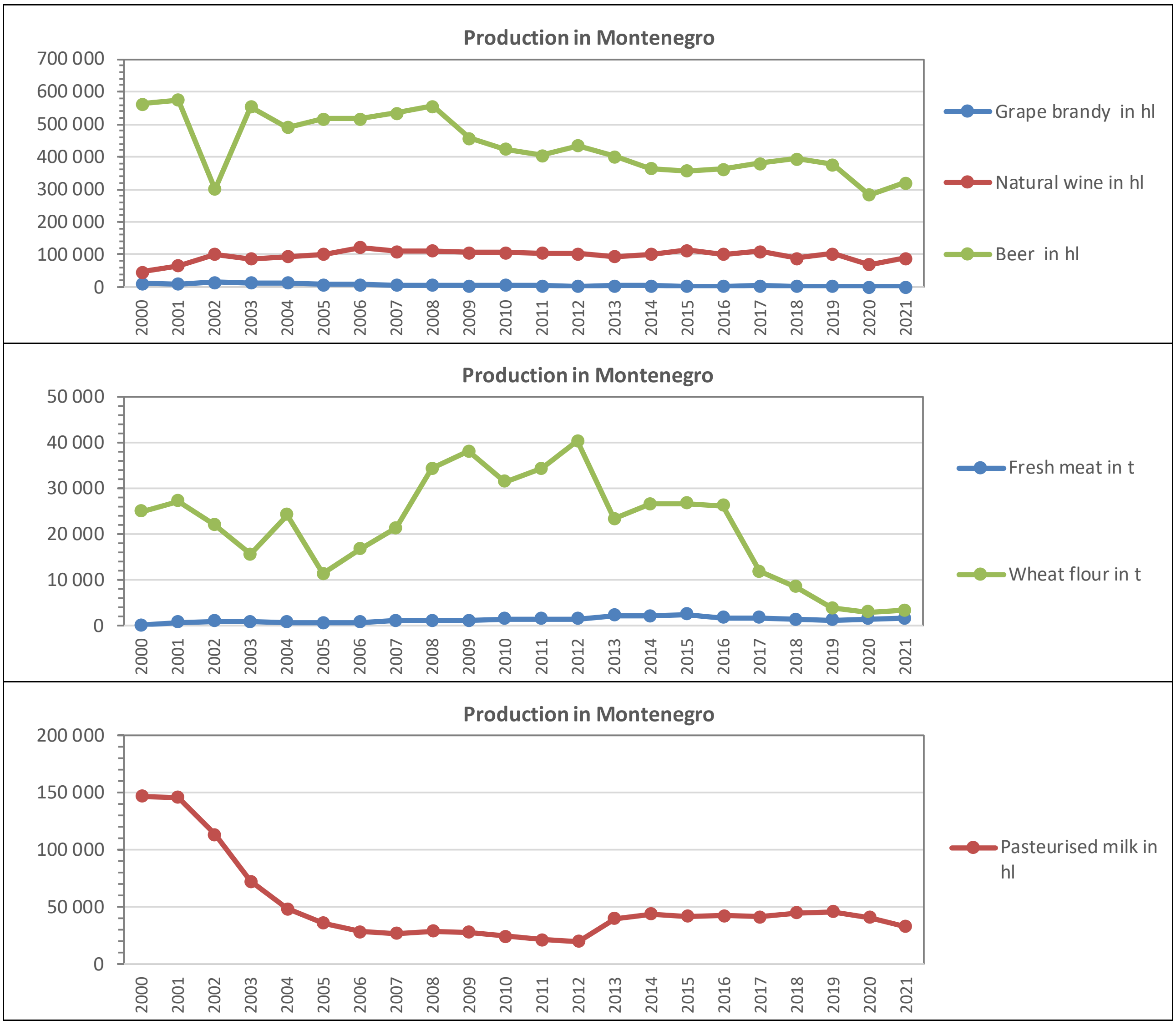


Figure 3-40 Main products in category 1.A.2.d Food Processing, Beverages and Tobacco in the period 2000-2022; Source: INSTAT

Table 3-85 GHG Emissions from CRT category 1.A.2.e Food Processing, Beverages and Tobacco

GHG emissions	TOTAL GHG	CO_2 (excluding biomass)	N_2O (including biomass)	CH_4 (including biomass)	CO_2 (biomass)
	kt CO2 equivalent	kt	kt CO2 equivalent	kt CO2 equivalent	kt
1990	4.51	4.49	0.010	0.006	NO
1991	2.23	2.22	0.010	0.005	NO
1992	1.87	1.86	0.008	0.005	NO
1993	1.87	1.86	0.008	0.005	NO
1994	1.87	1.86	0.008	0.005	NO
1995	1.87	1.86	0.008	0.005	NO
1996	2.81	2.79	0.012	0.007	NO
1997	4.51	4.49	0.010	0.006	NO
1998	1.87	1.86	0.008	0.005	NO
1999	3.75	3.72	0.016	0.009	NO
2000	1.87	1.86	0.008	0.005	NO
2001	1.87	1.86	0.008	0.005	NO
2002	2.81	2.79	0.012	0.007	NO
2003	0.94	0.93	0.004	0.002	NO
2004	0.94	0.93	0.004	0.002	NO
2005	14.36	14.30	0.037	0.017	NO
2006	46.50	46.34	0.116	0.049	NO
2007	31.21	31.09	0.083	0.037	NO
2008	28.97	28.87	0.069	0.031	NO
2009	12.07	12.03	0.030	0.013	NO
2010	18.10	18.04	0.045	0.019	NO
2011	7.91	7.87	0.023	0.011	NO
2012	13.94	13.89	0.038	0.017	NO
2013	21.67	21.60	0.051	0.022	NO
2014	53.70	53.48	0.126	0.057	0.032
2015	37.81	37.66	0.084	0.039	0.027
2016	35.26	35.11	0.083	0.038	0.028
2017	34.74	34.59	0.081	0.037	0.027
2018	36.09	35.94	0.084	0.039	0.028
2019	43.59	43.41	0.103	0.048	0.033
2020	43.50	43.32	0.099	0.046	0.032
2021	49.85	49.65	0.117	0.054	0.035
2022					
Trend					
1990 - 2022	*1006.3%*	*1005.5%*	*1113.1%*	*830.6%*	*NA*
2005 - 2022	*247.2%*	*247.1%*	*216.0%*	*222.7%*	*NA*
2021 - 2022	*14.6%*	*14.6%*	*17.6%*	*16.0%*	*9.8%*

3.2.5.5.2 Methodological issues

3.2.5.5.2.1 Choice of methods

For estimating the GHG emissions (CO_2, CH_4, N_2O) the 2006 IPCC Guidelines Tier 1 approach[76] has been applied:

Equation 2.1: GHG emissions from stationary combustion (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Emissions_{GHG,\,fuel}[kt] = Fuel\ Consumption_{fuel}[TJ]} \times \boldsymbol{Emission\ Factor_{GHG,\,fuel}} \left[\frac{\mathrm{kg}}{\mathrm{TJ}}\right] * \mathbf{10^{-6}}$$

Equation 2.2: Total emissions by greenhouse gas (2006 IPCC GL, Vol. 2, Chap. 2)

$$\begin{aligned} \boldsymbol{Emissions_{GHG}\left[kt_{CO2\ equivalent}\right]} = & \\ & \sum_{\boldsymbol{fuel}} \boldsymbol{emissions}_{\mathbf{CO2,\,fuel}}\ [\boldsymbol{kt}] \\ & + \sum_{\boldsymbol{fuel}} \boldsymbol{emissions}_{\mathbf{CH4,\,fuel}}[\boldsymbol{kt}] \times \boldsymbol{GWP_{CH4}} \\ & + \sum_{\boldsymbol{fuel}} \boldsymbol{emissions}_{\mathbf{N2O,\,fuel}}[\boldsymbol{kt}] \times \boldsymbol{GWP_{N2O}} \end{aligned}$$

Where:

Emissions $_{GHG}$	= emissions of GHG (kt $_{CO2\ equivalent}$)
Emissions $_{GHG,\ fuel}$	= emissions of a given GHG by type of fuel (kt GHG)
Fuel consumption $_{fuel}$	= amount of fuel combusted (TJ)
Emission factor $_{GHG,\ fuel}$	= default emission factor of a given GHG by type of fuel (kg gas/TJ) For CO_2, it includes the carbon oxidation factor, assumed to be 1.
10^{-6}	= conversion from kg to kt (≡ divided by 1.000.000)
GHG	= CO_2, CH_4, N_2O
GWP	= Global warming potential for CO_2, CH_4, N_2O according to the IPCC 5AR
Fuel	= liquid fuels, solid fuels, gaseous fuels, other fossil fuel, biomass, peat

The method applied is not in line with the decision tree, as the category 1.A.2.a *Main Activity Iron and Steel* is a key category. See here the chapter planned improvements.

[76] Source: 2006 IPCC Guidelines, Volume 2: Energy, Chapter 2: Stationary Combustion - 2.3.1 Methodological issues - Choice of method

3.2.5.5.2.2 Choice of activity data

Fuel consumption used for estimating the GHG and non-GHG emissions for the years 1990 - 2022 were taken from Statistical Office of Albania (INSTAT).

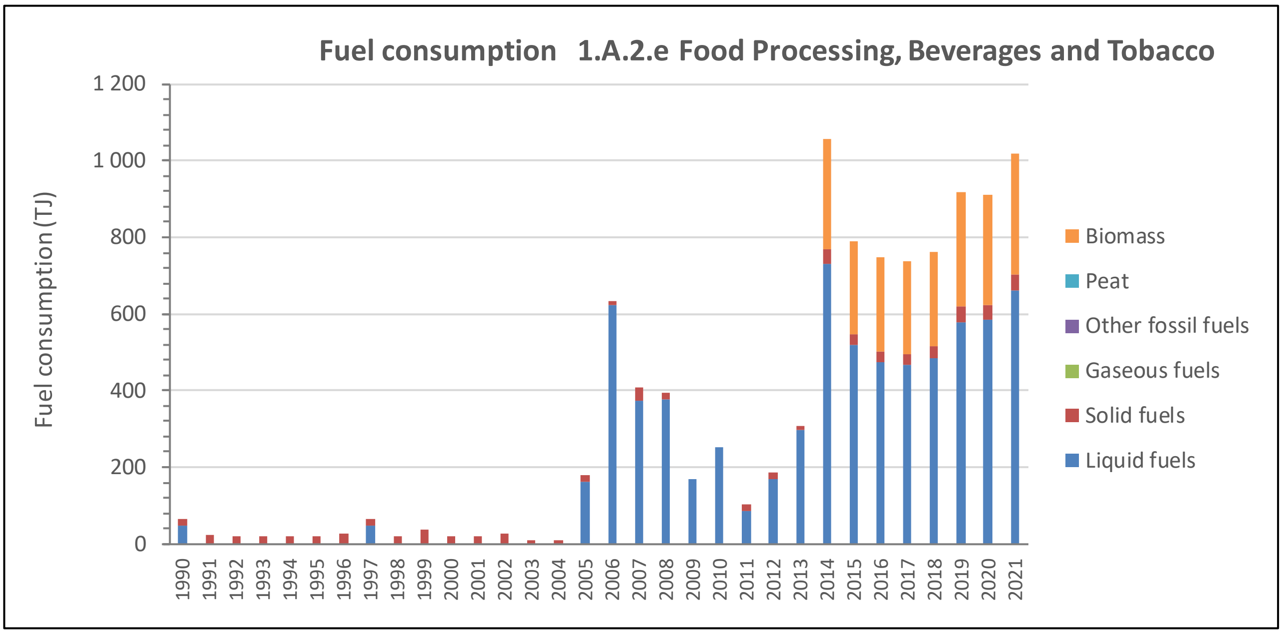


Figure 3-41 Activity data for sub-category 1.A.2.e Food Processing, Beverages and Tobacco

Use of notation key

IE 1.A.2.e (liquid) The energy statistics is still under development; a split of the fuel combustion for this subcategory has to be reviewed for the entire timeseries. Emissions are currently allocated in CRT category 1.A.2.m *Other*.

Table 3-86 Activity data for sub-category 1.A.2.e Food Processing, Beverages and Tobacco

Activity data 1.A.1.e	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
1990	65.31	46.89	18.42	NO	NO	NO	NO
1991	21.93	IE	21.93	NO	NO	NO	NO
1992	18.42	IE	18.42	NO	NO	NO	NO
1993	18.42	IE	18.42	NO	NO	NO	NO
1994	18.42	IE	18.42	NO	NO	NO	NO
1995	18.42	IE	18.42	NO	NO	NO	NO
1996	27.63	IE	27.63	NO	NO	NO	NO
1997	65.31	46.89	18.42	NO	NO	NO	NO
1998	18.42	IE	18.42	NO	NO	NO	NO
1999	36.84	IE	36.84	NO	NO	NO	NO
2000	18.42	IE	18.42	NO	NO	NO	NO
2001	18.42	IE	18.42	NO	NO	NO	NO
2002	27.63	IE	27.63	NO	NO	NO	NO
2003	9.21	IE	9.21	NO	NO	NO	NO
2004	9.21	IE	9.21	NO	NO	NO	NO
2005	179.18	160.76	18.42	NO	NO	NO	NO

Activity data 1.A.1.e	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
2006	633.24	624.03	9.21	NO	NO	NO	NO
2007	409.14	372.30	36.84	NO	NO	NO	NO
2008	395.40	376.98	18.42	NO	NO	NO	NO
2009	167.82	167.82	IE	NO	NO	NO	NO
2010	251.73	251.73	IE	NO	NO	NO	NO
2011	102.33	83.91	18.42	NO	NO	NO	NO
2012	186.24	167.82	18.42	NO	NO	NO	NO
2013	307.83	298.62	9.21	NO	NO	NO	NO
2014	1 057.40	731.56	36.84	NO	NO	NO	289.00
2015	790.15	519.52	27.63	NO	NO	NO	243.00
2016	748.08	472.63	28.45	NO	NO	NO	247.00
2017	736.23	465.80	30.43	NO	NO	NO	240.00
2018	762.41	483.15	32.26	NO	NO	NO	247.00
2019	916.90	577.57	42.33	NO	NO	NO	297.00
2020	911.33	584.08	40.24	NO	NO	NO	287.00
2021	1 019.51	660.40	44.11	NO	NO	NO	315.00
2022							
Trend							
1990 - 2022	*1461.0%*	*1308.4%*	*139.5%*	*NA*	*NA*	*NA*	*NA*
2005 - 2022	*469.0%*	*310.8%*	*139.5%*	*NA*	*NA*	*NA*	*NA*
2021 - 2022	*11.9%*	*13.1%*	*9.6%*	*NA*	*NA*	*NA*	*9.8%*

In energy statistics, production, transformation and consumption of solid, liquid, gaseous and renewable fuels are specified in physical units, e.g. in tonnes or cubic meters. To convert these data to energy units, in this case terajoules, requires calorific values. The emission calculations are bases on net calorific values. In the following table the applied net calorific values (NCVs) for conversion to energy units in sub-category 1.A.2.e *Food Processing, Beverages and Tobacco*.

Table 3-87 Net calorific values (NCVs) applied for conversion to energy units in sub-category 1.A.2.e Food Processing, Beverages and Tobacco

Fuel	Fuel type	Net calorific value (NCV) (TJ/Gg) or *(TJ/m3)		Source
		NCV	type	
Gas/Diesel Oil	liquid	42.71	CS	Statistical Office of Albania (INSTAT)
Residual fuel oil	liquid	41.20	CS	
Liquefied Petroleum Gases (LPG)	liquid	46.89	CS	
Petroleum Coke	liquid	40.19	CS	
Sub-Bituminous Coal	solid	16.75	CS	
Lignite	solid	9.21	CS	
Charcoal	biomass	29.30	CS	
Wood / Fuelwood	biomass	9.18*	CS	
Wood pellets	biomass	16.85	CS	
Note:				
D Default	CS Country specific	PS Plant specific		

3.2.5.5.2.3 Choice of emission factors

Default emission factors for greenhouse gases were taken from IPCC 2006 Guidelines and are presented in the following table.

Table 3-88 GHG Emission factor TIER 1 for CRT category 1.A.2.e Food Processing, Beverages and Tobacco

Fuel	Fuel type	CO_2 (kg/TJ)		CH_4 (kg/TJ)		N_2O (kg/TJ)		Source
		EF	type	EF	type	EF	type	2006 IPCC Guidelines Vol. 2, Chap. 2 (2.3.2.1)
Gas/Diesel Oil	liquid	74 100	D	3	D	0.6	D	**Table 2.3** Default emission factors for stationary combustion in manufacturing industries and construction (page 2.18)
Residual Fuel Oil / Total fuel oil	liquid	77 400	D	3	D	0.6	D	
Lignite	solid	101 000	D	10	D	1.5	D	
LPG	gaseous	63 100	D	1	D	0.1	D	
Natural gas	gaseous	56 100	D	1	D	0.1	D	
Wood pellets	biomass	112 000	D	30	D	4	D	

Note:
D Default CS Country specific PS Plant specific IEF Implied emission factor

3.2.5.5.3 Uncertainties and time-series consistency

The uncertainties for activity data and emission factors used for CRT category 1.A.2.e *Food Processing, Beverages and Tobacco* are presented in the following table.

Table 3-89 Uncertainty for CRT category 1.A.2.b Non-Ferrous Metals.

Uncertainty	Liquid fuels			Reference
	CO_2	CH_4	N_2O	2006 IPCC GL, Vol. 2, Chap. 2 (2.4.2)
Activity data (AD)	2%	2%	2%	Table 2.15 and Table 3.1
Emission factor (EF)	2%			Table 2.13
		100%		Table 2.12
			20%	Table 2.14
Combined Uncertainty (U)	2%	100%	20%	$U_{total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

The time-series are considered to be consistent as the same methodology is applied to the whole period. Activity data are considered to be consistent as national and international data were always compared.

3.2.5.5.4 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed out:

⇒ Checked of calculations by spreadsheets

- consistent use of energy balance data (energy statistic questionnaires),
- documented sources,
- use of units,
- strictly defined interfaces between spreadsheets/calculation modules,
- unique structure of sheets which do the same,

- record keeping, use of write protection,
- unique use of formulas, special cases are documented/highlighted,
- quick-control checks for data consistency through all steps of calculation.

⇒ cross-checked from different sources:

- National statistic published by INSTAT and
- Energy statistics of UN statistics[77] and data published by International Energy Agency (IEA)[78]

⇒ time series consistency - plausibility checks of dips and jumps.

3.2.5.5.5 Category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category 1.A.2.e *Food Processing, Beverages and Tobacco.*

Table 3-90 Recalculations done in sub-category 1.A.2.e *Food Processing, Beverages and Tobacco.*

source category	Revisions of data	Type of revision	Type of improvement
1.A.2.e	Revision of NCV	AD	Accuracy

3.2.5.5.6 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 3-91 Planned improvements for sub-category 1.A.2.e *Food Processing, Beverages and Tobacco*.

source category	Planned improvement	Type of improvement		Priority
1.A.2.e	Carbon content (%) of lignite, gas/diesel oil, residual fuel oil, etc. for preparing country specific emission factor (CS EF) ⇒ **CS EF$_{CO2}$** [t/TJ] = (C [%] • 44 • Ox)/(NCV [TJ/t] • 12• 100)	EF	Accuracy Transparency	Medium
1.A.2.e	Information about fitted/non-fitted equipment for flue gas cleaning, improvement in combustion	EF	Accuracy Transparency	Medium
1.A.2.e	Improvement of time series consistency and split of fuels: the energy statistics is still under development; a split of the fuel combustion for this subcategory has to be reviewed for the entire time series. Emissions are allocated in IPCC/NFR	AD	Accuracy Transparency	High

[77] United Nations - Department of Economic and Social Affairs - Statistics Division Statistics - Energy Statistics https://unstats.un.org/unsd/energystats/

[78] Data and statistics - Data tools - Data tables Energy data by category, indicator, country or region https://www.iea.org/data-and-statistics/data-browser?country=WORLD&fuel=Energy%20supply&indicator=TESbySource

source category	Planned improvement	Type of improvement		Priority
	subcategory 1.A.2.m Other.			
1.A.2.e	Cross-check of national and international data sources (Eurostat and UNSD)	AD	Consistency Transparency	Medium

3.2.5.6 Non-Metallic Minerals (CRT category 1.A.2.f)

The CRT category 1.A.2.f *Non-metallic minerals* includes GHG emissions resulting from fuel combustion activities in

Activities	Occurring in Albania
▪ ISIC Divisions 23 Manufacture of other non-metallic mineral products	
○ Manufacture of glass and glass products	-
○ Manufacture of non-metallic mineral products n.e.c.	
▪ Manufacture of refractory products. Manufacture of clay building materials	✓
▪ Manufacture of other porcelain and ceramic products	-
▪ Manufacture of • cement, • lime, limestone • plaster	 - ✓ -
▪ Manufacture of articles of concrete, cement and plaster	✓
▪ Cutting, shaping and finishing of stone	✓
▪ Manufacture of other non-metallic mineral products n.e.c.	✓

3.2.5.6.1 Source category description

GHG emissions/ removals	CO_2						CH_4						N_2O					
Estimated	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass
1.A.2.f	✓*	✓*	NO	NO	NO	✓	✓*	✓*	NO	NO	NO	✓	✓*	✓*	NO	NO	NO	✓
Key category	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential																		
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF																		
* data provided only in the period 2004 – 2008 and after 2012, all other years IE																		

<u>Use of notation key</u>

IE	1.A.2.e (liquid, solid)	The energy statistics is still under development; a split of the fuel combustion for this subcategory has to be reviewed for the entire timeseries. Emissions are currently allocated in CRT category 1.A.2.m *Other*.

An overview of the emissions from fuel combustion in CRT category *1.A.2.e Food Processing, Beverages and Tobacco* is provided in the following figures and tables:

- annual emissions of GHGs;
- Trend of the periods 1990 – 2022, 2005 – 2022, 2021 – 2022.

The main fuels used in 1.A.2.e were liquid fuel, such as gas/diesel oil and fuel oil.

In the last decade the GHG emissions increased due to increased processing of food and beverages. Whereas until 2005 the main fuel used was lignite which come from the Pljevija basin, the fuel mix changed to liquid fuel, such as gas/diesel oil and fuel oil.

The lime production stopped in 2008, thus no big amounts of lignite was needed anymore.

For 1990-2005 and 2009-2012, the emissions from solid and liquid fuels combusted in CRT category 1.A.2.f Non-Metallic Minerals is included in CRT category 1.A.2.m Other.

Figure 3-42: GHG Emissions from sub-category 1.A.2.f Non-Metallic Minerals

Figure 3-43 Main products in category 1.A.2.f Non-Metallic Minerals in the period 2000-2022; Source: INSTAT

Table 3-92 Emissions from CRT category 1.A.2.f Non-Metallic Minerals

GHG emissions	TOTAL GHG	CO_2 (excluding biomass)	N_2O (including biomass)	CH_4 (including biomass)	CO_2 (biomass)
	kt CO2 equivalent	kt	kt CO2 equivalent	kt CO2 equivalent	kt
1990					
1991					
1992					
1993					
1994					
1995					
1996					
1997					
1998					
1999					
2000					
2001					
2002					
2003					
2004					
2005					
2006					
2007					
2008					
2009					
2010					
2011					
2012					
2013					
2014					
2015					
2016					
2017					
2018					
2019					
2020					
2021					
2022					
Trend					
1990 - 2022					
2005 - 2022					
2021 - 2022					

3.2.5.6.2 Methodological issues

3.2.5.6.2.1 Choice of methods

For estimating the GHG emissions (CO_2, CH_4, N_2O) the 2006 IPCC Guidelines Tier 1 approach[79] has been applied:

Equation 2.1: GHG emissions from stationary combustion (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Emissions_{GHG,\,fuel}[kt] = Fuel\ Consumption_{fuel}[TJ] \times Emission\ Factor_{GHG,\,fuel}\left[\frac{\mathrm{kg}}{\mathrm{TJ}}\right] * 10^{-6}}$$

Equation 2.2: Total emissions by greenhouse gas (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Emissions_{GHG}\left[kt_{CO2\ equivalent}\right] = \sum_{fuel} emissions_{\mathrm{CO2,\,fuel}}\ [kt] + \sum_{fuel} emissions_{\mathrm{CH4,\,fuel}}[kt] \times GWP_{CH4} + \sum_{fuel} emissions_{\mathrm{N2O,\,fuel}}[kt] \times GWP_{N2O}}$$

Where:

Emissions $_{GHG}$	= emissions of GHG (kt $_{CO2\ equivalent}$)
Emissions $_{GHG,\ fuel}$	= emissions of a given GHG by type of fuel (kt GHG)
Fuel consumption $_{fuel}$	= amount of fuel combusted (TJ)
Emission factor $_{GHG,\ fuel}$	= default emission factor of a given GHG by type of fuel (kg gas/TJ) For CO_2, it includes the carbon oxidation factor, assumed to be 1.
10^{-6}	= conversion from kg to kt (≡ divided by 1.000.000)
GHG	= CO_2, CH_4, N_2O
GWP	= Global warming potential for CO_2, CH_4, N_2O according to the IPCC 5AR
Fuel	= liquid fuels, solid fuels, gaseous fuels, other fossil fuel, biomass, peat

The method applied is not in line with the decision tree, as the category 1.A.2.a *Main Activity Iron and Steel* is a key category. See here the chapter planned improvements.

[79] Source: 2006 IPCC Guidelines, Volume 2: Energy, Chapter 2: Stationary Combustion - 2.3.1 Methodological issues - Choice of method

3.2.5.6.2.2 Choice of activity data

Fuel consumption used for estimating the GHG and non-GHG emissions for the years 1990 - 2022 were taken from Statistical Office of Albania (INSTAT).

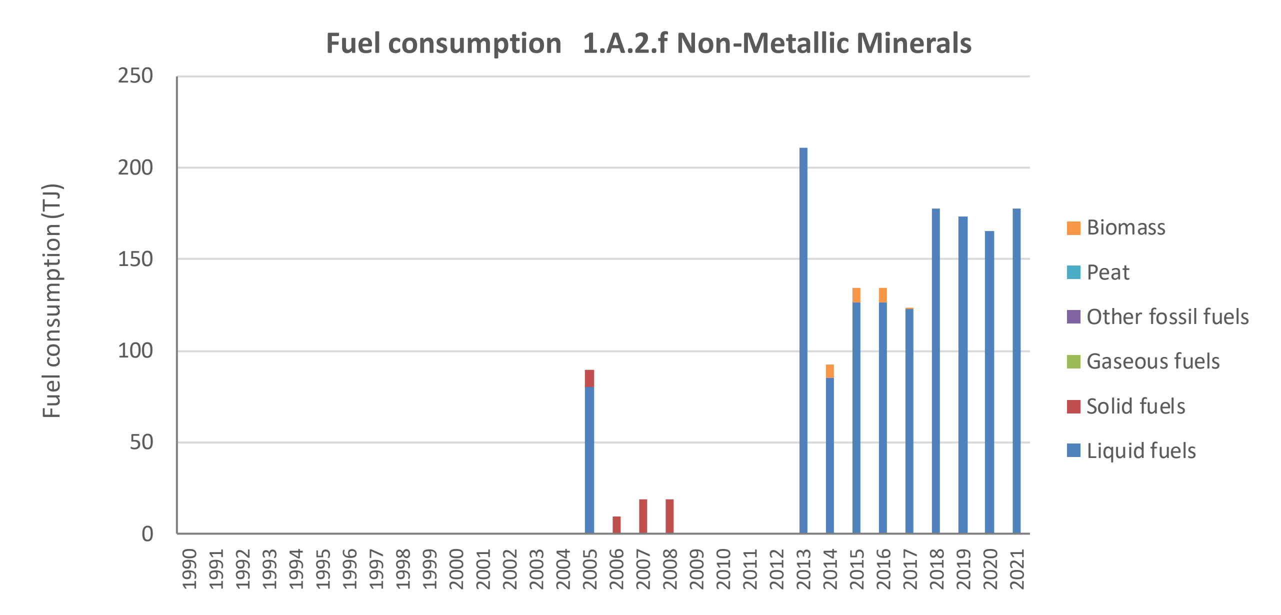


Figure 3-44 Activity data for sub-category 1.A.2.f Non-Metallic Minerals

<u>Use of notation key</u>

IE	1.A.2.e (liquid, solid)	The energy statistics is still under development; a split of the fuel combustion for this subcategory has to be reviewed for the entire timeseries. Emissions are currently allocated in CRT category 1.A.2.m *Other*.

Table 3-93 Activity data for sub-category 1.A.2.f Non-Metallic Minerals

Activity data 1.A.1.f	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
1990							
1991							
1992							
1993							
1994							
1995							
1996							
1997							
1998							
1999							
2000							
2001							
2002							
2003							
2004							
2005							
2006							

Activity data 1.A.1.f	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
2007							
2008							
2009							
2010							
2011							
2012							
2013							
2014							
2015							
2016							
2017							
2018							
2019							
2020							
2021							
2022							
Trend							
1990 - 2022							
2005 - 2022							
2021 - 2022							

In energy statistics, production, transformation and consumption of solid, liquid, gaseous and renewable fuels are specified in physical units, e.g. in tonnes or cubic meters. To convert these data to energy units, in this case terajoules, requires calorific values. The emission calculations are bases on net calorific values. In the following table the applied net calorific values (NCVs) for conversion to energy units in sub-category 1.A.2.f Non-Metallic Minerals.

Table 3-94 Net calorific values (NCVs) applied for conversion to energy units in sub-category 1.A.2.f Non-Metallic Minerals

Fuel	Fuel type	Net calorific value (NCV) (TJ/Gg) or *(TJ/m3)		Source
		NCV	type	
Gas/Diesel Oil	liquid	42.71	CS	Statistical Office of Albania (INSTAT)
Residual fuel oil	liquid	41.20	CS	
Liquefied Petroleum Gases (LPG)	liquid	46.89	CS	
Petroleum Coke	liquid	40.19	CS	
Sub-Bituminous Coal	solid	16.75	CS	
Lignite	solid	9.21	CS	
Charcoal	biomass	29.30	CS	
Wood / Fuelwood	biomass	9.18*	CS	
Wood pellets	biomass	16.85	CS	
Note: D Default CS Country specific PS Plant specific				

3.2.5.6.2.3 Choice of emission factors

Default emission factors for greenhouse gases were taken from IPCC 2006 Guidelines and are presented in the following table.

Table 3-95 GHG Emission factor TIER 1 for CRT category 1.A.2.f Non-Metallic Minerals

Fuel	Fuel type	CO_2 (kg/TJ)		CH_4 (kg/TJ)		N_2O (kg/TJ)		Source
		EF	type	EF	type	EF	type	2006 IPCC Guidelines Vol. 2, Chap. 2 (2.3.2.1)
Gas/Diesel Oil	liquid	74 100	D	3	D	0.6	D	**Table 2.3** Default emission factors for stationary combustion in manufacturing industries and construction (page 2.18)
Residual Fuel Oil / Total fuel oil	liquid	77 400	D	3	D	0.6	D	
Lignite	solid	101 000	D	10	D	1.5	D	
LPG	gaseous	63 100	D	1	D	0.1	D	
Natural gas	gaseous	56 100	D	1	D	0.1	D	
Wood pellets	biomass	112 000	D	30	D	4	D	

Note:
D Default CS Country specific PS Plant specific IEF Implied emission factor

3.2.5.6.3 Uncertainties and time-series consistency

The uncertainties for activity data and emission factors used for CRT category 1.A.2.f *Non-Metallic Minerals* are presented in the following table.

Table 3-96 Uncertainty for CRT category 1.A.2.f Non-Metallic Minerals.

Uncertainty	Liquid fuels			Reference
	CO_2	CH_4	N_2O	2006 IPCC GL, Vol. 2, Chap. 2 (2.4.2)
Activity data (AD)	2%	2%	2%	Table 2.15 and Table 3.1
Emission factor (EF)	2%			Table 2.13
		100%		Table 2.12
			20%	Table 2.14
Combined Uncertainty (U)	2%	100%	20%	$U_{total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

The time-series are considered to be consistent as the same methodology is applied to the whole period. Activity data are considered to be consistent as national and international data were always compared.

3.2.5.6.4 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed out:

⇒ Checked of calculations by spreadsheets
- consistent use of energy balance data (energy statistic questionnaires),
- documented sources,
- use of units,
- strictly defined interfaces between spreadsheets/calculation modules,
- unique structure of sheets which do the same,
- record keeping, use of write protection,

  - unique use of formulas, special cases are documented/highlighted,
  - quick-control checks for data consistency through all steps of calculation.

⇒ cross-checked from different sources:

- National statistic published by INSTAT and
- Energy statistics of UN statistics[80] and data published by International Energy Agency (IEA)[81]

⇒ time series consistency - plausibility checks of dips and jumps.

3.2.5.6.5 Category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category 1.A.2.f *Non-Metallic Minerals*.

Table 3-97 Recalculations done in sub-category 1.A.2.f Non-Metallic Minerals

source category	Revisions of data	Type of revision	Type of improvement
1.A.2.e	Revision of NCV	AD	Accuracy

3.2.5.6.6 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 3-98 Planned improvements for CRT category 1.A.2.f Non-Metallic Minerals

source category	Planned improvement	Type of improvement		Priority
1.A.2.e	Carbon content (%) of lignite, gas/diesel oil, residual fuel oil, etc. for preparing country specific emission factor (CS EF) ⇒ **CS EF$_{CO2}$** [t/TJ] = (C [%] • 44 • Ox)/(NCV [TJ/t] • 12• 100)	EF	Accuracy Transparency	Medium
1.A.2.e	Information about fitted/non-fitted equipment for flue gas cleaning, improvement in combustion	EF	Accuracy Transparency	Medium
1.A.2.e	Improvement of time series consistency and split of fuels: the energy statistics is still under development; a split of the fuel combustion for this subcategory has to be reviewed for the entire time series. Emissions are allocated in IPCC/NFR subcategory 1.A.2.m Other.	AD	Accuracy Transparency	High
1.A.2.e	Cross-check of national and international data sources	AD	Consistency	Medium

[80] United Nations - Department of Economic and Social Affairs - Statistics Division Statistics - Energy Statistics https://unstats.un.org/unsd/energystats/

[81] Data and statistics - Data tools - Data tables Energy data by category, indicator, country or region https://www.iea.org/data-and-statistics/data-browser?country=WORLD&fuel=Energy%20supply&indicator=TESbySource

source category	Planned improvement	Type of improvement		Priority
	(Eurostat and UNSD)		Transparency	

3.2.5.7 Manufacturing of transport equipment (CRT category 1.A.2.g)

The CRT category 1.A.2.g *Manufacturing of transport equipment* includes GHG emissions resulting from fuel combustion activities in

Activities	Occurring in Albania
▪ ISIC Division 29 Manufacture of motor vehicles, trailers and semi-trailers.	-
▪ ISIC Division 30 Manufacture of other transport equipment	-

3.2.5.7.1 Source category description

GHG emissions/ removals	CO_2						CH_4						N_2O					
Estimated	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass
1.A.2.g	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Key Category	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential																		
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF																		

The CRT category 1.A.2.g Manufacturing of transport equipment does not exist in Albania.

3.2.5.7.2 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 3-99 Planned improvements for CRT category 1.A.2.g Manufacturing of transport equipment

GHG source & sink category	Planned improvement	Type of improvement		Priority
1.A.2.g	Analysis of Manufacturing of transport equipment • annual quantities of product produced • annual consumption of fuel by type • annual electricity consumption	AD	Accuracy Transparency Completeness	high

3.2.5.8 Manufacturing of machinery (CRT category 1.A.2.h)

The CRT category 1.A.2.h *Manufacturing of machinery* includes GHG emissions resulting from fuel combustion activities in

Activities	Occurring in

	Albania
▪ ISIC Division 25 Manufacture of fabricated metal products, except machinery and equipment	
○ Manufacture of structural metal products, tanks, reservoirs and steam generators	-
○ Manufacture of weapons and ammunition	✓
○ Manufacture of other fabricated metal products; metalworking service activities	✓
▪ ISIC Division 26 Manufacture of computer, electronic and optical products	
○ Manufacture of electronic components and boards	-
○ Manufacture of computers and peripheral equipment	-
○ Manufacture of communication equipment	-
○ Manufacture of consumer electronics	-
○ Manufacture of measuring, testing, navigating and control equipment; watches and clocks	-
○ Manufacture of irradiation, electromedical and electrotherapeutic equipment	-
○ Manufacture of optical instruments and photographic equipment	-
○ Manufacture of magnetic and optical media	-
▪ ISIC Division 27 Manufacture of electrical equipment	
○ Manufacture of electric motors, generators, transformers and electricity distribution and control apparatus	-
○ Manufacture of batteries and accumulators	-
○ Manufacture of wiring and wiring devices	-
○ Manufacture of electric lighting equipment	-
○ Manufacture of domestic appliances	✓
○ Manufacture of other electrical equipment	-
▪ ISIC Division 28 Manufacture of machinery and equipment n.e.c.	
○ Manufacture of general-purpose machinery	✓
○ Manufacture of special-purpose machinery	✓

3.2.5.8.1 Source category description

GHG emissions/ removals	CO_2						CH_4						N_2O					
Estimated	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass
1.A.2.h	✓	✓	NO	NO	NO	✓	✓	✓	NO	NO	NO	✓	✓	✓	NO	NO	NO	✓
Key Category	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential																		
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF																		

An overview of the emissions from fuel combustion in CRT category *1.A.2.e Manufacturing of machinery* is provided in the following figures and tables:

- annual emissions of GHGs;
- Trend of the periods 1990 – 2022, 2005 – 2022 2021 – 2022.

The main fuels used in 1.A.2.e were

- liquid fuels, such as gas/diesel oil and fuel oil,
- solid fuels, here lignite which come from the Pljevija basin,
- biomass.

GHG emissions fluctuating due to the various activities as listed above.

For the period 1990-2013 the emissions from this sub-category are included in 1.A.2.m Other.

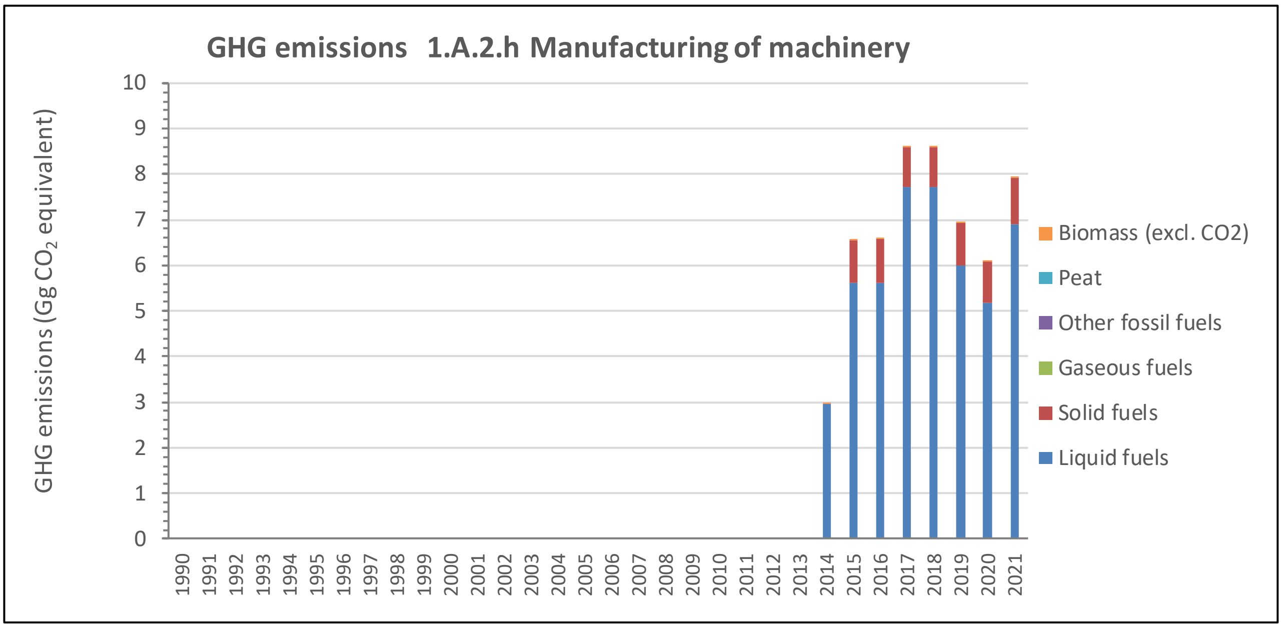


Figure 3-45: GHG Emissions from sub-category 1.A.2.h Manufacturing of machinery

Table 3-100 Emissions from CRT category 1.A.2. h Manufacturing of machinery

GHG emissions	TOTAL GHG	CO_2 (excluding biomass)	N_2O (including biomass)	CH_4 (including biomass)	CO_2 (biomass)
	kt CO2 equivalent	kt	kt CO2 equivalent	kt CO2 equivalent	kt
1990	IE	IE	IE	IE	NO
1991	IE	IE	IE	IE	NO
1992	IE	IE	IE	IE	NO
1993	IE	IE	IE	IE	NO
1994	IE	IE	IE	IE	NO
1995	IE	IE	IE	IE	NO
1996	IE	IE	IE	IE	NO
1997	IE	IE	IE	IE	NO
1998	IE	IE	IE	IE	NO
1999	IE	IE	IE	IE	NO
2000	IE	IE	IE	IE	NO
2001	IE	IE	IE	IE	NO
2002	IE	IE	IE	IE	NO
2003	IE	IE	IE	IE	NO
2004	IE	IE	IE	IE	NO

GHG emissions	TOTAL GHG	CO_2 (excluding biomass)	N_2O (including biomass)	CH_4 (including biomass)	CO_2 (biomass)
	kt CO2 equivalent	kt	kt CO2 equivalent	kt CO2 equivalent	kt
2005	IE	IE	IE	IE	NO
2006	IE	IE	IE	IE	NO
2007	IE	IE	IE	IE	NO
2008	IE	IE	IE	IE	NO
2009	IE	IE	IE	IE	NO
2010	IE	IE	IE	IE	NO
2011	IE	IE	IE	IE	NO
2012	IE	IE	IE	IE	NO
2013	IE	IE	IE	IE	NO
2014	2.973	2.960	0.0076	0.0032	0.0021
2015	6.543	6.521	0.0132	0.0067	0.0024
2016	6.570	6.548	0.0133	0.0068	0.0021
2017	8.593	8.564	0.0181	0.0087	0.0021
2018	8.591	8.562	0.0181	0.0087	0.0021
2019	6.943	6.919	0.0151	0.0074	0.0020
2020	6.095	6.073	0.0140	0.0068	0.0015
2021	7.918	7.890	0.0177	0.0085	0.0016
2022					
Trend					
1990 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*
2005 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*
2021 - 2022	*29.9%*	*29.9%*	*26.8%*	*25.8%*	*7.7%*

3.2.5.8.2 Methodological issues

3.2.5.8.2.1 Choice of methods

For estimating the GHG emissions (CO_2, CH_4, N_2O) the 2006 IPCC Guidelines Tier 1 approach[82] has been applied:

Equation 2.1: GHG emissions from stationary combustion (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Emissions_{GHG,\,fuel}[kt] = Fuel\ Consumption_{fuel}[TJ] \times Emission\ Factor_{GHG,\,fuel}\left[\frac{\mathrm{kg}}{\mathrm{TJ}}\right] * 10^{-6}}$$

Equation 2.2: Total emissions by greenhouse gas (2006 IPCC GL, Vol. 2, Chap. 2)

$$\begin{aligned}\boldsymbol{Emissions_{GHG}\left[kt_{CO2\ equivalent}\right]} &= \\ &\sum_{fuel} \boldsymbol{emissions_{\mathbf{CO2,\,fuel}}\ [kt]} \\ &+ \sum_{fuel} \boldsymbol{emissions_{\mathbf{CH4,\,fuel}}[kt] \times GWP_{CH4}} \\ &+ \sum_{fuel} \boldsymbol{emissions_{\mathbf{N2O,\,fuel}}[kt] \times GWP_{N2O}}\end{aligned}$$

[82] Source: 2006 IPCC Guidelines, Volume 2: Energy, Chapter 2: Stationary Combustion - 2.3.1 Methodological issues - Choice of method

Where:

Emissions $_{GHG}$	= emissions of GHG (kt $_{CO2\ equivalent}$)
Emissions $_{GHG,\ fuel}$	= emissions of a given GHG by type of fuel (kt GHG)
Fuel consumption $_{fuel}$	= amount of fuel combusted (TJ)
Emission factor $_{GHG,\ fuel}$	= default emission factor of a given GHG by type of fuel (kg gas/TJ) For CO_2, it includes the carbon oxidation factor, assumed to be 1.
10^{-6}	= conversion from kg to kt (≡ divided by 1.000.000)
GHG	= CO_2, CH_4, N_2O
GWP	= Global warming potential for CO_2, CH_4, N_2O according to the IPCC 5AR
Fuel	= liquid fuels, solid fuels, gaseous fuels, other fossil fuel, biomass, peat

The method applied is not in line with the decision tree, as the category 1.A.2.a *Main Activity Iron and Steel* is a key category. See here the chapter planned improvements.

3.2.5.8.2.2 Choice of activity data

Fuel consumption used for estimating the GHG and non-GHG emissions for the years 1990 - 2022 were taken from Statistical Office of Albania (INSTAT).

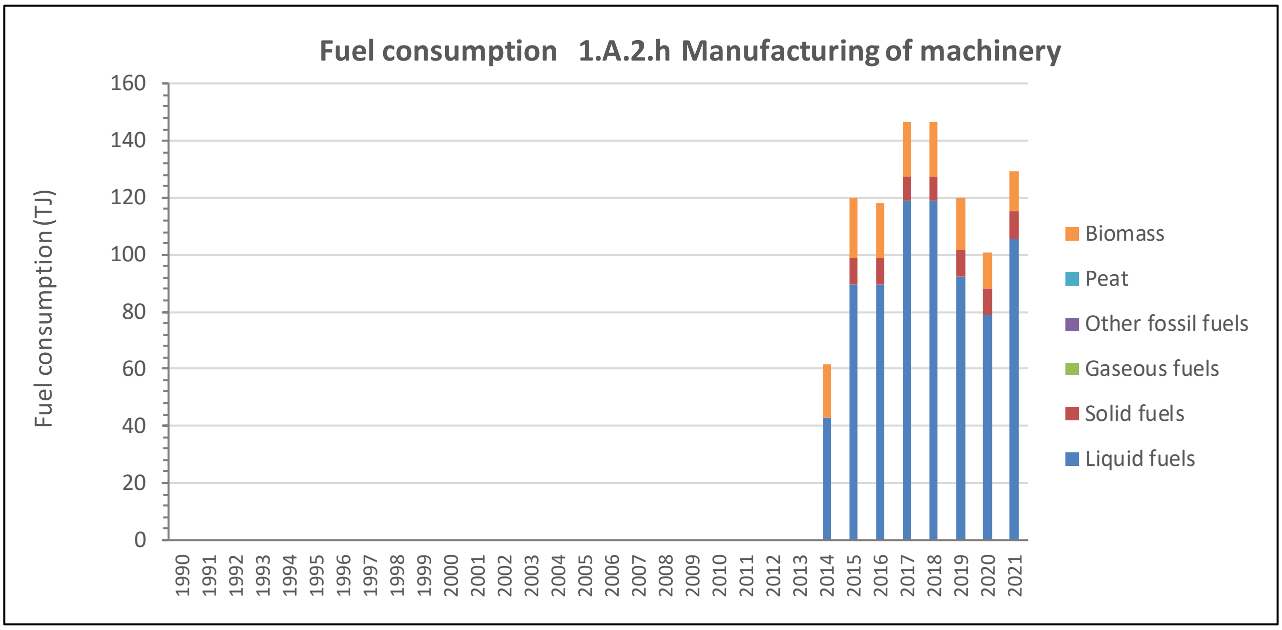


Figure 3-46 Activity data for sub-category 1.A.2.h Manufacturing of machinery

Table 3-101 Activity data for sub-category 1.A.2.h Manufacturing of machinery

Activity data 1.A.1.e	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
1990	IE	IE	IE	NO	NO	NO	NO
1991	IE	IE	IE	NO	NO	NO	NO
1992	IE	IE	IE	NO	NO	NO	NO
1993	IE	IE	IE	NO	NO	NO	NO
1994	IE	IE	IE	NO	NO	NO	NO
1995	IE	IE	IE	NO	NO	NO	NO
1996	IE	IE	IE	NO	NO	NO	NO
1997	IE	IE	IE	NO	NO	NO	NO

Activity data 1.A.1.e	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
1998	IE	IE	IE	NO	NO	NO	NO
1999	IE	IE	IE	NO	NO	NO	NO
2000	IE	IE	IE	NO	NO	NO	NO
2001	IE	IE	IE	NO	NO	NO	NO
2002	IE	IE	IE	NO	NO	NO	NO
2003	IE	IE	IE	NO	NO	NO	NO
2004	IE	IE	IE	NO	NO	NO	NO
2005	IE	IE	IE	NO	NO	NO	NO
2006	IE	IE	IE	NO	NO	NO	NO
2007	IE	IE	IE	NO	NO	NO	NO
2008	IE	IE	IE	NO	NO	NO	NO
2009	IE	IE	IE	NO	NO	NO	NO
2010	IE	IE	IE	NO	NO	NO	NO
2011	IE	IE	IE	NO	NO	NO	NO
2012	IE	IE	IE	NO	NO	NO	NO
2013	IE	IE	IE	NO	NO	NO	NO
2014	61.71	42.71	IE	NO	NO	NO	19.00
2015	119.81	89.60	9.21	NO	NO	NO	21.00
2016	118.08	89.60	9.48	NO	NO	NO	19.00
2017	146.45	118.89	8.56	NO	NO	NO	19.00
2018	146.43	118.89	8.54	NO	NO	NO	19.00
2019	119.87	92.58	9.29	NO	NO	NO	18.00
2020	100.99	78.93	9.05	NO	NO	NO	13.00
2021	129.27	105.24	10.03	NO	NO	NO	14.00
2022							
Trend							
1990 - 2022	NA	NA	NA	NA	NA	NA	NA
2005 - 2022	NA	NA	NA	NA	NA	NA	NA
2021 - 2022	28.0%	33.3%	10.7%	NA	NA	NA	7.7%

In energy statistics, production, transformation and consumption of solid, liquid, gaseous and renewable fuels are specified in physical units, e.g. in tonnes or cubic meters. To convert these data to energy units, in this case terajoules, requires calorific values. The emission calculations are bases on net calorific values. In the following table the applied net calorific values (NCVs) for conversion to energy units in sub-category 1.A.2.f Non-Metallic Minerals.

Table 3-102 Net calorific values (NCVs) applied for conversion to energy units in category 1.A.2.h Manufacturing of Machinery

Fuel	Fuel type	Net calorific value (NCV) (TJ/Gg) or *(TJ/m3)		Source
		NCV	type	
Gas/Diesel Oil	liquid	42.71	CS	Statistical Office of Albania (INSTAT)
Residual fuel oil	liquid	41.20	CS	

Fuel	Fuel type	Net calorific value (NCV) (TJ/Gg) or *(TJ/m3)		Source
		NCV	type	
Liquefied Petroleum Gases (LPG)	liquid	46.89	CS	
Petroleum Coke	liquid	40.19	CS	
Sub-Bituminous Coal	solid	16.75	CS	
Lignite	solid	9.21	CS	
Charcoal	biomass	29.30	CS	
Wood / Fuelwood	biomass	9.18*	CS	
Wood pellets	biomass	16.85	CS	
Note: D Default CS Country specific PS Plant specific				

3.2.5.8.2.3 Choice of emission factors

Default emission factors for greenhouse gases were taken from IPCC 2006 Guidelines and are presented in the following table.

Table 3-103 GHG Emission factor TIER 1 for CRT category 1.A.2.h Manufacturing of machinery

Fuel	Fuel type	CO_2 (kg/TJ)		CH_4 (kg/TJ)		N_2O (kg/TJ)		Source
		EF	type	EF	type	EF	type	2006 IPCC Guidelines Vol. 2, Chap. 2 (2.3.2.1)
Gas/Diesel Oil	liquid	74 100	D	3	D	0.6	D	**Table 2.3** Default emission factors for stationary combustion in manufacturing industries and construction (page 2.18)
Residual Fuel Oil / Total fuel oil	liquid	77 400	D	3	D	0.6	D	
Lignite	solid	101 000	D	10	D	1.5	D	
LPG	gaseous	63 100	D	1	D	0.1	D	
Natural gas	gaseous	56 100	D	1	D	0.1	D	
Wood pellets	biomass	112 000	D	30	D	4	D	
Note: D Default CS Country specific PS Plant specific IEF Implied emission factor								

3.2.5.8.3 Uncertainties and time-series consistency

The uncertainties for activity data and emission factors used for CRT category 1.A.2.h Manufacturing of machinery are presented in the following table.

Table 3-104 Uncertainty for CRT category 1.A.2.h Manufacturing of machinery.

Uncertainty	Liquid fuels			Reference
	CO_2	CH_4	N_2O	2006 IPCC GL, Vol. 2, Chap. 2 (2.4.2)
Activity data (AD)	2%	2%	2%	Table 2.15 and Table 3.1
Emission factor (EF)	2%			Table 2.13
		100%		Table 2.12
			20%	Table 2.14
Combined Uncertainty (U)	2%	100%	20%	$U_{total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

The time-series are considered to be consistent as the same methodology is applied to the whole period. Activity data are considered to be consistent as national and international data were always compared.

3.2.5.8.4 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed out:

⇒ Checked of calculations by spreadsheets
  - consistent use of energy balance data (energy statistic questionnaires),
  - documented sources,
  - use of units,
  - strictly defined interfaces between spreadsheets/calculation modules,
  - unique structure of sheets which do the same,
  - record keeping, use of write protection,
  - unique use of formulas, special cases are documented/highlighted,
  - quick-control checks for data consistency through all steps of calculation.

⇒ cross-checked from different sources:
  - National statistic published by INSTAT and
  - Energy statistics of UN statistics[83] and data published by International Energy Agency (IEA)[84]

⇒ time series consistency - plausibility checks of dips and jumps.

3.2.5.8.5 Category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category 1.A.2.h *Manufacturing of machinery*.

Table 3-105 Recalculations done in sub-category 1.A.2.h Manufacturing of machinery

source category	Revisions of data	Type of revision	Type of improvement
1.A.2.e	Revision of NCV	AD	Accuracy

3.2.5.8.6 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

[83] United Nations - Department of Economic and Social Affairs - Statistics Division Statistics - Energy Statistics https://unstats.un.org/unsd/energystats/

[84] Data and statistics - Data tools - Data tables Energy data by category, indicator, country or region https://www.iea.org/data-and-statistics/data-browser?country=WORLD&fuel=Energy%20supply&indicator=TESbySource

Table 3-106 Planned improvements for CRT category 1.A.2.h Manufacturing of machinery

source category	Planned improvement	Type of improvement		Priority
1.A.2.e	Carbon content (%) of lignite, gas/diesel oil, residual fuel oil, etc. for preparing country specific emission factor (CS EF) ⇒ **CS EF$_{CO2}$** [t/TJ] = (C [%] • 44 • Ox)/(NCV [TJ/t] • 12• 100)	EF	Accuracy Transparency	Medium
1.A.2.e	Information about fitted/non-fitted equipment for flue gas cleaning, improvement in combustion	EF	Accuracy Transparency	Medium
1.A.2.e	Improvement of time series consistency and split of fuels: the energy statistics is still under development; a split of the fuel combustion for this subcategory has to be reviewed for the entire time series. Emissions are allocated in IPCC/NFR subcategory 1.A.2.m Other.	AD	Accuracy Transparency	High
1.A.2.e	Cross-check of national and international data sources (Eurostat and UNSD)	AD	Consistency Transparency	Medium

3.2.5.9 Mining (excluding fuels) and Quarrying (CRT category 1.A.2.i)

The CRT category 1.A.2.i *Mining (excluding fuels) and Quarrying* includes GHG emissions resulting from fuel combustion activities in

Activities	Occurring in Albania
▪ ISIC Division 07 Mining of metal ores (iron ores and non-ferrous metal ores),	-
▪ ISIC Division 08 Other mining and quarrying	
○ Quarrying of stone, sand and clay	✓
○ Mining and quarrying n.e.c.:	
▪ Mining of chemical and fertilizer minerals (Extraction of peat, salt)	✓
▪ Other mining and quarrying n.e.c..	✓
▪ ISIC Division 09 Mining support service activities	
○ Support activities for petroleum and natural gas extraction	-
○ Support activities for other mining and quarrying	✓

3.2.5.9.1 Source category description

GHG emissions/ removals	CO_2						CH_4						N_2O					
Estimated	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass
1.A.2.i	√*	NO	NO	NO	NO	NO	√*	NO	NO	NO	NO	NO	√*	NO	NO	NO	NO	NO
Key Category	LA 2021																	

A '✓' indicates: emissions from this sub-category have been estimated.
Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential

LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF

* for 2010 and 2011

<u>Use of notation key</u>

IE	1.A.2.i (liquid)	The energy statistics is still under development; a split of the fuel combustion for this subcategory has to be reviewed for the entire timeseries. Emissions are currently allocated in CRT category 1.A.2.m *Other*.

An overview of the emissions from fuel combustion in CRT category *1.A.2.i Mining (excluding fuels) and Quarrying* is provided in the following figures and tables:

- annual emissions of GHGs;
- Trend of the periods 1990 – 2022, 2005 – 2022, 2021 – 2022.

The main fuels used in 1.A.2.i were liquid fuel, such as gas/diesel oil and fuel oil.

In the last decade, the GHG emissions increased due to increased red bauxite exploration and export.

For 1990-2007 and 2010-2011, the emissions from liquid fuels combusted in CRT category 1.A.2.i Mining (excluding fuels) and Quarrying are included in CRT category 1.A.2.m Other.

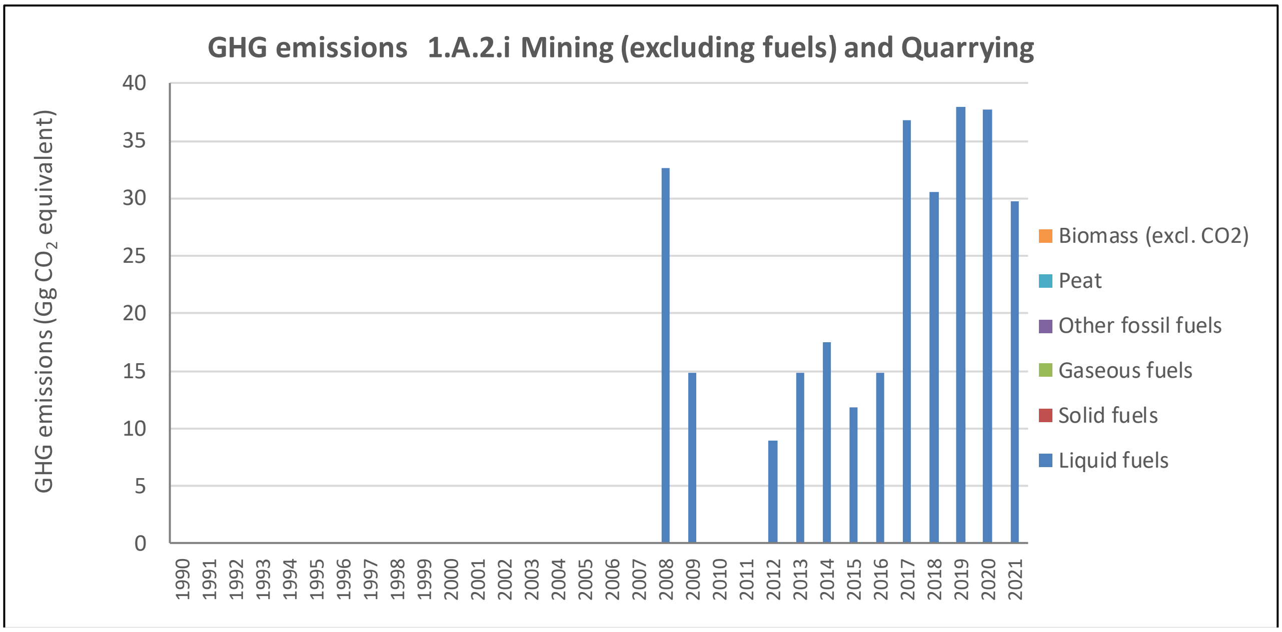


Figure 3-47 GHG Emissions from CRT category 1.A.2.i Mining and quarrying product: red bauxite, salt, marble, stucco, stone mortar, sand and gravel

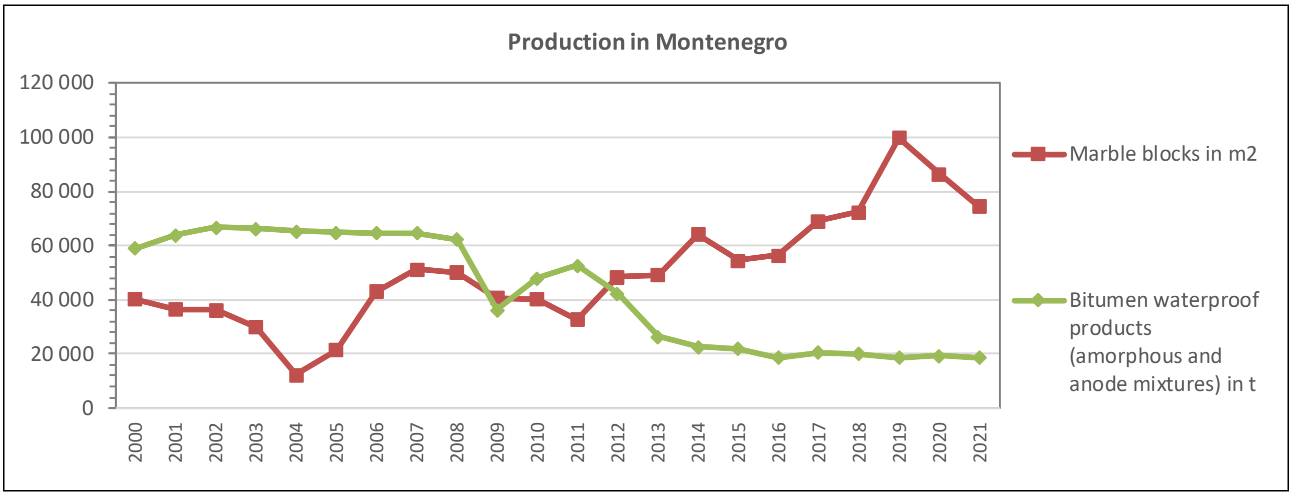


Figure 3-48 Main products in category 1.A.2.j Mining (excluding fuels) and Quarrying in the period 2000-2022; Source: INSTAT

Table 3-107 GHG Emissions from CRT category 1.A.2.i Mining and quarrying products

GHG emissions	TOTAL GHG	CO_2 (excluding biomass)	N_2O (including biomass)	CH_4 (including biomass)	CO_2 (biomass)
	kt CO2 equivalent	kt	kt CO2 equivalent	kt CO2 equivalent	kt
1990	IE	IE	IE	IE	NO
1991	IE	IE	IE	IE	NO
1992	IE	IE	IE	IE	NO
1993	IE	IE	IE	IE	NO
1994	IE	IE	IE	IE	NO
1995	IE	IE	IE	IE	NO
1996	IE	IE	IE	IE	NO
1997	IE	IE	IE	IE	NO
1998	IE	IE	IE	IE	NO
1999	IE	IE	IE	IE	NO
2000	IE	IE	IE	IE	NO
2001	IE	IE	IE	IE	NO
2002	IE	IE	IE	IE	NO
2003	IE	IE	IE	IE	NO
2004	IE	IE	IE	IE	NO
2005	IE	IE	IE	IE	NO
2006	IE	IE	IE	IE	NO
2007	IE	IE	IE	IE	NO
2008	32.68	32.56	0.084	0.035	NO
2009	14.85	14.80	0.038	0.016	NO
2010	IE	IE	IE	IE	NO
2011	IE	IE	IE	IE	NO
2012	8.91	8.88	0.023	0.010	NO
2013	14.85	14.80	0.038	0.016	NO
2014	17.49	17.43	0.040	0.017	NO
2015	11.88	11.84	0.031	0.013	NO
2016	14.85	14.80	0.038	0.016	NO
2017	36.84	36.70	0.095	0.040	NO
2018	30.60	30.49	0.079	0.033	NO
2019	38.02	37.89	0.098	0.041	NO
2020	37.73	37.59	0.097	0.041	NO
2021	29.71	29.60	0.076	0.032	NO
2022					
Trend					
1990 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*
2005 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*
2021 - 2022	*-21.3%*	*-21.3%*	*-21.3%*	*-21.3%*	*NA*

3.2.5.9.2 Methodological issues

3.2.5.9.2.1 Choice of methods

For estimating the GHG emissions (CO_2, CH_4, N_2O) the 2006 IPCC Guidelines Tier 1 approach[85] has been applied:

Equation 2.1: GHG emissions from stationary combustion (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Emissions_{GHG,\,fuel}[kt] = Fuel\ Consumption_{fuel}[TJ] \times Emission\ Factor_{GHG,\,fuel}} \left[\frac{\mathrm{kg}}{\mathrm{TJ}}\right] * \mathbf{10^{-6}}$$

Equation 2.2: Total emissions by greenhouse gas (2006 IPCC GL, Vol. 2, Chap. 2)

$$\begin{aligned}\boldsymbol{Emissions_{GHG}\left[kt_{CO2\ equivalent}\right]} &= \\ &\sum_{\boldsymbol{fuel}} \boldsymbol{emissions}_{\mathbf{CO2,\,fuel}}\ [\boldsymbol{kt}] \\ &+ \sum_{\boldsymbol{fuel}} \boldsymbol{emissions}_{\mathbf{CH4,\,fuel}}[\boldsymbol{kt}] \times \boldsymbol{GWP_{CH4}} \\ &+ \sum_{\boldsymbol{fuel}} \boldsymbol{emissions}_{\mathbf{N2O,\,fuel}}[\boldsymbol{kt}] \times \boldsymbol{GWP_{N2O}}\end{aligned}$$

Where:

Emissions $_{GHG}$	= emissions of GHG (kt $_{CO2\ equivalent}$)
Emissions $_{GHG,\ fuel}$	= emissions of a given GHG by type of fuel (kt GHG)
Fuel consumption $_{fuel}$	= amount of fuel combusted (TJ)
Emission factor $_{GHG,\ fuel}$	= default emission factor of a given GHG by type of fuel (kg gas/TJ) For CO_2, it includes the carbon oxidation factor, assumed to be 1.
10^{-6}	= conversion from kg to kt (≡ divided by 1.000.000)
GHG	= CO_2, CH_4, N_2O
GWP	= Global warming potential for CO_2, CH_4, N_2O according to the IPCC 5AR
Fuel	= liquid fuels, solid fuels, gaseous fuels, other fossil fuel, biomass, peat

The method applied is not in line with the decision tree, as the category 1.A.2.a *Main Activity Iron and Steel* is a key category. See here the chapter planned improvements.

3.2.5.9.2.2 Choice of activity data

Fuel consumption used for estimating the GHG and non-GHG emissions for the years 1990 - 2022 were taken from Statistical Office of Albania (INSTAT).

[85] Source: 2006 IPCC Guidelines, Volume 2: Energy, Chapter 2: Stationary Combustion - 2.3.1 Methodological issues - Choice of method

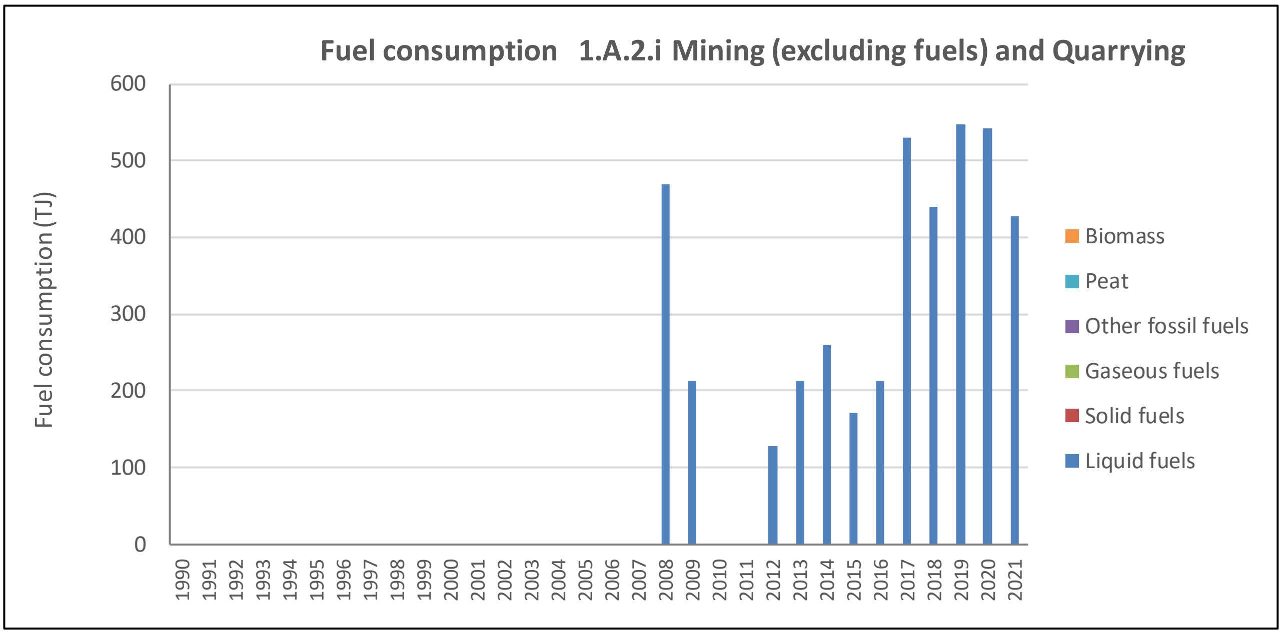


Figure 3-49: Activity data for sub-category 1.A.2.i Mining (excluding fuels) and Quarrying

Use of notation key

IE 1.A.2.i (liquid) The energy statistics is still under development; a split of the fuel combustion for this subcategory has to be reviewed for the entire timeseries. Emissions are currently allocated in CRT category 1.A.2.m *Other*.

Table 3-108: Activity data for sub-category 1.A.2.i Mining (excluding fuels) and Quarrying

Activity data 1.A.2.i	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
1990	IE	IE	NO	NO	NO	NO	NO
1991	IE	IE	NO	NO	NO	NO	NO
1992	IE	IE	NO	NO	NO	NO	NO
1993	IE	IE	NO	NO	NO	NO	NO
1994	IE	IE	NO	NO	NO	NO	NO
1995	IE	IE	NO	NO	NO	NO	NO
1996	IE	IE	NO	NO	NO	NO	NO
1997	IE	IE	NO	NO	NO	NO	NO
1998	IE	IE	NO	NO	NO	NO	NO
1999	IE	IE	NO	NO	NO	NO	NO
2000	IE	IE	NO	NO	NO	NO	NO
2001	IE	IE	NO	NO	NO	NO	NO
2002	IE	IE	NO	NO	NO	NO	NO
2003	IE	IE	NO	NO	NO	NO	NO
2004	IE	IE	NO	NO	NO	NO	NO
2005	IE	IE	NO	NO	NO	NO	NO
2006	IE	IE	NO	NO	NO	NO	NO
2007	IE	IE	NO	NO	NO	NO	NO
2008	469.81	469.81	NO	NO	NO	NO	NO

Activity data 1.A.2.i	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
2009	213.55	213.55	NO	NO	NO	NO	NO
2010	IE	IE	NO	NO	NO	NO	NO
2011	IE	IE	NO	NO	NO	NO	NO
2012	128.13	128.13	NO	NO	NO	NO	NO
2013	213.55	213.55	NO	NO	NO	NO	NO
2014	260.44	260.44	NO	NO	NO	NO	NO
2015	170.84	170.84	NO	NO	NO	NO	NO
2016	213.55	213.55	NO	NO	NO	NO	NO
2017	529.60	529.60	NO	NO	NO	NO	NO
2018	439.91	439.91	NO	NO	NO	NO	NO
2019	546.69	546.69	NO	NO	NO	NO	NO
2020	542.42	542.42	NO	NO	NO	NO	NO
2021	427.10	427.10	NO	NO	NO	NO	NO
2022							
Trend							
1990 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
2005 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
2021 - 2022	*-21.3%*	*-21.3%*	*NA*	*NA*	*NA*	*NA*	*NA*

In energy statistics, production, transformation and consumption of solid, liquid, gaseous and renewable fuels are specified in physical units, e.g. in tonnes or cubic meters. To convert these data to energy units, in this case terajoules, requires calorific values. The emission calculations are bases on net calorific values. In the following table the applied net calorific values (NCVs) for conversion to energy units in sub-category 1.A.2.i Mining (excluding fuels) and Quarrying.

Table 3-109 Net calorific values (NCVs) applied for conversion to energy units in category 1.A.2.i Mining (excluding fuels) and Quarrying

Fuel	Fuel type	Net calorific value (NCV) (TJ/Gg) or *(TJ/m3)		Source
		NCV	type	
Gas/Diesel Oil	liquid	42.71	CS	Statistical Office of Albania (INSTAT)
Residual fuel oil	liquid	41.20	CS	
Liquefied Petroleum Gases (LPG)	liquid	46.89	CS	
Petroleum Coke	liquid	40.19	CS	
Sub-Bituminous Coal	solid	16.75	CS	
Lignite	solid	9.21	CS	
Charcoal	biomass	29.30	CS	
Wood / Fuelwood	biomass	9.18*	CS	
Wood pellets	biomass	16.85	CS	

Note:
D Default CS Country specific PS Plant specific

3.2.5.9.2.3 Choice of emission factors

Default emission factors for greenhouse gases were taken from IPCC 2006 Guidelines and are presented in the following table.

Table 3-110 GHG Emission factor TIER 1 for CRT category 1.A.2.i Mining (excluding fuels) and Quarrying

Fuel	Fuel type	CO_2 (kg/TJ)		CH_4 (kg/TJ)		N_2O (kg/TJ)		Source
		EF	type	EF	type	EF	type	2006 IPCC Guidelines Vol. 2, Chap. 2 (2.3.2.1)
Gas/Diesel Oil	liquid	74 100	D	3	D	0.6	D	**Table 2.3** Default emission factors for stationary combustion in manufacturing industries and construction (page 2.18)
Residual Fuel Oil / Total fuel oil	liquid	77 400	D	3	D	0.6	D	
Lignite	solid	101 000	D	10	D	1.5	D	
LPG	gaseous	63 100	D	1	D	0.1	D	
Natural gas	gaseous	56 100	D	1	D	0.1	D	
Wood pellets	biomass	112 000	D	30	D	4	D	

Note:
D Default CS Country specific PS Plant specific IEF Implied emission factor

3.2.5.9.3 Uncertainties and time-series consistency

The uncertainties for activity data and emission factors used for CRT category 1.A.2.i Mining (excluding fuels) and Quarrying are presented in the following table.

Table 3-111 Uncertainty for CRT category 1.A.2.i Mining (excluding fuels) and Quarrying

Uncertainty	Liquid fuels			Reference
	CO_2	CH_4	N_2O	2006 IPCC GL, Vol. 2, Chap. 2 (2.4.2)
Activity data (AD)	2%	2%	2%	Table 2.15 and Table 3.1
Emission factor (EF)	2%			Table 2.13
		100%		Table 2.12
			20%	Table 2.14
Combined Uncertainty (U)	2%	100%	20%	$U_{total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

The time-series are considered to be consistent as the same methodology is applied to the whole period. Activity data are considered to be consistent as national and international data were always compared.

3.2.5.9.4 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed out:

⇒ Checked of calculations by spreadsheets
- consistent use of energy balance data (energy statistic questionnaires),
- documented sources,
- use of units,
- strictly defined interfaces between spreadsheets/calculation modules,
- unique structure of sheets which do the same,
- record keeping, use of write protection,
- unique use of formulas, special cases are documented/highlighted,

- quick-control checks for data consistency through all steps of calculation.

⇒ cross-checked from different sources:

- National statistic published by INSTAT and
- Energy statistics of UN statistics[86] and data published by International Energy Agency (IEA)[87]

⇒ time series consistency - plausibility checks of dips and jumps.

3.2.5.9.5 Category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category 1.A.2.i *Mining (excluding fuels) and Quarrying*.

Table 3-112 Recalculations done in sub-category 1.A.2.i Mining (excluding fuels) and Quarrying

source category	Revisions of data	Type of revision	Type of improvement
1.A.2.i	Revision of NCV	AD	Consistency

3.2.5.9.6 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 3-113 Planned improvements for CRT category 1.A.2.i Mining (excluding fuels) and Quarrying

source category	Planned improvement	Type of improvement		Priority
1.A.2.i	Carbon content (%) of lignite, gas/diesel oil, residual fuel oil, etc. for preparing country specific emission factor (CS EF) ⇒ **CS EF$_{CO2}$** [t/TJ] = (C [%] • 44 • Ox)/(NCV [TJ/t] • 12• 100)	EF	Accuracy Transparency	Medium
1.A.2.i	Improvement of time series consistency and split of fuels: the energy statistics is still under development; a split of the fuel combustion for this subcategory has to be reviewed for the entire time series. Emissions are allocated in IPCC/NFR subcategory 1.A.2.m Other.	AD	Accuracy Transparency	High
1.A.2.i	Cross-check of national and international data sources (Eurostat and UNSD)	AD	Consistency Transparency	Medium

[86] United Nations - Department of Economic and Social Affairs - Statistics Division Statistics - Energy Statistics https://unstats.un.org/unsd/energystats/

[87] Data and statistics - Data tools - Data tables Energy data by category, indicator, country or region https://www.iea.org/data-and-statistics/data-browser?country=WORLD&fuel=Energy%20supply&indicator=TESbySource

3.2.5.10 Wood and wood products (CRT category 1.A.2.j)

The CRT category 1.A.2.j *Wood and wood products* includes GHG emissions resulting from fuel combustion activities in

Activities	Occurring in Albania
▪ ISIC Division 16 Manufacture of wood and of products of wood and cork (except furniture), and manufacture of articles of straw and plaiting materials	
▪ Sawmilling and planing of wood	✓
▪ Manufacture of products of wood, cork, straw and plaiting materials	✓
○ Manufacture of veneer sheets and wood-based panels	
▪ Manufacture of builders' carpentry and joinery	✓
▪ Manufacture of wooden containers	✓
▪ Manufacture of other products of wood; manufacture of articles of cork, straw and plaiting materials Quarrying	✓

3.2.5.10.1 Source category description

GHG emissions/ removals	CO_2						CH_4						N_2O					
Estimated	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass
1.A.2.j	√*	√*	NO	NO	NO	√**	√*	√*	NO	NO	NO	√**	√*	√*	NO	NO	NO	√**
Key category	LA 2021	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential																		
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF																		
* data provided only from 2006 onwards; ** data provided only from 2011 onwards																		

Use of notation key

IE	1.A.2.j (liquid, solid, biomass)	The energy statistics is still under development; a split of the fuel combustion for this subcategory has to be reviewed for the entire timeseries. Emissions are currently allocated in CRT category 1.A.2.m *Other*.

An overview of the emissions from fuel combustion in CRT category *1.A.2.j Wood and wood products* is provided in the following figures and tables:

- annual emissions of GHGs;
- Trend of the periods 1990 – 2022, 2005 – 2022, 2021 – 2022.

The main fuels used in 1.A.2.j were liquid fuel, such as gas/diesel oil and fuel oil.

In the last decade, the GHG emissions increased due to increased wood and wood products such as Spruce and fir lumber, beech lumber, balcony doors and other doors.

For 1990-2005, the emissions from liquid fuels combusted in CRT category 1.A.2.j are included in CRT category 1.A.2.m Other.

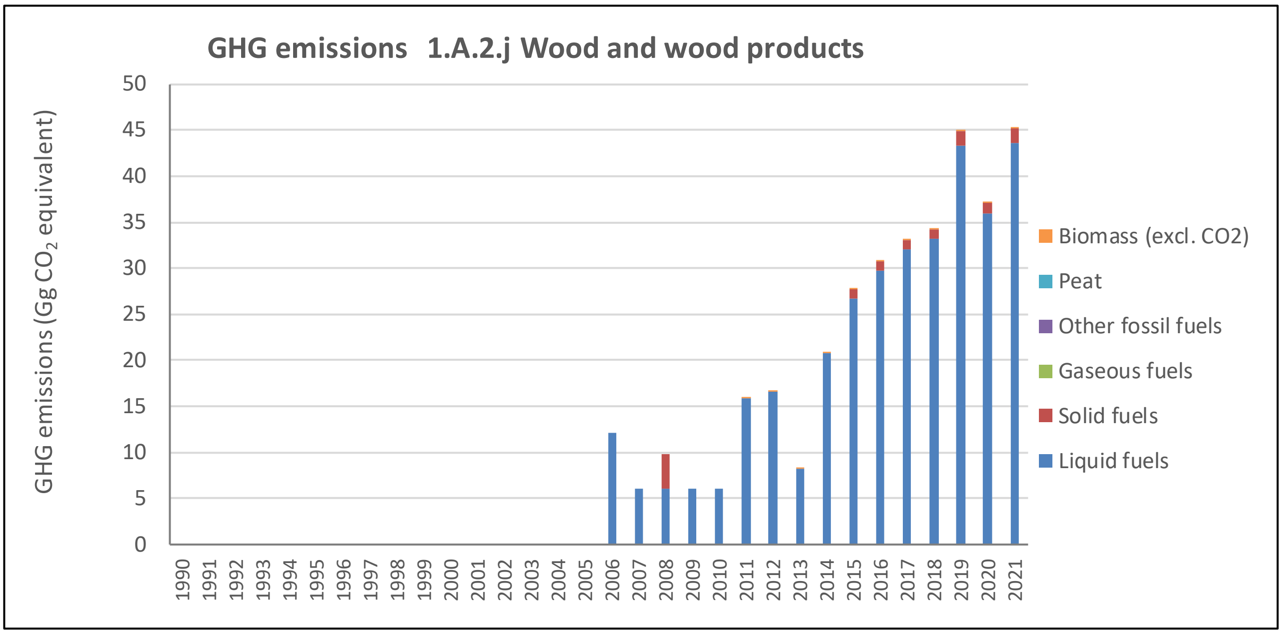


Figure 3-50 GHG emissions from sub-category 1.A.2.j Wood and wood products

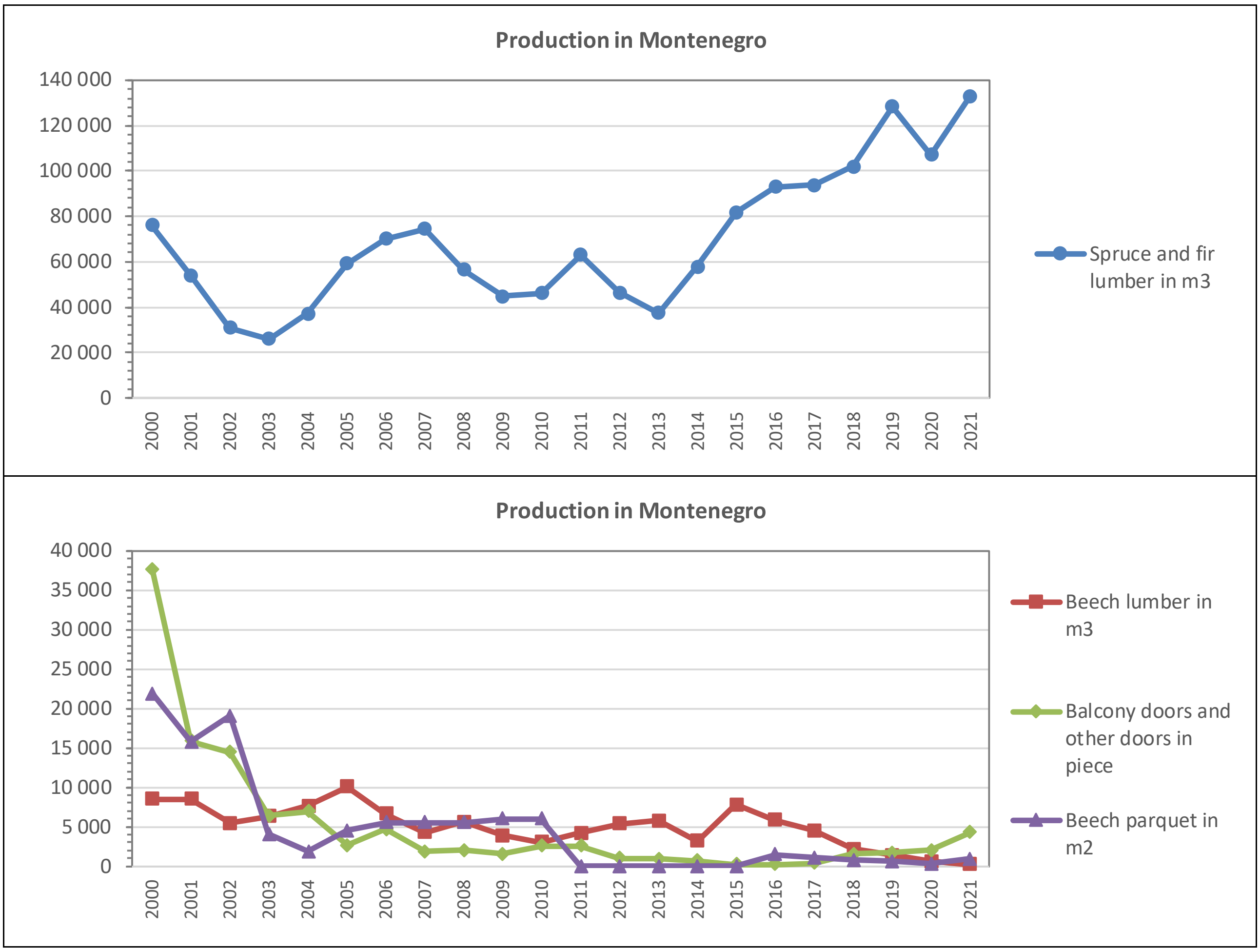


Figure 3-51 Main products in category 1.A.2.j Wood and wood products in the period 2000-2022; Source: INSTAT

Table 3-114 Emissions from CRT category 1.A.2.j Wood and wood products

GHG emissions	TOTAL GHG	CO_2 (excluding biomass)	N_2O (including biomass)	CH_4 (including biomass)	CO_2 (biomass)
	kt CO2 equivalent	kt	kt CO2 equivalent	kt CO2 equivalent	kt
1990	IE	IE	IE	IE	IE
1991	IE	IE	IE	IE	IE
1992	IE	IE	IE	IE	IE
1993	IE	IE	IE	IE	IE
1994	IE	IE	IE	IE	IE
1995	IE	IE	IE	IE	IE
1996	IE	IE	IE	IE	IE
1997	IE	IE	IE	IE	IE
1998	IE	IE	IE	IE	IE
1999	IE	IE	IE	IE	IE
2000	IE	IE	IE	IE	IE
2001	IE	IE	IE	IE	IE
2002	IE	IE	IE	IE	IE
2003	IE	IE	IE	IE	IE
2004	IE	IE	IE	IE	IE
2005	IE	IE	IE	IE	IE
2006	12.07	12.03	0.030	0.013	IE
2007	6.03	6.01	0.015	0.006	IE
2008	9.78	9.73	0.031	0.016	IE
2009	6.03	6.01	0.015	0.006	IE
2010	6.03	6.01	0.015	0.006	IE
2011	15.82	15.78	0.008	0.007	0.024
2012	16.59	16.53	0.021	0.011	0.025
2013	8.26	8.22	0.010	0.006	0.024
2014	20.80	20.72	0.053	0.022	0.001
2015	27.67	27.57	0.073	0.031	0.001
2016	30.67	30.56	0.081	0.034	0.001
2017	33.05	32.93	0.087	0.037	0.001
2018	34.24	34.11	0.090	0.038	0.001
2019	44.84	44.67	0.118	0.050	0.001
2020	37.17	37.03	0.098	0.042	0.001
2021	45.20	45.03	0.119	0.051	0.001
2022					
Trend					
1990 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*
2005 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*
2021 - 2022	*21.6%*	*21.6%*	*21.7%*	*21.7%*	*25.0%*

3.2.5.10.2 Methodological issues

3.2.5.10.2.1 Choice of methods

For estimating the GHG emissions (CO_2, CH_4, N_2O) the 2006 IPCC Guidelines Tier 1 approach[88] has been applied:

Equation 2.1: GHG emissions from stationary combustion (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Emissions_{GHG,\,fuel}[kt] = Fuel\ Consumption_{fuel}[TJ] \times Emission\ Factor_{GHG,\,fuel}\left[\frac{\mathrm{kg}}{\mathrm{TJ}}\right] * 10^{-6}}$$

Equation 2.2: Total emissions by greenhouse gas (2006 IPCC GL, Vol. 2, Chap. 2)

$$\begin{aligned}\boldsymbol{Emissions_{GHG}[kt_{CO2\ equivalent}]} = {} & \sum_{fuel} \boldsymbol{emissions_{\mathrm{CO2,\,fuel}}\ [kt]} \\ & + \sum_{fuel} \boldsymbol{emissions_{\mathrm{CH4,\,fuel}}[kt] \times GWP_{CH4}} \\ & + \sum_{fuel} \boldsymbol{emissions_{\mathrm{N2O,\,fuel}}[kt] \times GWP_{N2O}}\end{aligned}$$

Where:

Emissions $_{GHG}$	= emissions of GHG (kt $_{CO2\ equivalent}$)
Emissions $_{GHG,\ fuel}$	= emissions of a given GHG by type of fuel (kt GHG)
Fuel consumption $_{fuel}$	= amount of fuel combusted (TJ)
Emission factor $_{GHG,\ fuel}$	= default emission factor of a given GHG by type of fuel (kg gas/TJ) For CO_2, it includes the carbon oxidation factor, assumed to be 1.
10^{-6}	= conversion from kg to kt (≡ divided by 1.000.000)
GHG	= CO_2, CH_4, N_2O
GWP	= Global warming potential for CO_2, CH_4, N_2O according to the IPCC 5AR
Fuel	= liquid fuels, solid fuels, gaseous fuels, other fossil fuel, biomass, peat

The method applied is not in line with the decision tree, as the category 1.A.2.a *Main Activity Iron and Steel* is a key category. See here the chapter planned improvements.

3.2.5.10.2.2 Choice of activity data

Fuel consumption used for estimating the GHG and non-GHG emissions for the years 1990 - 2022 were taken from Statistical Office of Albania (INSTAT).

[88] Source: 2006 IPCC Guidelines, Volume 2: Energy, Chapter 2: Stationary Combustion - 2.3.1 Methodological issues - Choice of method

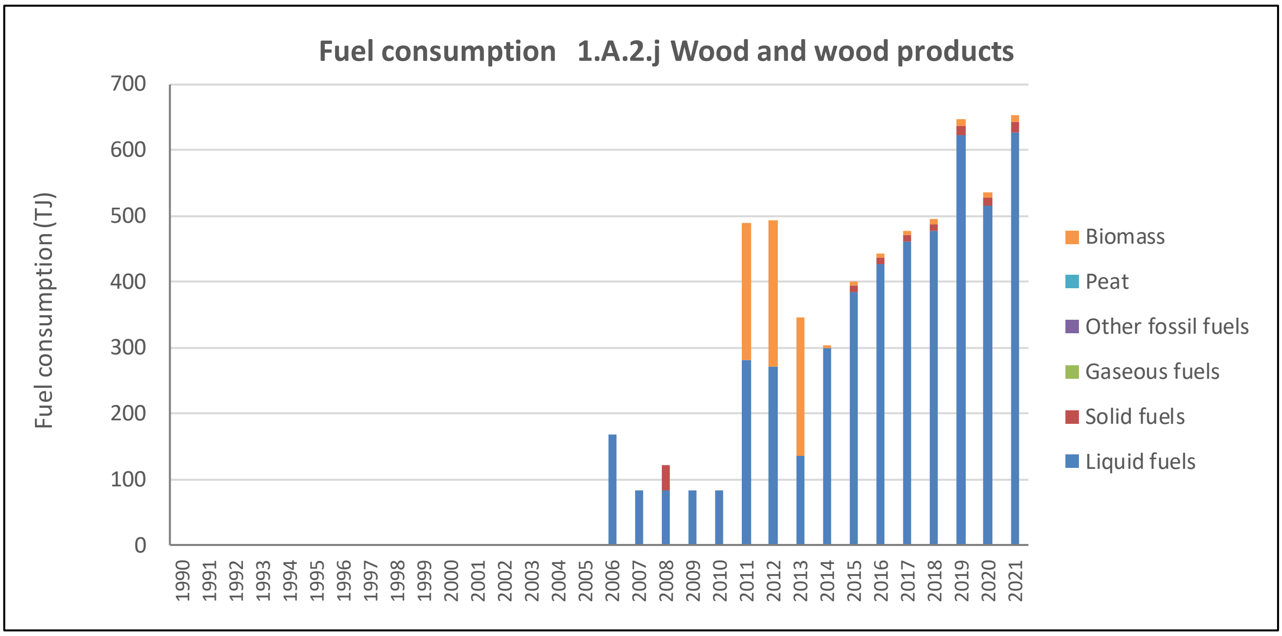


Figure 3-52: Activity data for sub-category 1.A.2.j *Wood and wood products*

<u>Use of notation key</u>

IE	1.A.2.j (liquid, solid, biomass)	The energy statistics is still under development; a split of the fuel combustion for this subcategory has to be reviewed for the entire timeseries. Emissions are currently allocated in CRT category 1.A.2.m *Other*.

Table 3-115: Activity data for sub-category 1.A.2.j *Wood and wood products*

Activity data 1.A.2.j	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
1990	IE	IE	IE	NO	NO	NO	NO
1991	IE	IE	IE	NO	NO	NO	NO
1992	IE	IE	IE	NO	NO	NO	NO
1993	IE	IE	IE	NO	NO	NO	NO
1994	IE	IE	IE	NO	NO	NO	NO
1995	IE	IE	IE	NO	NO	NO	NO
1996	IE	IE	IE	NO	NO	NO	NO
1997	IE	IE	IE	NO	NO	NO	NO
1998	IE	IE	IE	NO	NO	NO	NO
1999	IE	IE	IE	NO	NO	NO	NO
2000	IE	IE	IE	NO	NO	NO	NO
2001	IE	IE	IE	NO	NO	NO	NO
2002	IE	IE	IE	NO	NO	NO	NO
2003	IE	IE	IE	NO	NO	NO	NO
2004	IE	IE	IE	NO	NO	NO	NO
2005	IE	IE	IE	NO	NO	NO	NO
2006	167.82	167.82	IE	NO	NO	NO	NO
2007	83.91	83.91	IE	NO	NO	NO	NO
2008	120.75	83.91	36.84	NO	NO	NO	NO
2009	83.91	83.91	IE	NO	NO	NO	NO

Activity data 1.A.2.j	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
2010	83.91	83.91	IE	NO	NO	NO	NO
2011	490.34	281.34	IE	NO	NO	NO	209.00
2012	494.47	271.47	IE	NO	NO	NO	223.00
2013	345.49	136.49	IE	NO	NO	NO	209.00
2014	303.97	298.97	IE	NO	NO	NO	5.00
2015	399.60	384.39	9.21	NO	NO	NO	6.00
2016	443.58	427.10	9.48	NO	NO	NO	7.00
2017	477.78	461.27	9.51	NO	NO	NO	7.00
2018	495.84	478.35	9.49	NO	NO	NO	8.00
2019	648.02	623.57	14.46	NO	NO	NO	10.00
2020	536.86	516.79	12.07	NO	NO	NO	8.00
2021	652.88	627.84	15.04	NO	NO	NO	10.00
2022							
Trend							
1990 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
2005 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
2021 - 2022	*21.6%*	*21.5%*	*24.6%*	*NA*	*NA*	*NA*	*25.0%*

In energy statistics, production, transformation and consumption of solid, liquid, gaseous and renewable fuels are specified in physical units, e.g. in tonnes or cubic meters. To convert these data to energy units, in this case terajoules, requires calorific values. The emission calculations are bases on net calorific values. In the following table the applied net calorific values (NCVs) for conversion to energy units in category 1.A.2.j Wood and wood products.

Table 3-116 Net calorific values (NCVs) applied for conversion to energy units in category 1.A.2.j Wood and wood products

Fuel	Fuel type	Net calorific value (NCV) (TJ/Gg) or *(TJ/m3)		Source
		NCV	type	
Gas/Diesel Oil	liquid	42.71	CS	Statistical Office of Albania (INSTAT)
Residual fuel oil	liquid	41.20	CS	
Liquefied Petroleum Gases (LPG)	liquid	46.89	CS	
Petroleum Coke	liquid	40.19	CS	
Sub-Bituminous Coal	solid	16.75	CS	
Lignite	solid	9.21	CS	
Charcoal	biomass	29.30	CS	
Wood / Fuelwood	biomass	9.18*	CS	
Wood pellets	biomass	16.85	CS	
Note: D Default CS Country specific PS Plant specific				

3.2.5.10.2.3 Choice of emission factors

Default emission factors for greenhouse gases were taken from IPCC 2006 Guidelines and are presented in the following table.

Table 3-117 GHG Emission factor TIER 1 for CRT category 1.A.2.j Wood and wood products

Fuel	Fuel type	CO_2 (kg/TJ)		CH_4 (kg/TJ)		N_2O (kg/TJ)		Source
		EF	type	EF	type	EF	type	2006 IPCC Guidelines Vol. 2, Chap. 2 (2.3.2.1)
Gas/Diesel Oil	liquid	74 100	D	3	D	0.6	D	**Table 2.3** Default emission factors for stationary combustion in manufacturing industries and construction (page 2.18)
Residual Fuel Oil / Total fuel oil	liquid	77 400	D	3	D	0.6	D	
Lignite	solid	101 000	D	10	D	1.5	D	
LPG	gaseous	63 100	D	1	D	0.1	D	
Natural gas	gaseous	56 100	D	1	D	0.1	D	
Wood pellets	biomass	112 000	D	30	D	4	D	

Note:
D Default CS Country specific PS Plant specific IEF Implied emission factor

3.2.5.10.3 Uncertainties and time-series consistency

The uncertainties for activity data and emission factors used for CRT category 1.A.2.j Wood and wood products are presented in the following table.

Table 3-118 Uncertainty for CRT category 1.A.2.j Wood and wood products.

Uncertainty	Liquid fuels			Reference
	CO_2	CH_4	N_2O	2006 IPCC GL, Vol. 2, Chap. 2 (2.4.2)
Activity data (AD)	2%	2%	2%	Table 2.15 and Table 3.1
Emission factor (EF)	2%			Table 2.13
		100%		Table 2.12
			20%	Table 2.14
Combined Uncertainty (U)	2%	100%	20%	$U_{total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

The time-series are considered to be consistent as the same methodology is applied to the whole period. Activity data are considered to be consistent as national and international data were always compared.

3.2.5.10.4 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed out:

⇒ Checked of calculations by spreadsheets
  - consistent use of energy balance data (energy statistic questionnaires),
  - documented sources,
  - use of units,
  - strictly defined interfaces between spreadsheets/calculation modules,
  - unique structure of sheets which do the same,
  - record keeping, use of write protection,
  - unique use of formulas, special cases are documented/highlighted,

- quick-control checks for data consistency through all steps of calculation.

⇒ cross-checked from different sources:
- National statistic published by INSTAT and
- Energy statistics of UN statistics[89] and data published by International Energy Agency (IEA)[90]

⇒ time series consistency - plausibility checks of dips and jumps.

3.2.5.10.5 Category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category 1.A.2.j *Wood and wood products*.

Table 3-119 Recalculations done in category 1.A.2.j Wood and wood products

source category	Revisions of data	Type of revision	Type of improvement
1.A.2.j	Revision of NCV	AD	Accuracy

3.2.5.10.6 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 3-120 Planned improvements for CRT category 1.A.2.j Wood and wood products

source category	Planned improvement	Type of improvement		Priority
1.A.2.j	Carbon content (%) of lignite, gas/diesel oil, residual fuel oil, etc. for preparing country specific emission factor (CS EF) ⇒ **CS EF$_{CO2}$** [t/TJ] = (C [%] • 44 • Ox)/(NCV [TJ/t] • 12• 100)	EF	Accuracy Transparency	Medium
1.A.2.j	Information about fitted/non-fitted equipment for flue gas cleaning, improvement in combustion	EF	Accuracy Transparency	Medium
1.A.2.j	Improvement of time series consistency and split of fuels: the energy statistics is still under development; a split of the fuel combustion for this subcategory has to be reviewed for the entire time series. Emissions are allocated in IPCC/NFR subcategory 1.A.2.m Other.	AD	Accuracy Transparency	High
1.A.2.j	Cross-check of national and international data sources	AD	Consistency	Medium

[89] United Nations - Department of Economic and Social Affairs - Statistics Division Statistics - Energy Statistics https://unstats.un.org/unsd/energystats/

[90] Data and statistics - Data tools - Data tables Energy data by category, indicator, country or region https://www.iea.org/data-and-statistics/data-browser?country=WORLD&fuel=Energy%20supply&indicator=TESbySource

source category	Planned improvement	Type of improvement		Priority
	(Eurostat and UNSD)		Transparency	

3.2.5.11 Construction (CRT category 1.A.2.k)

The CRT category 1.A.2.k *Construction* includes GHG emissions resulting from fuel combustion activities in

Activities	Occurring in Albania
▪ ISIC Division 41 Construction of buildings	✓
▪ Division 42 Civil engineering	
○ Construction of roads and railways	✓
○ Construction of utility projects	✓
○ Construction of other civil engineering projects	✓
▪ Division 43 Specialized construction activities	
○ Demolition and site preparation	✓
○ Electrical, plumbing and heat and air-conditioning installation and other construction installation activities	✓
○ Building completion and finishing	✓
○ Other specialized construction activities Manufacture	✓

3.2.5.11.1 Source category description

GHG emissions/ removals	CO_2						CH_4						N_2O					
Estimated	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass
1.A.2.k	√*	√*	NO	NO	NO	NO	√*	√*	NO	NO	NO	NO	√*	√*	NO	NO	NO	NO
Key category	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential																		
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF																		
* data provided only from 2006 onwards; ** data provided only from 2011 onwards																		

<u>Use of notation key</u>

IE	1.A.2.j (liquid, solid, biomass)	The energy statistics is still under development; a split of the fuel combustion for this subcategory has to be reviewed for the entire timeseries. Emissions are currently allocated in CRT category 1.A.2.m *Other*.

An overview of the emissions from fuel combustion in CRT category *1.A.2.j Wood and wood products* is provided in the following figures and tables:

- annual emissions of GHGs;
- Trend of the periods 1990 – 2022, 2005 – 2022, 2021 – 2022.

For 1999, 2001-2005, 2008 and 2013, emissions from liquid fuels combusted in CRT category 1.A.2.k are provided; for all other years, emissions from CRT category 1.A.2.k are included in CRT category 1.A.2.m Other.

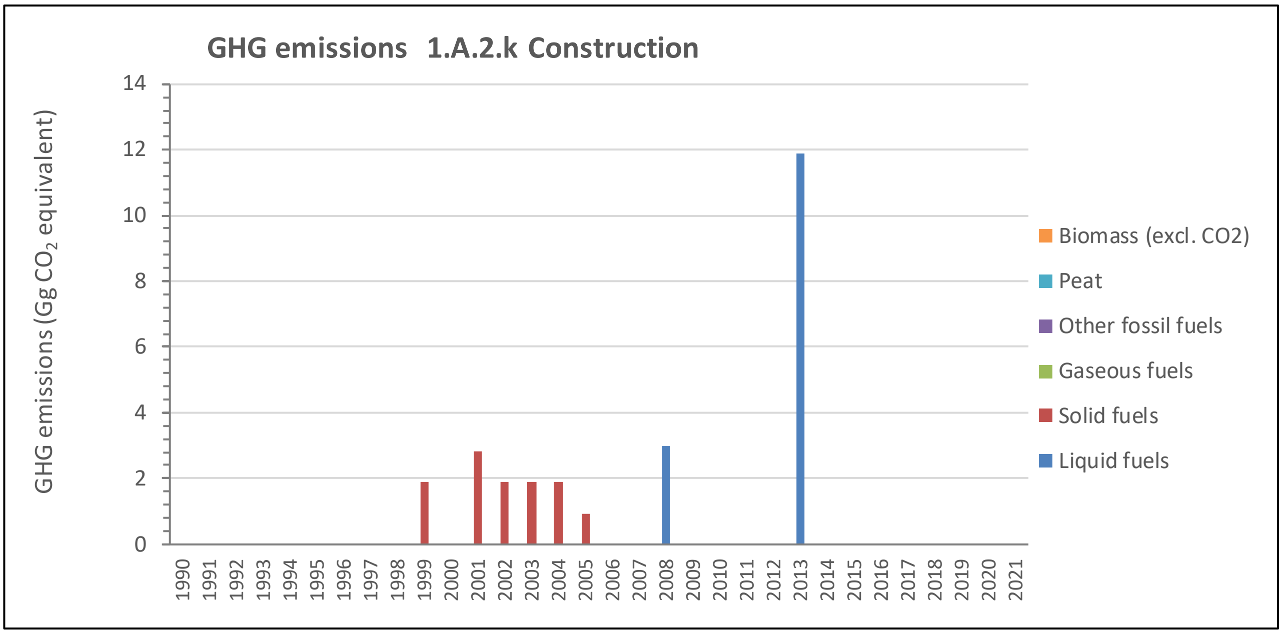


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Figure 3-53 GHG emissions from sub-category 1.A.2.k Construction

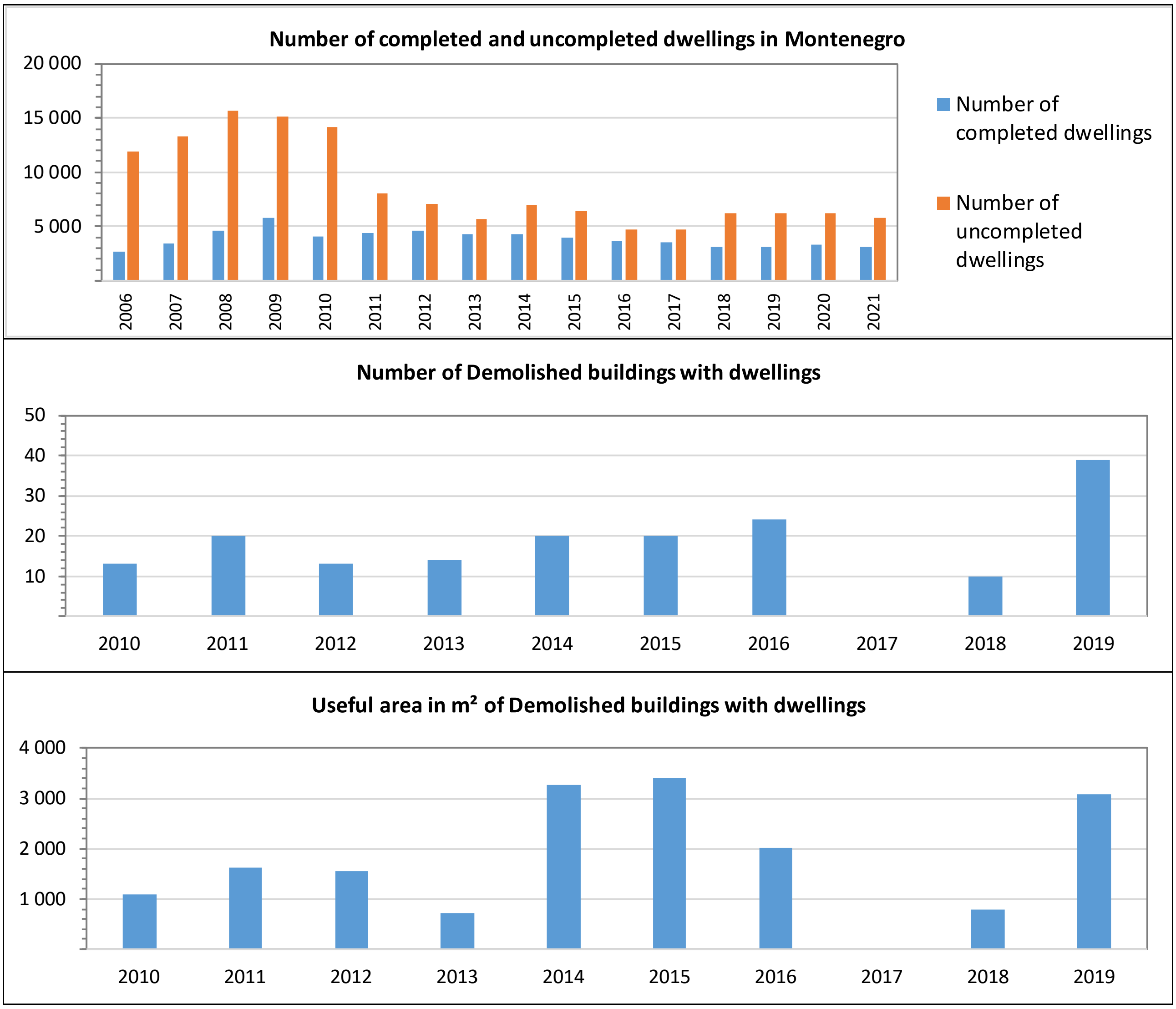


Figure 3-54 Number and floor area of completed and uncompleted dwellings and demolishing in category 1.A.2.k Constructioin in the period 2006-2022; Source: INSTAT

Table 3-121 Emissions from CRT category 1.A.2.k Construction

GHG emissions	TOTAL GHG	CO_2 (excluding biomass)	N_2O (including biomass)	CH_4 (including biomass)	CO_2 (biomass)
	kt CO2 equivalent	kt	kt CO2 equivalent	kt CO2 equivalent	kt
1990	IE	IE	IE	IE	NO
1991	IE	IE	IE	IE	NO
1992	IE	IE	IE	IE	NO
1993	IE	IE	IE	IE	NO
1994	IE	IE	IE	IE	NO
1995	IE	IE	IE	IE	NO
1996	IE	IE	IE	IE	NO
1997	IE	IE	IE	IE	NO
1998	IE	IE	IE	IE	NO
1999	1.87	1.86	0.008	0.005	NO
2000	IE	IE	IE	IE	NO
2001	2.81	2.79	0.012	0.007	NO
2002	1.87	1.86	0.008	0.005	NO
2003	1.87	1.86	0.008	0.005	NO
2004	1.87	1.86	0.008	0.005	NO
2005	0.94	0.93	0.004	0.002	NO
2006	IE	IE	IE	IE	NO
2007	IE	IE	IE	IE	NO
2008	2.97	2.96	0.008	0.003	NO
2009	IE	IE	IE	IE	NO
2010	IE	IE	IE	IE	NO
2011	IE	IE	IE	IE	NO
2012	IE	IE	IE	IE	NO
2013	11.88	11.84	0.031	0.013	NO
2014	IE	IE	IE	IE	NO
2015	IE	IE	IE	IE	NO
2016	IE	IE	IE	IE	NO
2017	IE	IE	IE	IE	NO
2018	IE	IE	IE	IE	NO
2019	IE	IE	IE	IE	NO
2020	IE	IE	IE	IE	NO
2021	IE	IE	IE	IE	NO
2022					
Trend					
1990 – 2022	*NA*	*NA*	*NA*	*NA*	*NA*
2005 – 2022	*NA*	*NA*	*NA*	*NA*	*NA*
2021 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*

3.2.5.11.2 Methodological issues

3.2.5.11.2.1 Choice of methods

For estimating the GHG emissions (CO_2, CH_4, N_2O) the 2006 IPCC Guidelines Tier 1 approach[91] has been applied:

Equation 2.1: GHG emissions from stationary combustion (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Emissions_{GHG,\,fuel}[kt] = Fuel\ Consumption_{fuel}[TJ] \times Emission\ Factor_{GHG,\,fuel}\left[\frac{\mathrm{kg}}{\mathrm{TJ}}\right] * 10^{-6}}$$

Equation 2.2: Total emissions by greenhouse gas (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Emissions_{GHG}\left[kt_{CO2\ equivalent}\right] = \sum_{fuel} emissions_{\mathrm{CO2,\,fuel}}\ [kt] + \sum_{fuel} emissions_{\mathrm{CH4,\,fuel}}[kt] \times GWP_{CH4} + \sum_{fuel} emissions_{\mathrm{N2O,\,fuel}}[kt] \times GWP_{N2O}}$$

Where:

Emissions $_{GHG}$	= emissions of GHG (kt $_{CO2\ equivalent}$)
Emissions $_{GHG,\ fuel}$	= emissions of a given GHG by type of fuel (kt GHG)
Fuel consumption $_{fuel}$	= amount of fuel combusted (TJ)
Emission factor $_{GHG,\ fuel}$	= default emission factor of a given GHG by type of fuel (kg gas/TJ) For CO_2, it includes the carbon oxidation factor, assumed to be 1.
10^{-6}	= conversion from kg to kt (≡ divided by 1.000.000)
GHG	= CO_2, CH_4, N_2O
GWP	= Global warming potential for CO_2, CH_4, N_2O according to the IPCC 5AR
Fuel	= liquid fuels, solid fuels, gaseous fuels, other fossil fuel, biomass, peat

The method applied is not in line with the decision tree, as the category 1.A.2.a *Main Activity Iron and Steel* is a key category. See here the chapter planned improvements.

3.2.5.11.2.2 Choice of activity data

Fuel consumption used for estimating the GHG and non-GHG emissions for the years 1990 - 2022 were taken from Statistical Office of Albania (INSTAT).

[91] Source: 2006 IPCC Guidelines, Volume 2: Energy, Chapter 2: Stationary Combustion - 2.3.1 Methodological issues - Choice of method

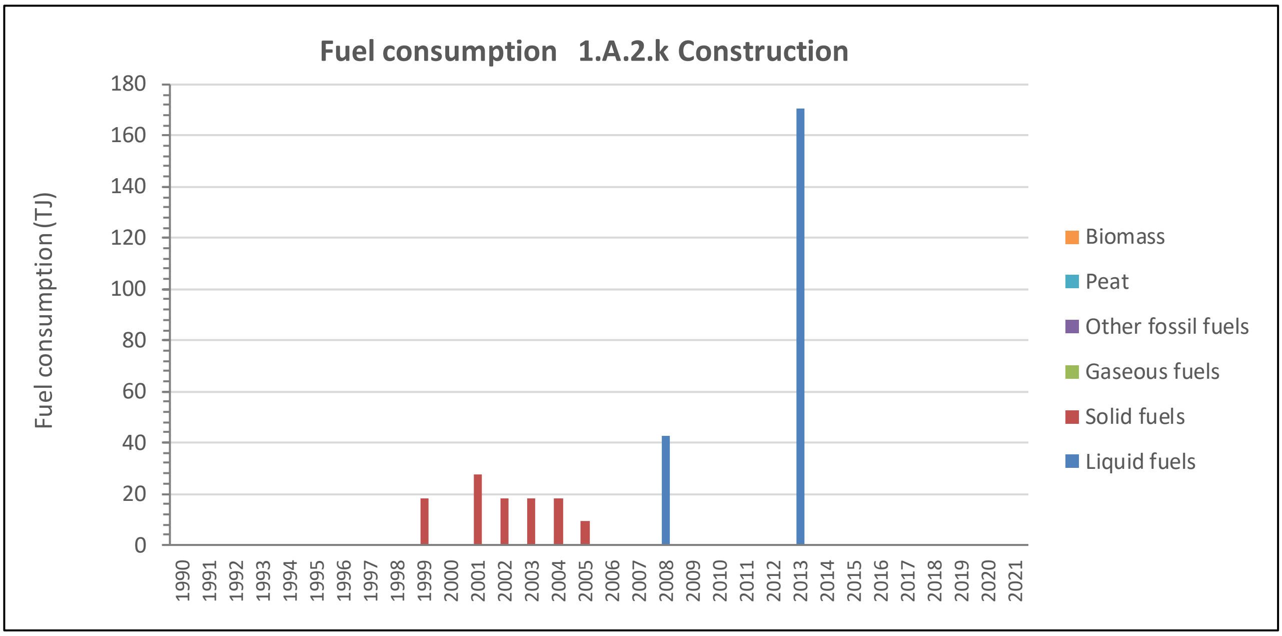


Figure 3-55 Activity data for sub-category 1.A.2.k *Construction* 1990 – 2022

Use of notation key

IE	1.A.2.j (liquid, solid)	The energy statistics is still under development; a split of the fuel combustion for this subcategory has to be reviewed for the entire timeseries. Emissions are currently allocated in CRT category 1.A.2.m *Other*.

Table 3-122 Activity data for sub-category 1.A.2.k *Construction* 1990 - 2022

Activity data 1.A.2.k	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
1990	IE	IE	IE	NO	NO	NO	NO
1991	IE	IE	IE	NO	NO	NO	NO
1992	IE	IE	IE	NO	NO	NO	NO
1993	IE	IE	IE	NO	NO	NO	NO
1994	IE	IE	IE	NO	NO	NO	NO
1995	IE	IE	IE	NO	NO	NO	NO
1996	IE	IE	IE	NO	NO	NO	NO
1997	IE	IE	IE	NO	NO	NO	NO
1998	IE	IE	IE	NO	NO	NO	NO
1999	18.42	IE	18.42	NO	NO	NO	NO
2000	IE	IE	IE	NO	NO	NO	NO
2001	27.63	IE	27.63	NO	NO	NO	NO
2002	18.42	IE	18.42	NO	NO	NO	NO
2003	18.42	IE	18.42	NO	NO	NO	NO
2004	18.42	IE	18.42	NO	NO	NO	NO
2005	9.21	IE	9.21	NO	NO	NO	NO
2006	IE	IE	IE	NO	NO	NO	NO
2007	IE	IE	IE	NO	NO	NO	NO
2008	42.71	42.71	IE	NO	NO	NO	NO
2009	IE	IE	IE	NO	NO	NO	NO

Activity data 1.A.2.k	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
2010	IE	IE	IE	NO	NO	NO	NO
2011	IE	IE	IE	NO	NO	NO	NO
2012	IE	IE	IE	NO	NO	NO	NO
2013	170.84	170.84	IE	NO	NO	NO	NO
2014	IE	IE	IE	NO	NO	NO	NO
2015	IE	IE	IE	NO	NO	NO	NO
2016	IE	IE	IE	NO	NO	NO	NO
2017	IE	IE	IE	NO	NO	NO	NO
2018	IE	IE	IE	NO	NO	NO	NO
2019	IE	IE	IE	NO	NO	NO	NO
2020	IE	IE	IE	NO	NO	NO	NO
2021	IE	IE	IE	NO	NO	NO	NO
2022							
Trend							
1990 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
2005 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
2021 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*

In energy statistics, production, transformation and consumption of solid, liquid, gaseous and renewable fuels are specified in physical units, e.g. in tonnes or cubic meters. To convert these data to energy units, in this case terajoules, requires calorific values. The emission calculations are bases on net calorific values. In the following table the applied net calorific values (NCVs) for conversion to energy units in sub-category 1.A.2.k Construction.

Table 3-123 Net calorific values (NCVs) applied for conversion to energy units in sub-category 1.A.2.k Construction

Fuel	Fuel type	Net calorific value (NCV) (TJ/Gg) or *(TJ/m3)		Source
		NCV	type	
Gas/Diesel Oil	liquid	42.71	CS	Statistical Office of Albania (INSTAT)
Residual fuel oil	liquid	41.20	CS	
Liquefied Petroleum Gases (LPG)	liquid	46.89	CS	
Petroleum Coke	liquid	40.19	CS	
Sub-Bituminous Coal	solid	16.75	CS	
Lignite	solid	9.21	CS	
Charcoal	biomass	29.30	CS	
Wood / Fuelwood	biomass	9.18*	CS	
Wood pellets	biomass	16.85	CS	
Note: D Default CS Country specific PS Plant specific				

3.2.5.11.2.3 Choice of emission factors

Default emission factors for greenhouse gases were taken from IPCC 2006 Guidelines and are presented in the following table.

Table 3-124 GHG Emission factor TIER 1 for CRT category 1.A.2.k *Construction*

Fuel	Fuel type	CO_2 (kg/TJ)		CH_4 (kg/TJ)		N_2O (kg/TJ)		Source
		EF	type	EF	type	EF	type	2006 IPCC Guidelines Vol. 2, Chap. 2 (2.3.2.1)
Gas/Diesel Oil	liquid	74 100	D	3	D	0.6	D	**Table 2.3** Default emission factors for stationary combustion in manufacturing industries and construction (page 2.18)
Residual Fuel Oil / Total fuel oil	liquid	77 400	D	3	D	0.6	D	
Lignite	solid	101 000	D	10	D	1.5	D	
LPG	gaseous	63 100	D	1	D	0.1	D	
Natural gas	gaseous	56 100	D	1	D	0.1	D	
Wood pellets	biomass	112 000	D	30	D	4	D	
Note:								
D Default		CS Country specific		PS Plant specific		IEF Implied emission factor		

3.2.5.11.3 Uncertainties and time-series consistency

The uncertainties for activity data and emission factors used for CRT category 1.A.2.k Construction are presented in the following table.

Table 3-125 Uncertainty for CRT category 1.A.2.k Construction.

Uncertainty	Liquid fuels			Reference
	CO_2	CH_4	N_2O	2006 IPCC GL, Vol. 2, Chap. 2 (2.4.2)
Activity data (AD)	2%	2%	2%	Table 2.15 and Table 3.1
Emission factor (EF)	2%			Table 2.13
		100%		Table 2.12
			20%	Table 2.14
Combined Uncertainty (U)	2%	100%	20%	$U_{total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

The time-series are considered to be consistent as the same methodology is applied to the whole period. Activity data are considered to be consistent as national and international data were always compared.

3.2.5.11.4 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed out:

⇒ Checked of calculations by spreadsheets
  - consistent use of energy balance data (energy statistic questionnaires),
  - documented sources,
  - use of units,
  - strictly defined interfaces between spreadsheets/calculation modules,
  - unique structure of sheets which do the same,
  - record keeping, use of write protection,
  - unique use of formulas, special cases are documented/highlighted,
  - quick-control checks for data consistency through all steps of calculation.

⇒ cross-checked from different sources:
  - National statistic published by INSTAT and

- Energy statistics of UN statistics[92] and data published by International Energy Agency (IEA)[93]

⇒ time series consistency - plausibility checks of dips and jumps.

3.2.5.11.5 Category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category 1.A.2.k *Construction*.

Table 3-126 Recalculations done in sub-category 1.A.2.k Construction

source category	Revisions of data	Type of revision	Type of improvement
1.A.2.j	Revision of NCV	AD	Accuracy

3.2.5.11.6 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 3-127 Planned improvements for CRT category 1.A.2.k Construction

source category	Planned improvement	Type of improvement		Priority
1.A.2.k	Carbon content (%) of lignite, gas/diesel oil, residual fuel oil, etc. for preparing country specific emission factor (CS EF) ⇒ **CS EF$_{CO2}$** [t/TJ] = (C [%] • 44 • Ox)/(NCV [TJ/t] • 12• 100)	EF	Accuracy Transparency	Medium
1.A.2.k	Information about fitted/non-fitted equipment for flue gas cleaning, improvement in combustion	EF	Accuracy Transparency	Medium
1.A.2.k	Improvement of time series consistency and split of fuels: the energy statistics is still under development; a split of the fuel combustion for this subcategory has to be reviewed for the entire time series. Emissions are allocated in IPCC/NFR subcategory 1.A.2.m Other.	AD	Accuracy Transparency	High
1.A.2.k	Cross-check of national and international data sources (Eurostat and UNSD)	AD	Consistency Transparency	Medium

3.2.5.12 Textile and Leather (CRT category 1.A.2.l)

The CRT category 1.A.2.l *Textile and Leather* includes GHG emissions resulting from fuel combustion activities in

[92] United Nations - Department of Economic and Social Affairs - Statistics Division Statistics - Energy Statistics https://unstats.un.org/unsd/energystats/

[93] Data and statistics - Data tools - Data tables Energy data by category, indicator, country or region https://www.iea.org/data-and-statistics/data-browser?country=WORLD&fuel=Energy%20supply&indicator=TESbySource

Activities	Occurring in Albania
▪ ISIC Division 13 Manufacture of textiles	✓
○ Spinning, weaving and finishing of textiles	
○ Manufacture of other textiles	
▪ Manufacture of knitted and crocheted fabrics, made-up textile articles (except apparel)	
▪ Manufacture of carpets and rugs, cordage, rope, twine and netting	
▪ Manufacture of other textiles n.e.c.	
▪ ISIC Division 14 Manufacture of wearing apparel	✓
○ Manufacture of wearing apparel, except fur apparel	
○ Manufacture of articles of fur	
○ Manufacture of knitted and crocheted apparel	
▪ ISIC Division 15 Manufacture of leather and related products	✓
○ Tanning and dressing of leather; manufacture of luggage, handbags, saddlery and harness; dressing and dyeing of fur	
○ Manufacture of footwear	

3.2.5.12.1 Source category description

GHG emissions/ removals	CO_2						CH_4						N_2O					
Estimated	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass
1.A.2.l	√*	√*	NO	NO	NO	NO	√*	√*	NO	NO	NO	NO	√*	√*	NO	NO	NO	NO
Key category	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

A '✓' indicates: emissions from this sub-category have been estimated.
Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential

LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF

* data provided not for all years; for those years IE

Use of notation key

IE	1.A.2.l (liquid, solid)	The energy statistics is still under development; a split of the fuel combustion for this subcategory has to be reviewed for the entire timeseries. Emissions are currently allocated in CRT category 1.A.2.m *Other*.

An overview of the emissions from fuel combustion in CRT category *1.A.2.j Wood and wood products* is provided in the following figures and tables:

- annual emissions of GHGs;
- Trend of the periods 1990 – 2022, 2005 – 2022, 2021 – 2022.

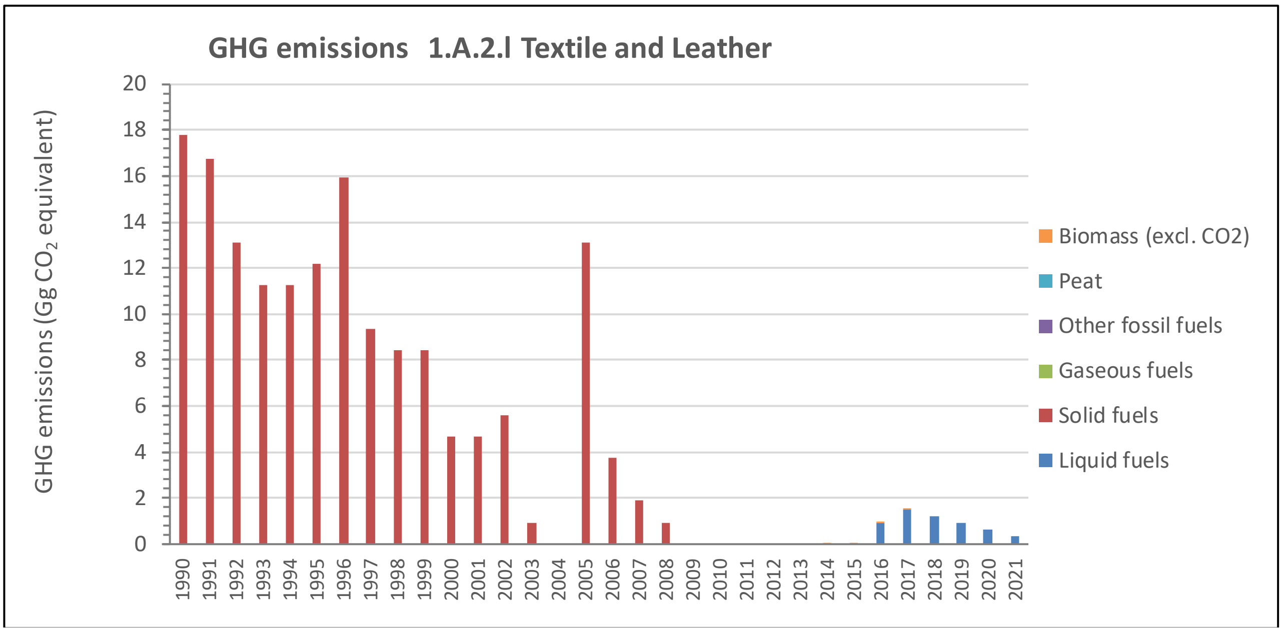


Figure 3-56 GHG emissions from sub-category 1.A.2.l Textile and Leather

Table 3-128 Emissions from CRT category 1.A.2.l Textile and Leather

GHG emissions	TOTAL GHG	CO_2 (excluding biomass)	N_2O (including biomass)	CH_4 (including biomass)	CO_2 (biomass)
	kt CO2 equivalent	**kt**	**kt CO2 equivalent**	**kt CO2 equivalent**	**kt**
1990	17.80	17.67	0.078	0.0437	NO
1991	16.73	16.61	0.074	0.0411	NO
1992	13.11	13.02	0.058	0.0322	NO
1993	11.24	11.16	0.049	0.0276	NO
1994	11.24	11.16	0.049	0.0276	NO
1995	12.18	12.09	0.054	0.0299	NO
1996	15.92	15.81	0.070	0.0391	NO
1997	9.37	9.30	0.041	0.0230	NO
1998	8.43	8.37	0.037	0.0207	NO
1999	8.43	8.37	0.037	0.0207	NO
2000	4.68	4.65	0.021	0.0115	NO
2001	4.68	4.65	0.021	0.0115	NO
2002	5.62	5.58	0.025	0.0138	NO
2003	0.94	0.93	0.004	0.0023	NO
2004	IE	IE	IE	IE	NO
2005	13.11	13.02	0.058	0.0322	NO
2006	3.75	3.72	0.016	0.0092	NO
2007	1.87	1.86	0.008	0.0046	NO
2008	0.94	0.93	0.004	0.0023	NO
2009	IE	IE	IE	IE	NO
2010	IE	IE	IE	IE	NO
2011	IE	IE	IE	IE	NO
2012	IE	IE	IE	IE	NO
2013	IE	IE	IE	IE	NO
2014	0.00	IE	IE	0.0000	0.0003
2015	0.00	IE	IE	0.0000	0.0003
2016	0.89	0.89	0.002	0.0010	0.0006
2017	1.51	1.51	0.004	0.0016	0.0005
2018	1.21	1.20	0.003	0.0013	NO
2019	0.91	0.91	0.002	0.0009	NO
2020	0.60	0.60	0.002	0.0006	NO
2021	0.31	0.31	0.001	0.0003	NO
2022					
Trend					
1990 – 2022	*-96.6%*	*-96.6%*	*-98.1%*	*-98.6%*	*NA*
2005 - 2022	*-95.4%*	*-95.4%*	*-97.4%*	*-98.0%*	*NA*
2021 - 2022	*-33.7%*	*-33.7%*	*-32.9%*	*-32.9%*	*NA*

3.2.5.12.2 Methodological issues

3.2.5.12.2.1 Choice of methods

For estimating the GHG emissions (CO_2, CH_4, N_2O) the 2006 IPCC Guidelines Tier 1 approach[94] has been applied:

Equation 2.1: GHG emissions from stationary combustion (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Emissions_{GHG,\,fuel}[kt] = Fuel\ Consumption_{fuel}[TJ] \times Emission\ Factor_{GHG,\,fuel}\left[\frac{\mathrm{kg}}{\mathrm{TJ}}\right] * 10^{-6}}$$

Equation 2.2: Total emissions by greenhouse gas (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Emissions_{GHG}[kt_{CO2\ equivalent}] = \sum_{fuel} emissions_{\mathrm{CO2,\,fuel}}\ [kt] + \sum_{fuel} emissions_{\mathrm{CH4,\,fuel}}[kt] \times GWP_{CH4} + \sum_{fuel} emissions_{\mathrm{N2O,\,fuel}}[kt] \times GWP_{N2O}}$$

Where:

Emissions $_{GHG}$	= emissions of GHG (kt $_{CO2\ equivalent}$)
Emissions $_{GHG,\ fuel}$	= emissions of a given GHG by type of fuel (kt GHG)
Fuel consumption $_{fuel}$	= amount of fuel combusted (TJ)
Emission factor $_{GHG,\ fuel}$	= default emission factor of a given GHG by type of fuel (kg gas/TJ) For CO_2, it includes the carbon oxidation factor, assumed to be 1.
10^{-6}	= conversion from kg to kt (≡ divided by 1.000.000)
GHG	= CO_2, CH_4, N_2O
GWP	= Global warming potential for CO_2, CH_4, N_2O according to the IPCC 5AR
Fuel	= liquid fuels, solid fuels, gaseous fuels, other fossil fuel, biomass, peat

The method applied is not in line with the decision tree, as the category 1.A.2.a *Main Activity Iron and Steel* is a key category. See here the chapter planned improvements.

3.2.5.12.2.2 Choice of activity data

Fuel consumption used for estimating the GHG and non-GHG emissions for the years 1990 - 2022 were taken from Statistical Office of Albania (INSTAT).

[94] Source: 2006 IPCC Guidelines, Volume 2: Energy, Chapter 2: Stationary Combustion - 2.3.1 Methodological issues - Choice of method

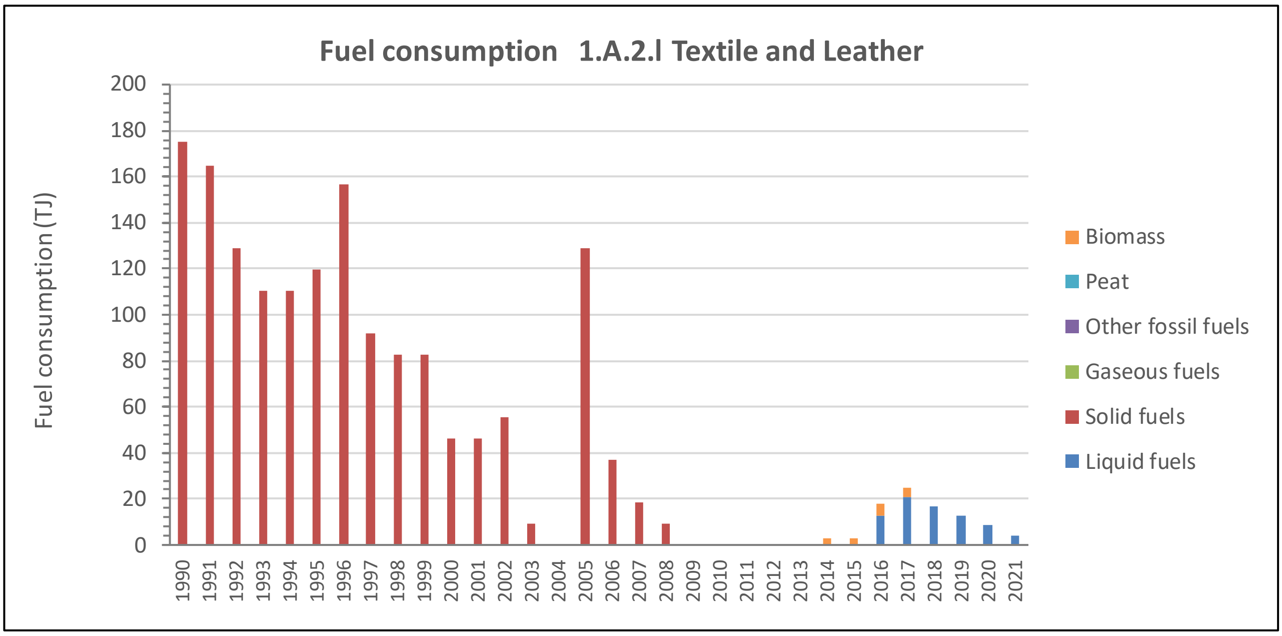


Figure 3-57 Activity data for sub-category 1.A.2.l Textile and Leather

Use of notation key

IE 1.A.2.l (liquid, solid) The energy statistics is still under development; a split of the fuel combustion for this subcategory has to be reviewed for the entire timeseries. Emissions are currently allocated in CRT category 1.A.2.m *Other*.

Table 3-129 Activity data for sub-category 1.A.2.l Textile and Leather

Activity data 1.A.2.l	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
1990							
1991							
1992							
1993							
1994							
1995							
1996							
1997							
1998							
1999							
2000							
2001							
2002							
2003							
2004							
2005							

Activity data 1.A.2.l	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
2006							
2007							
2008							
2009							
2010							
2011							
2012							
2013							
2014							
2015							
2016							
2017							
2018							
2019							
2020							
2021							
2022							
Trend							
1990 - 2022							
2005 - 2022							
2021 - 2022							

In energy statistics, production, transformation and consumption of solid, liquid, gaseous and renewable fuels are specified in physical units, e.g. in tonnes or cubic meters. To convert these data to energy units, in this case terajoules, requires calorific values. The emission calculations are bases on net calorific values. In the following table the applied net calorific values (NCVs) for conversion to energy units in sub-category 1.A.2.l Textile and Leather.

Table 3-130 Net calorific values (NCVs) applied for conversion to energy units in sub-category 1.A.2.l Textile and Leather

Fuel	Fuel type	Net calorific value (NCV) (TJ/Gg) or *(TJ/m3)		Source
		NCV	type	
Gas/Diesel Oil	liquid	42.71	CS	Statistical Office of Albania (INSTAT)
Residual fuel oil	liquid	41.20	CS	
Liquefied Petroleum Gases (LPG)	liquid	46.89	CS	
Petroleum Coke	liquid	40.19	CS	
Sub-Bituminous Coal	solid	16.75	CS	
Lignite	solid	9.21	CS	
Charcoal	biomass	29.30	CS	
Wood / Fuelwood	biomass	9.18*	CS	
Wood pellets	biomass	16.85	CS	
Note:				

Fuel	Fuel type	Net calorific value (NCV) (TJ/Gg) or *(TJ/m3)		Source
		NCV	type	
D Default	CS Country specific	PS	Plant specific	

3.2.5.12.2.3 Choice of emission factors

Default emission factors for greenhouse gases were taken from IPCC 2006 Guidelines and are presented in the following table.

Table 3-131 GHG Emission factor TIER 1 for CRT category 1.A.2.l Textile and Leather

Fuel	Fuel type	CO_2 (kg/TJ)		CH_4 (kg/TJ)		N_2O (kg/TJ)		Source
		EF	type	EF	type	EF	type	2006 IPCC Guidelines Vol. 2, Chap. 2 (2.3.2.1)
Gas/Diesel Oil	liquid	74 100	D	3	D	0.6	D	**Table 2.3** Default emission factors for stationary combustion in manufacturing industries and construction (page 2.18)
Residual Fuel Oil / Total fuel oil	liquid	77 400	D	3	D	0.6	D	
Lignite	solid	101 000	D	10	D	1.5	D	
LPG	gaseous	63 100	D	1	D	0.1	D	
Natural gas	gaseous	56 100	D	1	D	0.1	D	
Wood pellets	biomass	112 000	D	30	D	4	D	
Note:								
D Default	CS Country specific		PS Plant specific			IEF Implied emission factor		

3.2.5.12.3 Uncertainties and time-series consistency

The uncertainties for activity data and emission factors used for CRT category 1.A.2.l Textile and Leather are presented in the following table.

Table 3-132 Uncertainty for CRT category 1.A.2.l Textile and Leather.

Uncertainty	Liquid fuels			Reference
	CO_2	CH_4	N_2O	2006 IPCC GL, Vol. 2, Chap. 2 (2.4.2)
Activity data (AD)	2%	2%	2%	Table 2.15 and Table 3.1
Emission factor (EF)	2%			Table 2.13
		100%		Table 2.12
			20%	Table 2.14
Combined Uncertainty (U)	2%	100%	20%	$U_{total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

The time-series are considered to be consistent as the same methodology is applied to the whole period. Activity data are considered to be consistent as national and international data were always compared.

3.2.5.12.4 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed out:

⇒ Checked of calculations by spreadsheets
- consistent use of energy balance data (energy statistic questionnaires),
- documented sources,

  - o use of units,
  - o strictly defined interfaces between spreadsheets/calculation modules,
  - o unique structure of sheets which do the same,
  - o record keeping, use of write protection,
  - o unique use of formulas, special cases are documented/highlighted,
  - o quick-control checks for data consistency through all steps of calculation.

⇒ cross-checked from different sources:

- National statistic published by INSTAT and
- Energy statistics of UN statistics[95] and data published by International Energy Agency (IEA)[96]

⇒ time series consistency - plausibility checks of dips and jumps.

3.2.5.12.5 Category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category 1.A.2.l *Textile and Leather*.

Table 3-133 Recalculations done in sub-category 1.A.2.l Textile and Leather

source category	Revisions of data	Type of revision	Type of improvement
1.A.2.l	Revision of NCV	AD	Consistency

3.2.5.12.6 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 3-134 Planned improvements for CRT category 1.A.2.l Textile and Leather

source category	Planned improvement	Type of improvement		Priority
1.A.2.l	Carbon content (%) of lignite, gas/diesel oil, residual fuel oil, etc. for preparing country specific emission factor (CS EF) ⇒ **CS EF$_{CO2}$** [t/TJ] = (C [%] • 44 • Ox)/(NCV [TJ/t] • 12• 100)	EF	Accuracy Transparency	Medium
1.A.2.l	Information about fitted/non-fitted equipment for flue gas cleaning, improvement in combustion	EF	Accuracy Transparency	Medium
1.A.2.l	Improvement of time series consistency and split of fuels: the energy statistics is still under development; a split of the fuel combustion for this subcategory has to be reviewed for	AD	Accuracy Transparency	High

[95] United Nations - Department of Economic and Social Affairs - Statistics Division Statistics - Energy Statistics https://unstats.un.org/unsd/energystats/

[96] Data and statistics - Data tools - Data tables Energy data by category, indicator, country or region https://www.iea.org/data-and-statistics/data-browser?country=WORLD&fuel=Energy%20supply&indicator=TESbySource

source category	Planned improvement	Type of improvement		Priority
	the entire time series. Emissions are allocated in IPCC/NFR subcategory 1.A.2.m Other.			
1.A.2.l	Cross-check of national and international data sources (Eurostat and UNSD)	AD	Consistency Transparency	Medium

3.2.5.13 Other (CRT category 1.A.2.m)

3.2.5.13.1 Source category description

GHG emissions/ removals	CO_2						CH_4						N_2O					
Estimated	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass
1.A.2.m	✓	✓	NO	NO	NO	✓	✓	✓	NO	NO	NO	✓	✓	✓	NO	NO	NO	✓
Key catergory																		

A '✓' indicates: emissions from this sub-category have been estimated.
Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential

LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF

* data provided not for all years; for those years IE

The CRT category 1.A.2.m *Other (not-specified industry)* includes GHG emissions resulting from fuel combustion activities in any manufacturing industry/construction not included in 1.A.2.a - 1.A.2.l when the energy balance was not disaggregated.

An overview of the emissions from fuel combustion in CRT category 1.A.2.m *Other* is provided in the following figures and tables:

- annual emissions of GHGs;
- Trend of the periods 1990 – 2022, 2005 – 2022, 2021 – 2022.

The main fuels used in 1.A.2.m were

- liquid fuels, such as gas/diesel oil and fuel oil,
- solid fuels, here lignite which come from the Pljevija basin,
- biomass.

Until 2004, GHG emissions decreased due to political situation in the region. The significant drop in GHG emissions in the period 2010-2012 were due to the global economic crisis.

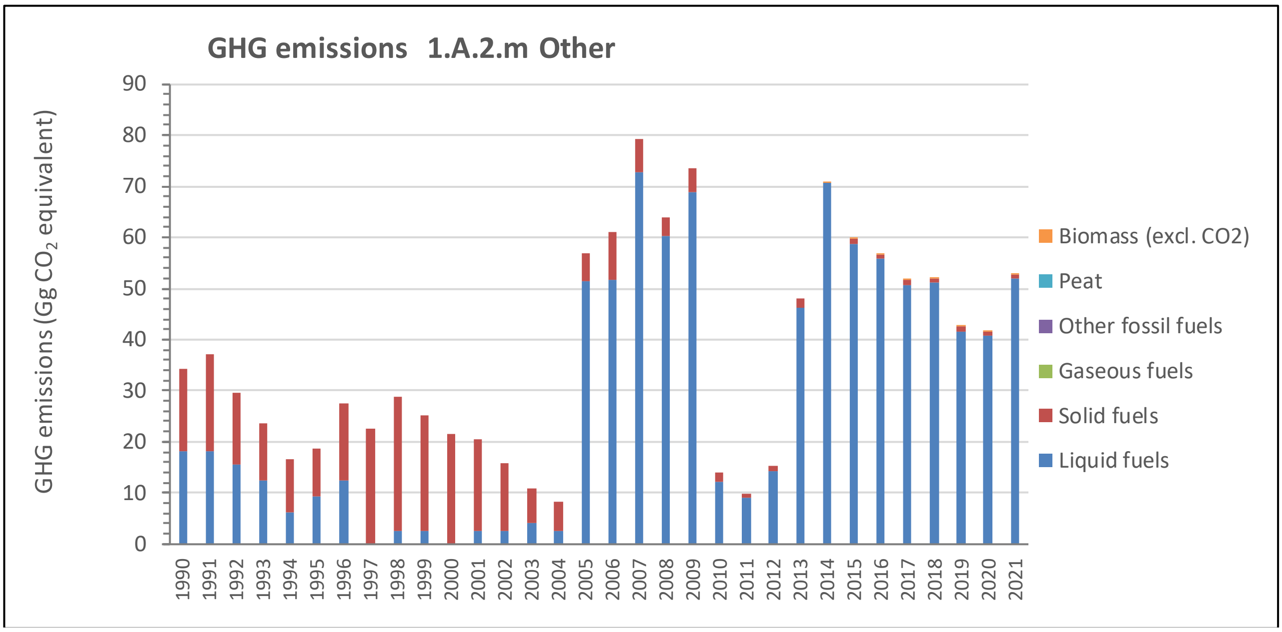


Figure 3-58 Emissions from CRT category 1.A.2.m Other

Table 3-135 Emissions from CRT category 1.A.2.m Other

GHG emissions	TOTAL GHG	CO_2 (excluding biomass)	N_2O (including biomass)	CH_4 (including biomass)	CO_2 (biomass)
	kt CO2 equivalent	kt CO2 equivalent	kt CO2 equivalent	kt CO2 equivalent	kt CO2 equivalent
1990					
1991					
1992					
1993					
1994					
1995					
1996					
1997					
1998					
1999					
2000					
2001					
2002					
2003					
2004					
2005					
2006					
2007					
2008					
2009					
2010					
2011					
2012					
2013					
2014					
2015					
2016					
2017					
2018					
2019					
2020					
2021					
2022					
Trend					
1990 – 2022					
2005 - 20221					
2021 - 2022					

3.2.5.13.2 Methodological issues

3.2.5.13.2.1 Choice of methods

For estimating the GHG emissions (CO_2, CH_4, N_2O) the 2006 IPCC Guidelines Tier 1 approach[97] has been applied:

Equation 2.1: GHG emissions from stationary combustion (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Emissions_{GHG,\,fuel}[kt] = Fuel\ Consumption_{fuel}[TJ] \times Emission\ Factor_{GHG,\,fuel}\left[\frac{\mathrm{kg}}{\mathrm{TJ}}\right] * 10^{-6}}$$

Equation 2.2: Total emissions by greenhouse gas (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Emissions_{GHG}[kt_{CO2\ equivalent}] = \sum_{fuel} emissions_{\mathrm{CO2,\,fuel}}\,[kt] + \sum_{fuel} emissions_{\mathrm{CH4,\,fuel}}[kt] \times GWP_{CH4} + \sum_{fuel} emissions_{\mathrm{N2O,\,fuel}}[kt] \times GWP_{N2O}}$$

Where:

Emissions $_{GHG}$	= emissions of GHG (kt $_{CO2\ equivalent}$)
Emissions $_{GHG,\ fuel}$	= emissions of a given GHG by type of fuel (kt GHG)
Fuel consumption $_{fuel}$	= amount of fuel combusted (TJ)
Emission factor $_{GHG,\ fuel}$	= default emission factor of a given GHG by type of fuel (kg gas/TJ) For CO_2, it includes the carbon oxidation factor, assumed to be 1.
10^{-6}	= conversion from kg to kt (≡ divided by 1.000.000)
GHG	= CO_2, CH_4, N_2O
GWP	= Global warming potential for CO_2, CH_4, N_2O according to the IPCC 5AR
Fuel	= liquid fuels, solid fuels, gaseous fuels, other fossil fuel, biomass, peat

The method applied is not in line with the decision tree, as the category 1.A.2.a *Main Activity Iron and Steel* is a key category. See here the chapter planned improvements.

3.2.5.13.2.2 Choice of activity data

Fuel consumption used for estimating the GHG and non-GHG emissions for the years 1990 - 2022 were taken from Statistical Office of Albania (INSTAT).

[97] Source: 2006 IPCC Guidelines, Volume 2: Energy, Chapter 2: Stationary Combustion - 2.3.1 Methodological issues - Choice of method

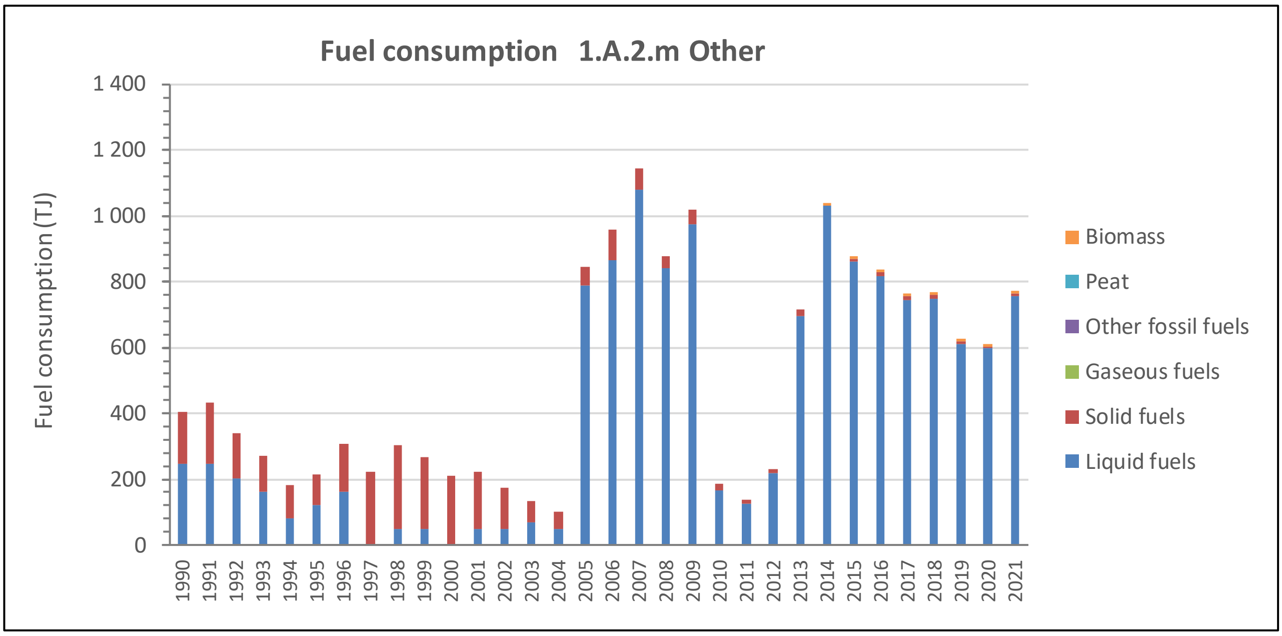


Figure 3-59 Activity data for CRT category 1.A.2.m Other

Table 3-136 Activity data for CRT category 1.A.2.m Other

Activity data 1.A.2.m	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
1990							
1991							
1992							
1993							
1994							
1995							
1996							
1997							
1998							
1999							
2000							
2001							
2002							
2003							
2004							
2005							
2006							
2007							
2008							
2009							
2010							
2011							
2012							

Activity data 1.A.2.m	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
2013							
2014							
2015							
2016							
2017							
2018							
2019							
2020							
2021							
2022							
Trend							
1990 - 2022							
2005 - 2022							
2021 - 2022							

In energy statistics, production, transformation and consumption of solid, liquid, gaseous and renewable fuels are specified in physical units, e.g. in tonnes or cubic meters. To convert these data to energy units, in this case terajoules, requires calorific values. The emission calculations are bases on net calorific values. In the following table the applied net calorific values (NCVs) for conversion to energy units in sub-category 1.A.2.m *Other*.

Table 3-137 Net calorific values (NCVs) applied for conversion to energy units in category 1.A.2.m Other

Fuel	Fuel type	Net calorific value (NCV) (TJ/Gg) or *(TJ/m3)		Source
		NCV	type	
Gas/Diesel Oil	liquid	42.71	CS	Statistical Office of Albania (INSTAT)
Residual fuel oil	liquid	41.20	CS	
Liquefied Petroleum Gases (LPG)	liquid	46.89	CS	
Petroleum Coke	liquid	40.19	CS	
Sub-Bituminous Coal	solid	16.75	CS	
Lignite	solid	9.21	CS	
Charcoal	biomass	29.30	CS	
Wood / Fuelwood	biomass	9.18*	CS	
Wood pellets	biomass	16.85	CS	

Note:
D Default CS Country specific PS Plant specific

3.2.5.13.2.3 Choice of emission factors

Default emission factors for greenhouse gases were taken from IPCC 2006 Guidelines and are presented in the following table.

Table 3-138 GHG Emission factor TIER 1 for CRT category 1.A.2.m Other

Fuel	Fuel type	CO_2 (kg/TJ)		CH_4 (kg/TJ)		N_2O (kg/TJ)		Source
		EF	type	EF	type	EF	type	2006 IPCC Guidelines Vol. 2, Chap. 2 (2.3.2.1)
Gas/Diesel Oil	liquid	74 100	D	3	D	0.6	D	**Table 2.3** Default emission factors for stationary combustion in manufacturing industries and construction (page 2.18)
Residual Fuel Oil / Total fuel oil	liquid	77 400	D	3	D	0.6	D	
Lignite	solid	101 000	D	10	D	1.5	D	
LPG	gaseous	63 100	D	1	D	0.1	D	
Natural gas	gaseous	56 100	D	1	D	0.1	D	
Wood pellets	biomass	112 000	D	30	D	4	D	

Note:
D Default CS Country specific PS Plant specific IEF Implied emission factor

3.2.5.13.3 Uncertainties and time-series consistency

The uncertainties for activity data and emission factors used for CRT category 1.A.2.m *Other* are presented in the following table.

Table 3-139 Uncertainty for CRT category 1.A.2.m Other.

Uncertainty	Liquid fuels			Reference
	CO_2	CH_4	N_2O	2006 IPCC GL, Vol. 2, Chap. 2 (2.4.2)
Activity data (AD)	2%	2%	2%	Table 2.15 and Table 3.1
Emission factor (EF)	2%			Table 2.13
		100%		Table 2.12
			20%	Table 2.14
Combined Uncertainty (U)	2%	100%	20%	$U_{total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

The time-series are considered to be consistent as the same methodology is applied to the whole period. Activity data are considered to be consistent as national and international data were always compared.

3.2.5.13.4 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed out:

⇒ Checked of calculations by spreadsheets
- consistent use of energy balance data (energy statistic questionnaires),
- documented sources,
- use of units,
- strictly defined interfaces between spreadsheets/calculation modules,
- unique structure of sheets which do the same,

   - record keeping, use of write protection,
   - unique use of formulas, special cases are documented/highlighted,
   - quick-control checks for data consistency through all steps of calculation.

⇒ cross-checked from different sources:
- National statistic published by INSTAT and
- Energy statistics of UN statistics[98] and data published by International Energy Agency (IEA)[99]

⇒ time series consistency - plausibility checks of dips and jumps.

3.2.5.13.5 Category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category 1.A.2.m *Other*.

Table 3-140 Recalculations done in sub-category 1.A.2.m Other

source category	Revisions of data	Type of revision	Type of improvement
1.A.2.m	Revision of NCV	AD	Accuracy

3.2.5.13.6 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 3-141 Planned improvements for CRT category 1.A.2.m *Other*

source category	Planned improvement	Type of improvement		Priority
1.A.2.m	Carbon content (%) of lignite, gas/diesel oil, residual fuel oil, etc. for preparing country specific emission factor (CS EF) ⇒ **CS EF$_{CO2}$** [t/TJ] = (C [%] • 44 • Ox)/(NCV [TJ/t] • 12• 100)	EF	Accuracy Transparency	Medium
1.A.2.m	Information about fitted/non-fitted equipment for flue gas cleaning, improvement in combustion	EF	Accuracy Transparency	Medium
1.A.2.m	Improvement of time series consistency and split of fuels: the energy statistics is still under development; a split of the fuel combustion for this subcategory has to be reviewed for the entire time series. Emissions are allocated in IPCC/NFR subcategory 1.A.2.m Other from IPCC/NFR subcategory 1.A.2.a - 1.A.2.l.	AD	Accuracy Transparency	High

[98] United Nations - Department of Economic and Social Affairs - Statistics Division Statistics - Energy Statistics https://unstats.un.org/unsd/energystats/

[99] Data and statistics - Data tools - Data tables Energy data by category, indicator, country or region https://www.iea.org/data-and-statistics/data-browser?country=WORLD&fuel=Energy%20supply&indicator=TESbySource

source category	Planned improvement	Type of improvement		Priority
1.A.2.m	Cross-check of national and international data sources (Eurostat and UNSD)	AD	Consistency Transparency	Medium

3.2.6 Transport (CRT category 1.A.3)

This section describes GHG emissions resulting from fuel combustion in transport sector, which originate from the following subcategories.

IPCC code	Description	Occurrent			Not occurrent (NO)
		Estimated	Not estimated (NE)	Included elsewhere (IE)	
1.A.3.a.i	Domestic Aviation (Civil)	✓			
1.A.3.b	Road Transportation				
1.A.3.b.i	Cars	✓			
1.A.3.b.ii	Light-duty trucks	✓			
1.A.3.b.iii	Heavy-duty trucks and buses	✓			
1.A.3.b.iv	Motorcycles	✓			
1.A.3.b.v	Evaporative emissions from vehicles		✓		
1.A.3.b.vi	Urea-based catalysts		✓		
1.A.3.c	Railways	✓			
1.A.3.d	Domestic Water-borne Navigation	✓			
1.A.3.e	Other Transportation				
1.A.3.e.i	Pipeline transport				✓
1.A.3.e.ii	Other				✓

3.2.7 Other Sectors (CRT category 1.A.4)

Category 1.A.4 *Other sectors* comprise emissions from stationary fuel combustion in the small combustion sector including combustion for the generation of electricity and heat for own use in these sectors. It also includes emissions from mobile sources in households and gardening as well as from agriculture and forestry.

CRT category Code	CRT category description
1.A.4	Other Sectors
1.A.4.a	Commercial/Institutional
1.A.4.a.i	Stationary combustion
1.A.4.a.ii	Off-road vehicles and other machinery
1.A.4.b	Residential
1.A.4.b.i	Stationary combustion
1.A.4.b.ii	Off-road vehicles and other machinery
1.A.4.c	Agriculture/Forestry/Fishing/Fish Farms
1.A.4.c.i	Stationary
1.A.4.c.ii	Off-road vehicles and other machinery
1.A.4.c.iii	Fishing

GHG emissions/ removals	CO_2						CH_4						N_2O					
Estimated	Liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass
1.A.4.a																		
1.A.4.a.i	✓	✓	✓	NO	NO	✓	✓	✓	NO	NO	NO	✓	✓	✓	NO	NO	NO	✓
1.A.4.a.ii	IE	IE	NO	NO	NO	NO	IE	IE	NO	NO	NO	NO	IE	IE	NO	NO	NO	NO
1.A.4.b																		
1.A.4.b.i	✓	✓	✓	NO	NO	✓	✓	✓	NO	NO	NO	✓	✓	✓	NO	NO	NO	✓
1.A.4.b.ii	IE	IE	NO	NO	NO	NO	IE	IE	NO	NO	NO	NO	IE	IE	NO	NO	NO	NO
1.A.4.c																		
1.A.4.c.i	IE	NO	NO	NO	NO	✓	IE	NO	NO	NO	NO	NO	IE	NO	NO	NO	NO	✓
1.A.4.c.ii	✓	NO	NO	NO	NO	NO	✓	NO	NO	NO	NO	NO	✓	NO	NO	NO	NO	NO
1.A.4.c.iii	IE	NO	NO	NO	NO	NO	IE	NO	NO	NO	NO	NO	IE	NO	NO	NO	NO	NO

A '✓' indicates: emissions from this sub-category have been estimated.
Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential

An overview of the emissions from fuel combustion in CRT category 1.A.4 *Other Sectors* is provided in the following figures and tables:

- annual GHG, CO2, CH4 and N2O emissions
- Trend of the periods 1990 – 2022, 2005 – 2022, 2021 – 2022
- by sub-category.

The main fuels used in CRT category 1.A.4 *Other sectors* were biomass and liquid fuels. In the 1990th also Natural gas and lignite was used.
Fluctuation of emissions are due to please check reasons and provide more reasons

- overall economic downturn in the country in the beginning of 1990;
- use of biomass
- world-wide economic crisis in 2007/2008;
- implementation of legislation related to air quality

- ###.

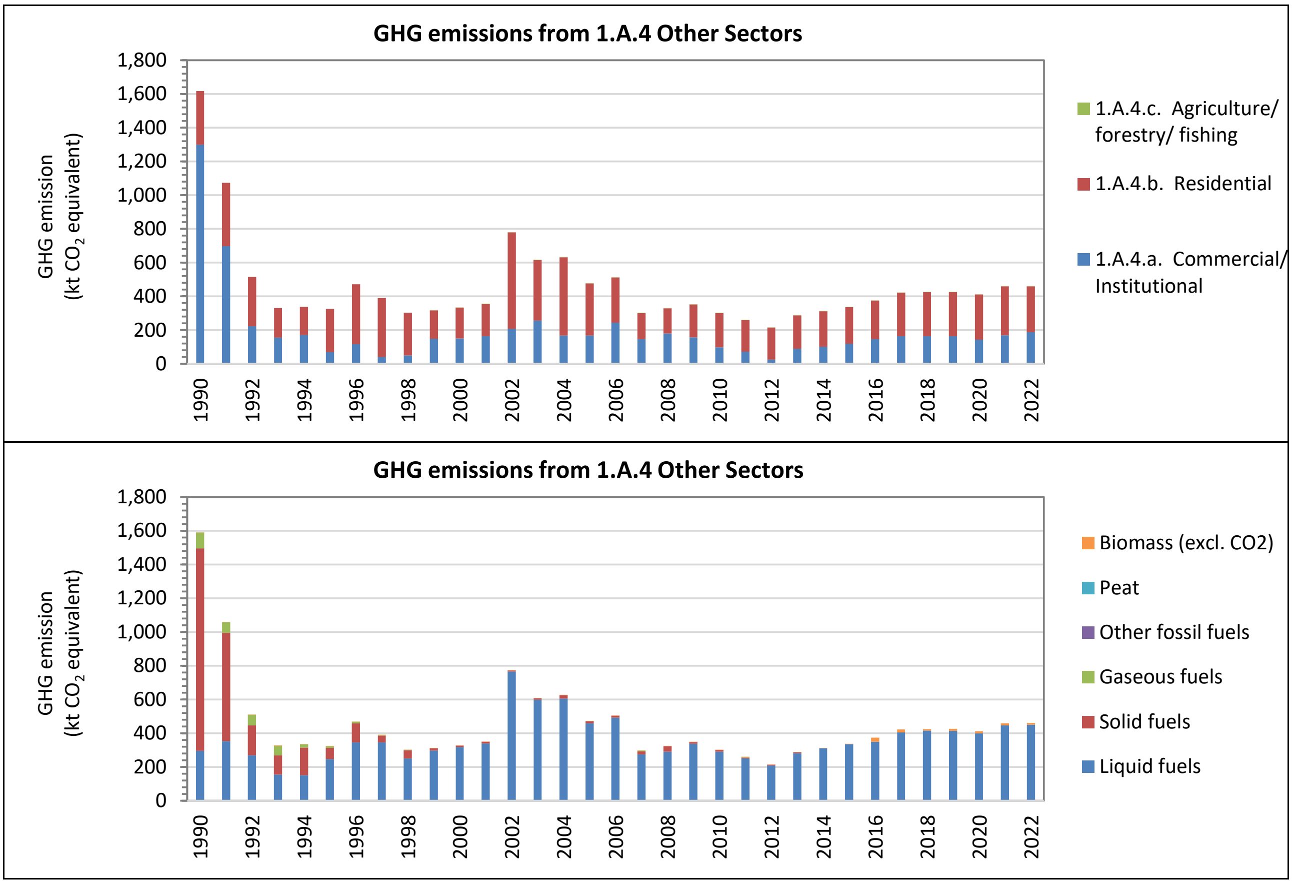


Figure 3-60 GHG Emissions from CRT category 1.A.4 Other Sectors by category and by fuel type

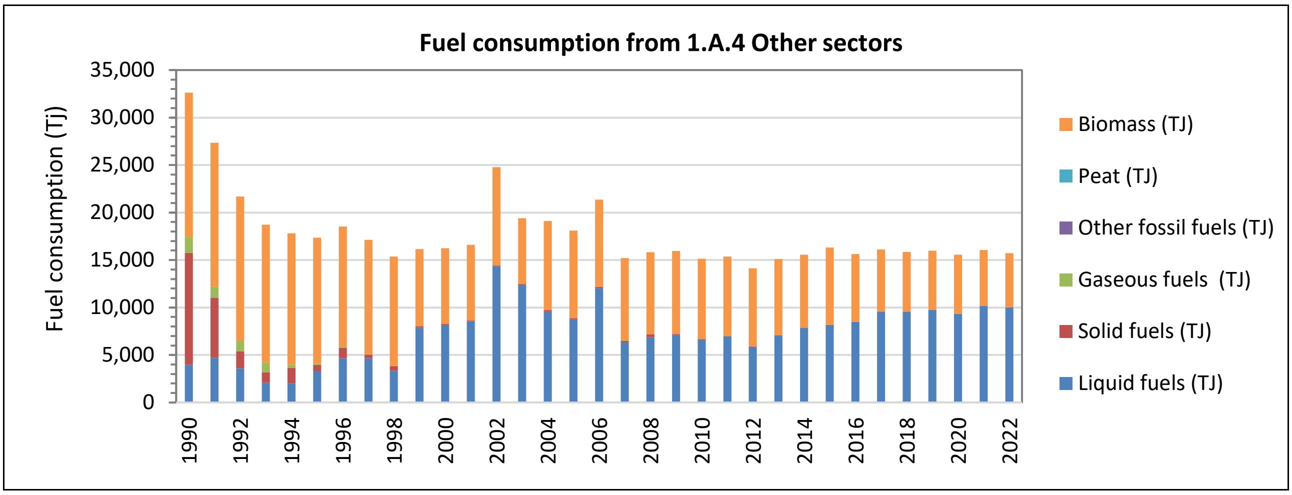


Figure 3-61 Fuel consumption in CRT category 1.A.4 Other Sectors by fuel type

Table 3-142 Emissions from CRT category 1.A.4 Other Sectors

GHG emissions	TOTAL GHG	CO_2 (excluding biomass)	N_2O (including biomass)	CH_4 (including biomass)	CO_2 (biomass) not included in Total
	kt CO2 equivalent	kt	kt	kt	kt
1990	1,590.02	1,579.87	0.020	0.17	1.70
1991	1,058.93	1,052.25	0.012	0.12	1.70
1992	511.22	508.12	0.005	0.06	1.70
1993	327.42	325.44	0.003	0.04	1.62
1994	334.33	332.17	0.004	0.04	1.55
1995	324.28	322.23	0.003	0.04	1.48
1996	468.94	466.00	0.005	0.06	1.41
1997	389.94	387.52	0.003	0.05	1.35
1998	302.26	300.35	0.003	0.04	1.29
1999	312.15	310.40	0.002	0.04	0.79
2000	327.96	326.14	0.002	0.04	0.77
2001	350.80	348.87	0.002	0.05	0.77
2002	773.33	768.94	0.006	0.10	1.10
2003	607.70	604.35	0.004	0.08	0.69
2004	626.12	622.64	0.005	0.08	1.03
2005	472.11	469.54	0.003	0.06	1.02
2006	504.66	502.07	0.003	0.06	1.02
2007	297.91	296.51	0.002	0.03	0.95
2008	324.81	323.30	0.002	0.04	0.94
2009	347.82	346.37	0.001	0.04	0.95
2010	301.63	300.50	0.001	0.03	0.91
2011	260.01	259.15	0.001	0.03	0.87
2012	214.71	213.98	0.000	0.02	0.87
2013	287.02	286.01	0.001	0.03	0.84
2014	312.32	311.25	0.001	0.03	0.80
2015	336.32	335.18	0.001	0.03	0.86
2016	373.91	371.52	0.001	0.08	23.93
2017	422.11	419.91	0.001	0.07	17.23
2018	424.34	422.56	0.001	0.05	8.92
2019	425.35	423.48	0.001	0.06	10.59
2020	411.80	409.89	0.001	0.06	12.23
2021	459.47	457.41	0.001	0.06	12.19
2022	459.96	458.04	0.001	0.06	9.19
Trend					
1990 - 2022	*-71.1%*	*-71.0%*	*-94.7%*	*-65.8%*	*439.9%*
2005 - 2022	*52.5%*	*52.4%*	*11.6%*	*86.4%*	*905.0%*
2021 - 2022	*0.1%*	*0.1%*	*<0.1%*	*-7.8%*	*-24.6%*

3.2.7.1 Commercial/Institutional (CRT category 1.A.4.a)

3.2.7.1.1 Source category description

GHG emissions/ removals	CO_2						CH_4						N_2O					
Estimated	Liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass
1.A.4.a																		
1.A.4.a.i	✓	✓	✓	NO	NO	✓	✓	✓	✓	NO	NO	✓	✓	✓	✓	NO	NO	✓
1.A.4.a.ii	IE	NO	NO	NO	NO	NO	IE	NO	NO	NO	NO	NO	IE	NO	NO	NO	NO	NO
Key category	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

A '✓' indicates: emissions from this sub-category have been estimated.
Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential

LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF

1.A.4.a	Commercial/Institutional
1.A.4.a.i	Stationary combustion
1.A.4.a.ii	Off-road vehicles and other machinery

An overview of the emissions from fuel combustion in CRT category *1.A.4.a Commercial/Institutional* is provided in the following figures and tables:

- annual GHG emissions
- Trend of the periods 1990 – 2022, 2005 – 2022, 2021 – 2022.

Fluctuation of emissions are due to please check reasons and provide more reasons

- overall economic downturn in the country in the beginning of 1990;
- use of biomass
- world-wide economic crisis in 2007/2008;
- implementation of legislation related to air quality
- ###.

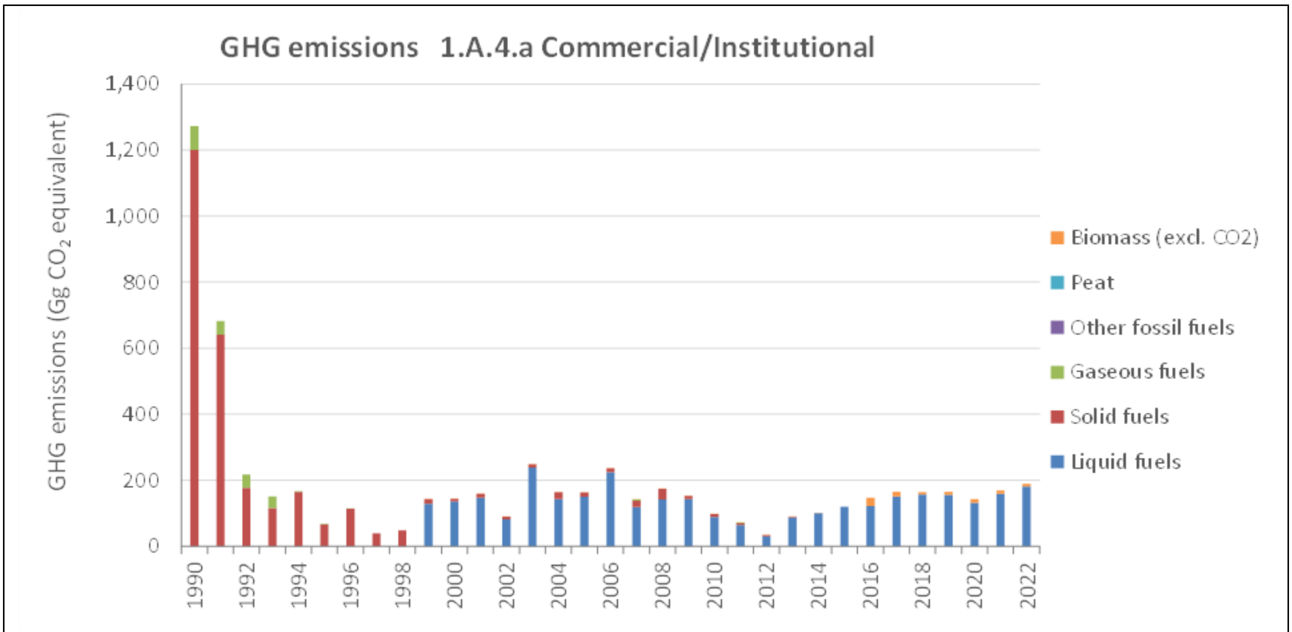


Figure 3-62 Emissions from CRT category 1.A.4.a Commercial/Institutional for the period 1990-2022

Table 3-143 Emissions from CRT category 1.A.4.a Commercial/Institutional for the period 1990-2022

GHG emissions	TOTAL GHG	CO_2 (excluding biomass)	N_2O (including biomass)	CH_4 (including biomass)	CO_2 (biomass)
	kt CO2 equivalent	kt	kt	kt	kt
1990	1,271.88	1,263.67	0.0178	0.124	IE
1991	682.03	677.64	0.0095	0.067	IE
1992	217.66	216.36	0.0027	0.021	IE
1993	151.55	150.68	0.0018	0.015	IE
1994	167.73	166.62	0.0024	0.016	IE
1995	68.03	67.58	0.0010	0.007	IE
1996	114.71	113.95	0.0017	0.011	IE
1997	39.03	38.77	0.0006	0.004	IE
1998	49.04	48.71	0.0007	0.005	IE
1999	143.89	142.80	0.0012	0.019	0.23
2000	144.61	143.52	0.0012	0.019	0.23
2001	158.95	157.79	0.0013	0.021	0.23
2002	89.33	88.75	0.0006	0.011	0.12
2003	248.35	246.69	0.0019	0.033	0.24
2004	163.39	162.42	0.0013	0.020	0.06
2005	162.37	161.60	0.0009	0.018	0.05
2006	236.12	234.71	0.0019	0.031	0.05
2007	141.96	141.12	0.0011	0.017	0.06
2008	174.66	173.56	0.0015	0.022	0.10
2009	153.19	152.32	0.0010	0.018	0.10
2010	98.38	97.89	0.0005	0.010	0.07
2011	72.62	72.31	0.0002	0.007	0.08
2012	34.71	34.44	0.0002	0.004	0.11
2013	89.75	89.30	0.0004	0.009	0.09
2014	101.02	100.59	0.0003	0.010	0.05
2015	119.71	119.17	0.0004	0.012	0.10
2016	146.77	121.82	0.0006	0.054	23.29
2017	164.91	150.36	0.0005	0.038	13.33
2018	163.59	156.02	0.0005	0.027	6.69
2019	164.95	155.26	0.0005	0.031	8.70
2020	142.76	131.76	0.0005	0.031	10.02
2021	169.14	158.08	0.0005	0.033	9.99
2022	188.65	180.31	0.0006	0.031	7.34
Trend					
1990 – 2022	*-85.2%*	*-85.7%*	-96.8%	-75.4%	*NA*
2005 – 2022	*16.2%*	*11.6%*	-34.4%	72.1%	*-3.2%*
2021 - 2022	*11.5%*	*14.1%*	6.9%	-7.8%	*7.8%*

3.2.7.1.2 Methodological issues

3.2.7.1.2.1 Choice of methods

For estimating the GHG emissions (CO_2, CH_4, N_2O) the 2006 IPCC Guidelines Tier 1 approach[100] has been applied:

Equation 2.1: GHG emissions from stationary combustion (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Emissions_{GHG,\,fuel}[kt] = Fuel\ Consumption_{fuel}[TJ] \times Emission\ Factor_{GHG,\,fuel}\left[\frac{\mathrm{kg}}{\mathrm{TJ}}\right] * 10^{-6}}$$

Equation 2.2: Total emissions by greenhouse gas (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Emissions_{GHG}[kt_{CO2\ equivalent}] = \sum_{fuel} emissions_{\mathrm{CO2,\,fuel}}\ [kt] + \sum_{fuel} emissions_{\mathrm{CH4,\,fuel}}[kt] \times GWP_{CH4} + \sum_{fuel} emissions_{\mathrm{N2O,\,fuel}}[kt] \times GWP_{N2O}}$$

Where:

Emissions $_{GHG}$	= emissions of GHG (kt $_{CO2\ equivalent}$)
Emissions $_{GHG,\ fuel}$	= emissions of a given GHG by type of fuel (kt GHG)
Fuel consumption $_{fuel}$	= amount of fuel combusted (TJ)
Emission factor $_{GHG,\ fuel}$	= default emission factor of a given GHG by type of fuel (kg gas/TJ) For CO_2, it includes the carbon oxidation factor, assumed to be 1.
10^{-6}	= conversion from kg to kt (≡ divided by 1.000.000)
GHG	= CO_2, CH_4, N_2O
GWP	= Global warming potential for CO_2, CH_4, N_2O according to the IPCC 5AR
Fuel	= liquid fuels, solid fuels, gaseous fuels, other fossil fuel, biomass, peat

The method applied is not in line with the decision tree, as the category 1.A.4.a *Commercial/Institutional* is a key category. See here the chapter planned improvements.

3.2.7.1.2.2 Choice of activity data

The following fuels are used for electricity production:

Liquid fuels:
- Liquefied Petroleum Gases
- Other kerosene
- Residual fuel oil
- Gas/Diesel Oil (Non-bio gas/diesel oil)
- Motor Gasoline (Non-biogasoline)
- Other Oil - Other Petroleum Products

Solid fuels:
- Lignite

Gaseous fuels
- Natural gas

Biomass
- Wood/ Wood Waste/ Fuelwood
- Charcoal

Fuel consumption used for estimating the GHG emissions for the years 1990 - 2022 were taken from EUROSTAT but were prepared by Albanian Institute of Statistics (INSTAT). The fuel consumption is presented in the following table. Explanation for fluctuations is provided in chapter 'Category description' above.

[100] Source: 2006 IPCC Guidelines, Volume 2: Energy, Chapter 2: Stationary Combustion - 2.3.1 Methodological issues - Choice of method

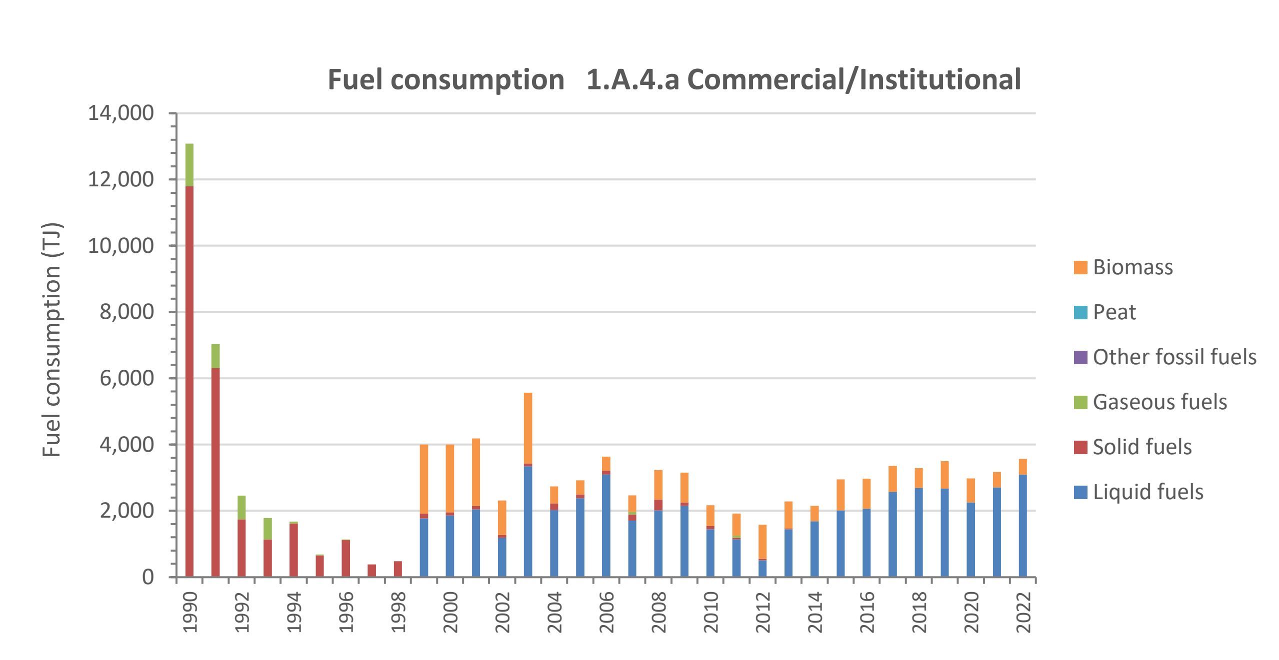


Figure 3-63 Activity data for CRT category 1.A.4.a Commercial/Institutional for the period 1990-2022

Table 3-144 Activity data for CRT category 1.A.4.a Commercial/Institutional for the period 1990-2022

Activity data 1.A.4a	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
1990	13,079.76	IE	11,801.76	1,278.00	NO	NO	IE
1991	7,029.36	IE	6,309.36	720.00	NO	NO	IE
1992	2,462.21	IE	1,742.21	720.00	NO	NO	IE
1993	1,779.95	IE	1,131.95	648.00	NO	NO	IE
1994	1,678.15	IE	1,614.25	63.90	NO	NO	IE
1995	684.74	IE	649.64	35.10	NO	NO	IE
1996	1,141.06	IE	1,112.26	28.80	NO	NO	IE
1997	383.88	IE	383.88	NO	NO	NO	IE
1998	482.31	IE	482.31	NO	NO	NO	IE
1999	4,003.16	1,771.51	147.65	NO	NO	NO	2,084.00
2000	4,003.69	1,863.11	88.59	NO	NO	NO	2,052.00
2001	4,186.09	2,040.82	108.27	NO	NO	NO	2,037.00
2002	2,314.12	1,188.38	78.74	NO	NO	NO	1,047.00
2003	5,568.65	3,345.07	88.59	NO	NO	NO	2,135.00
2004	2,733.30	2,024.59	206.70	NO	NO	NO	502.00
2005	2,916.55	2,379.43	118.12	NO	NO	NO	419.00
2006	3,632.55	3,095.43	118.12	NO	NO	NO	419.00
2007	2,469.60	1,704.98	187.02	75.60	NO	NO	502.00
2008	3,231.39	2,014.58	324.82	NO	NO	NO	892.00
2009	3,155.71	2,153.28	98.43	NO	NO	NO	904.00
2010	2,170.46	1,444.03	98.43	NO	NO	NO	628.00
2011	1,919.48	1,135.46	49.22	64.80	NO	NO	670.00
2012	1,577.06	511.69	39.37	NO	NO	NO	1,026.00

Activity data 1.A.4a	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
2013	2,283.23	1,446.55	19.69	NO	NO	NO	817.00
2014	2,152.10	1,683.10	NO	NO	NO	NO	469.00
2015	2,949.28	2,014.28	NO	NO	NO	NO	935.00
2016	2,971.79	2,061.59	NO	NO	NO	NO	910.20
2017	3,353.26	2,577.12	NO	NO	NO	NO	776.15
2018	3,287.40	2,687.69	NO	NO	NO	NO	599.72
2019	3,496.41	2,674.20	NO	NO	NO	NO	822.21
2020	2,983.67	2,255.27	NO	NO	NO	NO	728.40
2021	3,175.86	2,710.72	NO	NO	NO	NO	465.14
2022	3,563.92	3,093.13	NO	NO	NO	NO	470.78
Trend							
1990 - 2022	*-72.8%*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
2005 - 2022	*22.2%*	*30.0%*	*NA*	*NA*	*NA*	*NA*	*12.4%*
2021 - 2022	*12.2%*	*14.1%*	*NA*	*NA*	*NA*	*NA*	*1.2%*

In energy statistics, production, transformation and consumption of solid, liquid, gaseous and renewable fuels are specified in physical units, e.g. in tonnes or cubic meters. To convert these data to energy units, in this case terajoules, requires calorific values. The emission calculations are bases on net calorific values. In the following table the applied net calorific values (NCVs) for conversion to energy units in CRT category 1.A.4.a *Commercial/Institutional*.

Table 3-145 Net calorific values (NCVs) applied for conversion to energy units in CRT category 1.A.4.a Commercial/ Institutional

Fuel	Fuel type	Net calorific value (NCV)					
		NCV	unit	type	NCV	unit	type
Liquefied Petroleum Gases (LPG)	liquid	47.311	TJ/Gg	CS	47.3	TJ/Gg	D
Other Kerosene	liquid	43.0	TJ/Gg	CS	43.8	TJ/Gg	D
Gas/Diesel Oil (Non-bio)	liquid	43.292	TJ/Gg	CS	47.3	TJ/Gg	D
Motor Gasoline (Non-biogasoline)	liquid	44.799	TJ/Gg	CS	44.3	TJ/Gg	D
Residual fuel oil	liquid	40.193	TJ/Gg	CS	40.4	TJ/Gg	D
Other oil products n.e.c.	liquid	44.799	TJ/Gg	CS	40.2	TJ/Gg	D
Lignite	solid	9.843	TJ/Gg	CS	11.9	TJ/Gg	D
Natural gas	Gaseous	32.484	TJ/1000 cm3	CS	48.0	TJ/Gg	D
Wood/ Fuelwood	biomass		TJ/Gg	CS	15.6	TJ/Gg	D
Charcoal	biomass	29.600	TJ/Gg	CS	29.5	TJ/Gg	D
					for comparison		
Source		Eurostat (2023): Complete energy balances (Code: nrg_bal_c)			2006 IPCC guidelines, Vol. 2, Chapter 1, Table 1.2		
Note:							
D Default		CS Country specific			PS Plant specific		

3.2.7.1.2.3 Choice of emission factors

Default emission factors for greenhouse gases were taken from IPCC 2006 Guidelines and are presented in the following table.

Table 3-146 GHG Emission factor TIER 1 for CRT category 1.A.4.a Commercial/Institutional

Fuel	Fuel type	CO_2 (kg/TJ)		CH_4 (kg/TJ)		N_2O (kg/TJ)		Source
		EF	type	EF	type	EF	type	
LPG	liquid	63 100	D	5	D	0.1	D	**2006 IPCC Guidelines Vol. 2, Chap. 2 (2.3.2.1)** **Table 2.4** Default emission factors for stationary combustion in Commercial/ Institutional
Other Kerosene	liquid	71 900	D	10	D	0.6	D	
Gas/Diesel Oil	liquid	74 100	D	3	D	0.6	D	
Motor Gasoline (Non-biogasoline)	liquid	69 300	D	10	D	0.6	D	
Residual Fuel Oil / Total fuel oil	liquid	77 400	D	10	D	0.6	D	
Other oil products n.e.c.	liquid	73 300	D	10	D	0.6	D	
Lignite	solid	101 000	D	10	D	1.5	D	
Natural gas	Gaseous	56 100	D	5	D	0.1	D	
Wood/Wood waste	biomass	112 000	D	300	D	4	D	
Charcoal	biomass	112 000	D	200	D	1	D	
Note: D Default CS Country specific PS Plant specific IEF Implied emission factor								

3.2.7.1.3 Uncertainties and time-series consistency

The uncertainties for activity data and emission factors used for CRT category 1.A.4.a Commercial/ Institutional are presented in the following table.

Table 3-147 Uncertainty for CRT category 1.A.4.a Commercial/Institutional.

Uncertainty	Liquid fuels			Solid fuels			Gaseous fuels			Biomass			Reference
	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	2006 IPCC GL, Vol. 2, Chap. 2 (2.4.2)
Activity data (AD)	5%	5%	5%	3%	3%	3%	2%	2%	2%	20%	20%	20%	Table 2.15 and Table 3.1
Emission factor (EF)	1%			2%			1%			5%			Table 2.13
		150%			150%			150%			150%		Table 2.12
			220%			220%			220%			220%	Table 2.14
Combined Uncertainty (U)	5%	150%	220%	4%	150%	220%	2%	150%	220%	21%	151%	221%	$U_{total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

The time-series are considered to be consistent as the same methodology is applied to the whole period. Activity data are considered to be consistent as national and international data were always compared.

3.2.7.1.4 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed out:

⇒ Checked of calculations by spreadsheets
  - consistent use of energy balance data (energy statistic questionnaires),
  - documented sources,
  - use of units,
  - strictly defined interfaces between spreadsheets/calculation modules,
  - unique structure of sheets which do the same,
  - record keeping, use of write protection,
  - unique use of formulas, special cases are documented/highlighted,
  - quick-control checks for data consistency through all steps of calculation.

⇒ cross-checked from different sources:
- National statistic published by INSTAT and
- Energy statistics of UN statistics[101] and data published by International Energy Agency (IEA)[102]

⇒ time series consistency - plausibility checks of dips and jumps.

3.2.7.1.5 Category-specific recalculations including explanatory information and justifications

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category 1.A.4.a *Commercial/ Institutional*.

Table 3-148 Recalculations done in CRT category 1.A.4.a Commercial/Institutional.

GHG source & sink category	Revisions of data	Type of revision	Type of improvement
1.A.4.a	Revision of NCV	AD	Accuracy

3.2.7.1.6 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 3-149 Planned improvements for CRT category 1.A.4.a Commercial/Institutional.

GHG source & sink category	Planned improvement	Type of improvement		Priority
1.A.4	Split of fuel consumption to relevant categories	EF	Transparency	high
1.A.4.a	Further investigation of on fuel used (solid, liquid fuels, other fossil fuels, biomass,) and allocation in energy balance	AD	Transparency	High

[101] United Nations - Department of Economic and Social Affairs - Statistics Division Statistics - Energy Statistics https://unstats.un.org/unsd/energystats/

[102] Data and statistics - Data tools - Data tables Energy data by category, indicator, country or region https://www.iea.org/data-and-statistics/data-browser?country=WORLD&fuel=Energy%20supply&indicator=TESbySource

GHG source & sink category	Planned improvement	Type of improvement		Priority
1.A.4.b	Further investigation of on fuel used combustion technologies (stoves, boilers, etc.) for non-CO2 emissions	AD	Transparency	Low
1.A.4.a	Improving the time-series of fuel consumption	AD	Consistency	high

3.2.7.2 Residential (CRT category 1.A.4.b)

3.2.7.2.1 Source category description

GHG emissions/ removals	CO_2						CH_4						N_2O					
Estimated	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass
1.A.4.b																		
1.A.4.b.i	✓	✓	NO	NO	NO	✓	✓	✓	NO	NO	NO	✓	✓	✓	NO	NO	NO	✓
1.A.4.b.ii	IE	IE	NO	NO	NO	NO	IE	IE	NO	NO	NO	NO	IE	IE	NO	NO	NO	NO
Key category	LA 2022																	

A '✓' indicates: emissions from this sub-category have been estimated.
Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential

LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF

Use of notation key			
1.A.4.b	Residential		
1.A.4.b.i	Stationary combustion		
1.A.4.b.ii	Off-road vehicles and other machinery	IE	reported under 1.A.4.b.i Residential – stationary or 1.A.3.b road transport

This section describes GHG emissions resulting from fuel combustion activities for cooking, heating and lightning in households. An overview of the GHG emission from fuel combustion in CRT category 1.A.4.b *residentials* is provided in the following figure and table.

Fluctuation of emissions are due to please check reasons and provide more reasons

- overall economic downturn in the country in the beginning of 1990;
- use of biomass
- world-wide economic crisis in 2007/2008;
- implementation of legislation related to air quality
- ###.

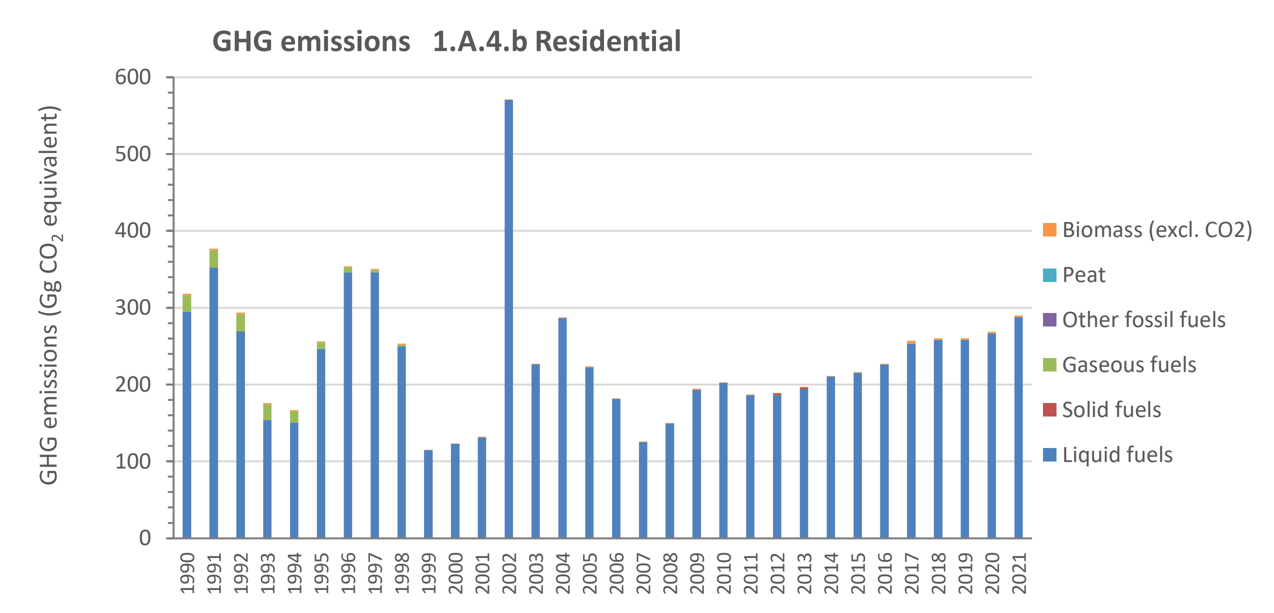


Figure 3-64 Emissions from CRT category 1.A.4.b Residential for the period 1990-2022

Table 3-150 Emissions from CRT category 1.A.4.b Residential for the period 1990-2022

GHG emissions	TOTAL GHG	CO_2 (excluding biomass)	N_2O (including biomass)	CH_4 (including biomass)	CO_2 (biomass)
	kt CO2 equivalent	kt	kt	kt	kt
1990	318.09	314.50	0.0025	0.046	1.70
1991	376.84	372.91	0.0029	0.054	1.70
1992	293.51	290.07	0.0023	0.043	1.70
1993	175.83	173.14	0.0013	0.027	1.62
1994	166.57	163.99	0.0013	0.026	1.55
1995	256.21	253.17	0.0021	0.038	1.48
1996	354.17	350.63	0.0028	0.051	1.41
1997	350.86	347.40	0.0028	0.050	1.35
1998	253.18	250.35	0.0021	0.037	1.29
1999	115.11	114.01	0.0011	0.022	0.55
2000	123.60	122.47	0.0011	0.023	0.54
2001	132.09	130.94	0.0012	0.024	0.54
2002	571.32	567.18	0.0042	0.076	0.98
2003	226.89	225.33	0.0024	0.046	0.45
2004	287.53	285.09	0.0032	0.061	0.97
2005	223.65	221.39	0.0024	0.043	0.97
2006	182.25	180.62	0.0012	0.032	0.97
2007	126.05	124.74	0.0005	0.018	0.89
2008	149.95	148.63	0.0003	0.016	0.84
2009	194.46	192.99	0.0004	0.020	0.84
2010	203.09	201.58	0.0005	0.021	0.84
2011	187.16	185.79	0.0004	0.019	0.80
2012	189.08	187.74	0.0004	0.019	0.75
2013	197.06	195.71	0.0004	0.019	0.75
2014	211.06	209.68	0.0004	0.021	0.75
2015	216.39	214.99	0.0004	0.021	0.75
2016	226.92	225.60	0.0004	0.022	0.64
2017	256.94	252.14	0.0005	0.030	3.90
2018	260.52	257.45	0.0005	0.027	2.23
2019	260.15	257.45	0.0005	0.027	1.88
2020	268.80	265.73	0.0005	0.028	2.22
2021	290.08	286.97	0.0005	0.030	2.20
2022	271.08	268.39	0.0005	0.028	1.85
Trend					
1990 - 2022	*-14.8%*	*-14.7%*	*-79.4%*	*-39.8%*	*8.7%*
2005 - 2022	*21.2%*	*21.2%*	*-78.7%*	*-35.9%*	*90.7%*
2021 - 2022	*-6.6%*	*-6.5%*	*-6.8%*	*-7.7%*	*-16.0%*

3.2.7.2.2 Methodological issues

3.2.7.2.2.1 Choice of methods

For estimating the GHG emissions (CO_2, CH_4, N_2O) the 2006 IPCC Guidelines Tier 1 approach[103] has been applied:

Equation 2.1: GHG emissions from stationary combustion (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Emissions_{GHG,\,fuel}[kt] = Fuel\ Consumption_{fuel}[TJ] \times Emission\ Factor_{GHG,\,fuel}\left[\frac{\mathrm{kg}}{\mathrm{TJ}}\right] * 10^{-6}}$$

Equation 2.2: Total emissions by greenhouse gas (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Emissions_{GHG}\left[kt_{CO2\ equivalent}\right] = \sum_{fuel} emissions_{\mathrm{CO2,\,fuel}}\ [kt] + \sum_{fuel} emissions_{\mathrm{CH4,\,fuel}}[kt] \times GWP_{CH4} + \sum_{fuel} emissions_{\mathrm{N2O,\,fuel}}[kt] \times GWP_{N2O}}$$

Where:

Emissions $_{GHG}$	= emissions of GHG (kt $_{CO2\ equivalent}$)
Emissions $_{GHG,\ fuel}$	= emissions of a given GHG by type of fuel (kt GHG)
Fuel consumption $_{fuel}$	= amount of fuel combusted (TJ)
Emission factor $_{GHG,\ fuel}$	= default emission factor of a given GHG by type of fuel (kg gas/TJ) For CO_2, it includes the carbon oxidation factor, assumed to be 1.
10^{-6}	= conversion from kg to kt (≡ divided by 1.000.000)
GHG	= CO_2, CH_4, N_2O
GWP	= Global warming potential for CO_2, CH_4, N_2O according to the IPCC 5AR
Fuel	= liquid fuels, solid fuels, gaseous fuels, other fossil fuel, biomass, peat

The method applied is not in line with the decision tree, as the category 1.A.4.b *Residentials* is a key category. See here the chapter planned improvements.

3.2.7.2.2.2 Choice of activity data

The following fuels are used for electricity production:

Liquid fuels:	• Liquefied Petroleum Gases • Other kerosene • Gas/Diesel Oil (Non-bio gas/diesel oil) • Motor Gasoline (Non-biogasoline) • Other Oil - Other Petroleum Products
Solid fuels:	• Lignite
Gaseous fuels	• Natural gas
Biomass	• Wood/ Wood Waste/ Fuelwood • Charcoal

Fuel consumption used for estimating the GHG emissions for the years 1990 - 2022 were taken from EUROSTAT but were prepared by Albanian Institute of Statistics (INSTAT). The fuel consumption is presented in the following table. Explanation for fluctuations is provided in chapter 'Category description' above.

[103] Source: 2006 IPCC Guidelines, Volume 2: Energy, Chapter 2: Stationary Combustion - 2.3.1 Methodological issues - Choice of method

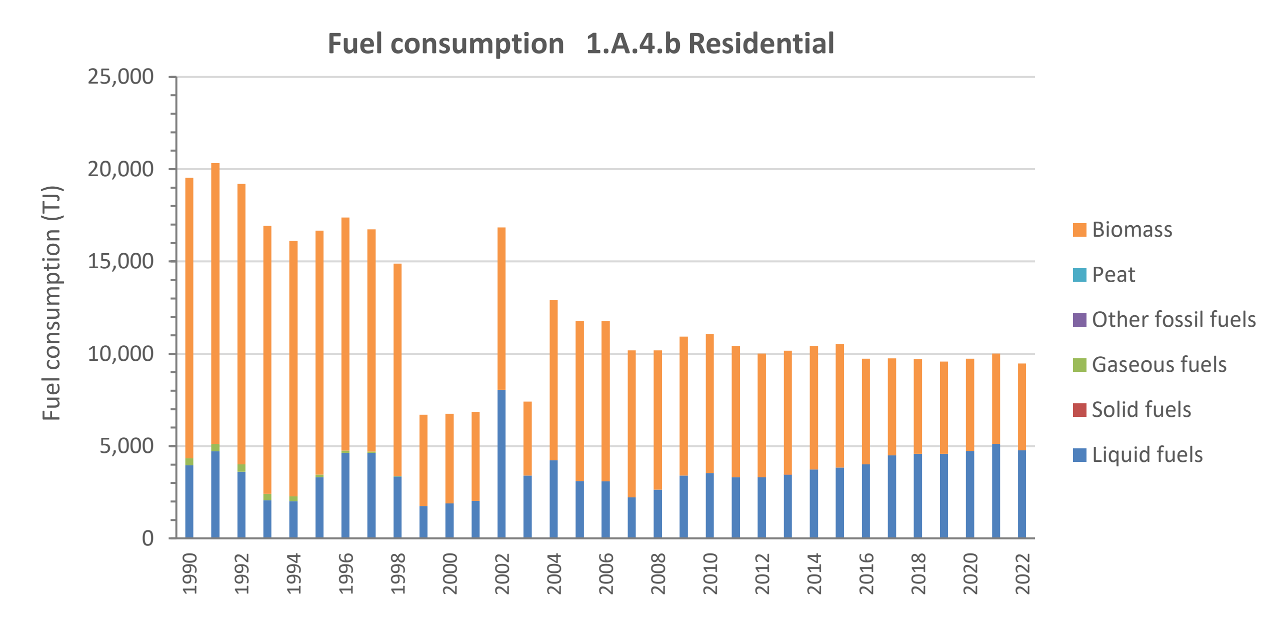


Figure 3-65 Activity data for CRT category 1.A.4.b Residentials for the period 1990-2022

Table 3-151 Activity data for CRT category 1.A.4.b Residentials for the period 1990-2022

Activity data 1.A.4.b	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
1990	19,535.70	3,956.00	NO	380.70	NO	NO	15,199.00
1991	20,328.60	4,730.00	NO	399.60	NO	NO	15,199.00
1992	19,210.60	3,612.00	NO	399.60	NO	NO	15,199.00
1993	16,931.00	2,064.00	NO	360.00	NO	NO	14,507.00
1994	16,121.80	2,021.00	NO	253.80	NO	NO	13,847.00
1995	16,667.50	3,311.00	NO	139.50	NO	NO	13,217.00
1996	17,375.10	4,644.00	NO	116.10	NO	NO	12,615.00
1997	16,743.50	4,644.00	NO	58.50	NO	NO	12,041.00
1998	14,879.40	3,354.00	NO	32.40	NO	NO	11,493.00
1999	6,692.91	1,756.91	NO	NO	NO	NO	4,936.00
2000	6,755.13	1,894.13	NO	NO	NO	NO	4,861.00
2001	6,854.35	2,031.35	NO	NO	NO	NO	4,823.00
2002	16,841.49	8,049.49	NO	NO	NO	NO	8,792.00
2003	7,417.30	3,398.30	NO	NO	NO	NO	4,019.00
2004	12,911.03	4,244.03	NO	NO	NO	NO	8,667.00
2005	11,775.56	3,108.56	NO	NO	NO	NO	8,667.00
2006	11,762.92	3,095.92	NO	NO	NO	NO	8,667.00
2007	10,178.62	2,223.62	NO	NO	NO	NO	7,955.00
2008	10,185.42	2,649.42	NO	NO	NO	NO	7,536.00
2009	10,934.86	3,398.86	NO	NO	NO	NO	7,536.00
2010	11,074.28	3,538.28	NO	NO	NO	NO	7,536.00
2011	10,429.77	3,311.77	NO	NO	NO	NO	7,118.00
2012	10,020.61	3,311.77	9.84	NO	NO	NO	6,699.00
2013	10,162.55	3,453.70	9.84	NO	NO	NO	6,699.00

Activity data 1.A.4.b	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
2014	10,436.57	3,737.57	NO	NO	NO	NO	6,699.00
2015	10,531.19	3,832.19	NO	NO	NO	NO	6,699.00
2016	9,741.44	4,021.44	NO	NO	NO	NO	5,720.00
2017	9,744.99	4,494.55	NO	NO	NO	NO	5,250.44
2018	9,726.47	4,589.17	NO	NO	NO	NO	5,137.30
2019	9,583.30	4,589.17	NO	NO	NO	NO	4,994.13
2020	9,736.58	4,736.78	NO	NO	NO	NO	4,999.80
2021	10,013.32	5,115.27	NO	NO	NO	NO	4,898.05
2022	9,483.98	4,784.09	NO	NO	NO	NO	4,699.90
Trend							
1990 - 2022	*-51.5%*	*20.9%*	*NA*	*NA*	*NA*	*NA*	*-69.1%*
2005 - 2022	*-19.5%*	*53.9%*	*NA*	*NA*	*NA*	*NA*	*-45.8%*
2021 - 2022	*-5.3%*	*-6.5%*	*NA*	*NA*	*NA*	*NA*	*-4.0%*

In energy statistics, production, transformation and consumption of solid, liquid, gaseous and renewable fuels are specified in physical units, e.g., in tonnes or cubic meters. To convert these data to energy units, in this case terajoules, requires calorific values. The emission calculations are bases on net calorific values. In the following table the applied net calorific values (NCVs) for conversion to energy units in CRT category 1.A.4.b *Residentials*.

Table 3-152 Net calorific values (NCVs) applied for conversion to energy units in CRT category 1.A.4.b Residentials

Fuel	Fuel type	Net calorific value (NCV)					
		NCV	unit	type	NCV	unit	type
Liquefied Petroleum Gases (LPG)	liquid	47.311	TJ/Gg	CS	47.3	TJ/Gg	D
Other Kerosene	liquid	43.0	TJ/Gg	CS	43.8	TJ/Gg	D
Gas/Diesel Oil (Non-bio)	liquid	43.292	TJ/Gg	CS	47.3	TJ/Gg	D
Motor Gasoline (Non-biogasoline)	liquid	44.799	TJ/Gg	CS	44.3	TJ/Gg	D
Other oil products n.e.c.	liquid	44.799	TJ/Gg	CS	40.2	TJ/Gg	D
Lignite	solid	9.843	TJ/Gg	CS	11.9	TJ/Gg	D
Natural gas	Gaseous	32.484	TJ/1000 cm3	CS	48.0	TJ/Gg	D
Wood/ Fuelwood	biomass	#	TJ/Gg	CS	15.6	TJ/Gg	D
Charcoal	biomass	29.600	TJ/Gg	CS	29.5	TJ/Gg	D
					for comparison		
Source		Eurostat (2023): Complete energy balances (Code: nrg_bal_c)			2006 IPCC guidelines, Vol. 2, Chapter 1, Table 1.2		
Note:							
D Default		CS Country specific			PS Plant specific		

3.2.7.2.2.3 Choice of emission factors

Default emission factors for greenhouse gases were taken from IPCC 2006 Guidelines and are presented in the following table.

Table 3-153 GHG Emission factor TIER 1 for CRT category 1.A.4.b Residentials

Fuel	Fuel type	CO_2 (kg/TJ)		CH_4 (kg/TJ)		N_2O (kg/TJ)		Source
		EF	type	EF	type	EF	type	
LPG	liquid	63 100	D	5	D	0.1	D	**2006 IPCC Guidelines Vol. 2, Chap. 2 (2.3.2.1)** **Table 2.5** Default emission factors for stationary combustion in residential and agriculture/ forestry/ fishing/ fishing farms
Other Kerosene	liquid	71 900	D	10	D	0.6	D	
Gas/Diesel Oil	liquid	74 100	D	3	D	0.6	D	
Motor Gasoline (Non-biogasoline)	liquid	69 300	D	10	D	0.6	D	
Other oil products n.e.c.	liquid	73 300	D	10	D	0.6	D	
Lignite	solid	101 000	D	10	D	1.5	D	
Natural gas	Gaseous	56 100	D	5	D	0.1	D	
Wood/Wood waste	biomass	112 000	D	300	D	4	D	
Charcoal	biomass	112 000	D	200	D	1	D	

Note:
D Default CS Country specific PS Plant specific IEF Implied emission factor

3.2.7.2.3 Uncertainties and time-series consistency

The uncertainties for activity data and emission factors used for CRT category 1.A.4.b Residentials are presented in the following table.

Table 3-154 Uncertainty for CRT category 1.A.4.b Residentials.

Uncertainty	Liquid fuels			Solid fuels			Gaseous fuels			Biomass			Reference
	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	2006 IPCC GL, Vol. 2, Chap. 2 (2.4.2)
Activity data (AD)	5%	5%	5%	3%	3%	3%	2%	2%	2%	20%	20%	20%	Table 2.15 and Table 3.1
Emission factor (EF)	1%	150%	220%	2%	150%	220%	1%	150%	220%	5%	150%	220%	Table 2.13 Table 2.12 Table 2.14
Combined Uncertainty (U)	5%	150%	220%	4%	150%	220%	2%	150%	220%	21%	151%	221%	$U_{total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

The time-series are considered to be consistent as the same methodology is applied to the whole period. Activity data are considered to be consistent as national and international data were always compared.

3.2.7.2.4 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed out:

⇒ Checked of calculations by spreadsheets

- consistent use of energy balance data (energy statistic questionnaires),
- documented sources,
- use of units,
- strictly defined interfaces between spreadsheets/calculation modules,
- unique structure of sheets which do the same,
- record keeping, use of write protection,
- unique use of formulas, special cases are documented/highlighted,
- quick-control checks for data consistency through all steps of calculation.

⇒ cross-checked from different sources:

- National statistic published by INSTAT and
- Energy statistics of UN statistics[104] and data published by International Energy Agency (IEA)[105]

⇒ time series consistency - plausibility checks of dips and jumps.

3.2.7.2.5 Category-specific recalculations including explanatory information and justifications

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category 1.A.4.b *Residentials*.

Table 3-155 Recalculations done in CRT category 1.A.4.b Residentials.

GHG source & sink category	Revisions of data	Type of revision	Type of improvement
1.A.4.b	Revision of NCV	AD	Accuracy

3.2.7.2.6 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 3-156 Planned improvements for CRT category 1.A.4.b Residentials.

GHG source & sink category	Planned improvement	Type of improvement		Priority
1.A.4	Split of fuel consumption to relevant categories	EF	Transparency	high
1.A.4.b	Further investigation of on fuel used (solid, liquid fuels, other fossil fuels, biomass,) and allocation in energy balance	AD	Transparency	High
1.A.4.b	Further investigation of on fuel used combustion technologies (stoves, boilers, etc.) for non-CO2 emissions	AD	Transparency	Low

[104] United Nations - Department of Economic and Social Affairs - Statistics Division Statistics - Energy Statistics https://unstats.un.org/unsd/energystats/

[105] Data and statistics - Data tools - Data tables Energy data by category, indicator, country or region https://www.iea.org/data-and-statistics/data-browser?country=WORLD&fuel=Energy%20supply&indicator=TESbySource

GHG source & sink category	Planned improvement	Type of improvement		Priority
1.A.4.b	Survey on fuel used and relevant characteristics: Waste – biomass fraction / non-biomass fraction	AD	Completeness	medium
1.A.4.b	Improving the time-series of fuel consumption	AD	Consistency	High

3.2.7.3 Agriculture/Forestry/Fishing/Fish Farms (CRT category 1.A.4.c)

3.2.7.3.1 Source category description

GHG emissions/ removals	CO_2						CH_4						N_2O					
Estimated	Liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass
1.A.4.c																		
1.A.4.c.i	IE	NO	NO	NO	NO	IE	IE	NO	NO	NO	NO	IE	IE	NO	NO	NO	NO	IE
1.A.4.c.ii	√	NO	√	NO	NO	√	√	NO	√	NO	NO	NO	√	NO	√	NO	NO	√
1.A.4.c.iii	IE	NO	NO	NO	NO	NO	IE	NO	NO	NO	NO	NO	IE	NO	NO	NO	NO	NO
Key category	LA 1990	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

A '✓' indicates emissions from this sub-category have been estimated.
Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential

LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF

Use of notation key			
1.A.4.c.i	Stationary		
1.A.4.c.ii	Off-road vehicles and other machinery	IE	reported under 1.A.4.b Residential – stationary or 1.A.3.b road transport
1.A.4.c.iii	Fishing	IE	reported under 1.A.4.cii – offroad vehicles

This section describes GHG emissions resulting from fuel combustion activities for heating and lightning in agriculture. An overview of the GHG emission from fuel combustion in CRT category 1.A.4.c *Agriculture/Forestry/ Fishing/Fish Farms* is provided in the following figure and table.

Fluctuation of emissions are due to please check reasons and provide more reasons

- overall economic downturn in the country in the beginning of 1990;
- use of biomass
- implementation of legislation related to air quality ###.

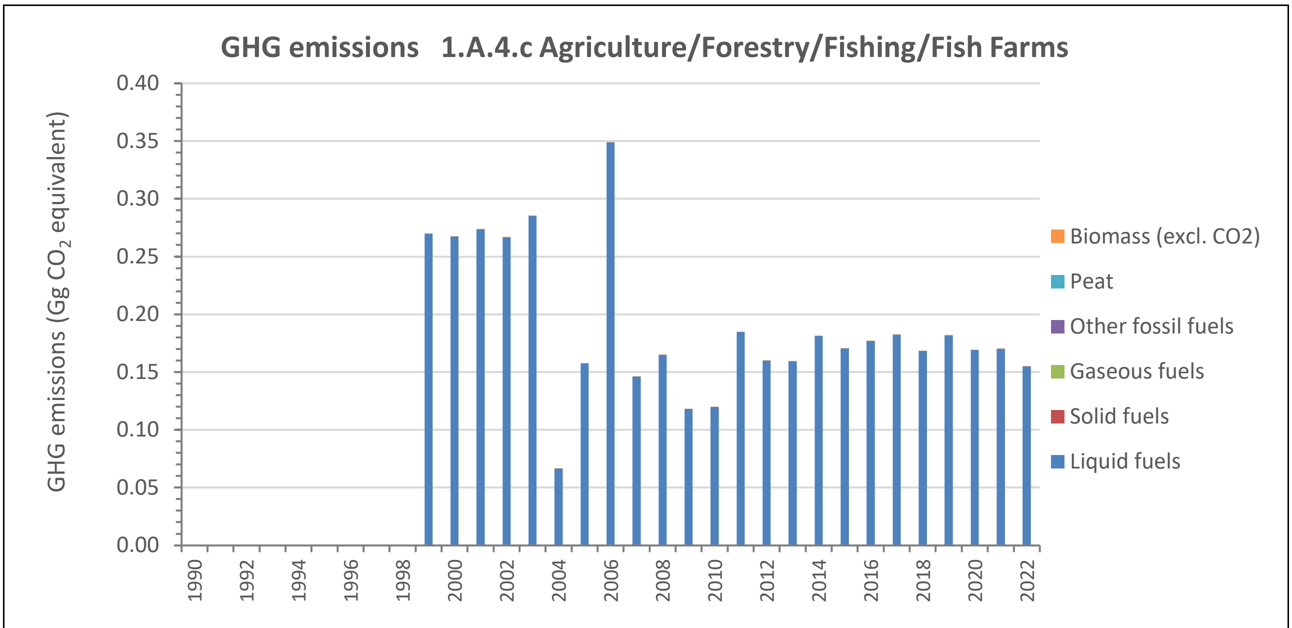


Figure 3-66 Emissions from CRT category 1.A.4.c Agriculture/Forestry/Fishing/Fish Farms for the period 1990-2022

Table 3-157 Emissions from CRT category 1.A.4. cii Agriculture/Forestry/Fishing/Fish Farms

GHG emissions	TOTAL GHG	CO_2 (excluding biomass)	N_2O (including biomass)	CH_4 (including biomass)	CO_2 (biomass)
	kt CO2 equivalent	kt	kt	kt	kt
1990	IE	IE	IE	IE	IE
1991	IE	IE	IE	IE	IE
1992	IE	IE	IE	IE	IE
1993	IE	IE	IE	IE	IE
1994	IE	IE	IE	IE	IE
1995	IE	IE	IE	IE	IE
1996	IE	IE	IE	IE	IE
1997	IE	IE	IE	IE	IE
1998	IE	IE	IE	IE	IE
1999	0.270	0.268	0.000002	0.00004	0.00012
2000	0.268	0.266	0.000002	0.00004	0.00012
2001	0.274	0.272	0.000002	0.00004	0.00012
2002	0.267	0.265	0.000002	0.00004	0.00006
2003	0.285	0.284	0.000002	0.00004	0.00009
2004	0.066	0.066	0.000001	0.00001	0.00002
2005	0.158	0.157	0.000001	0.00002	0.00001
2006	0.349	0.347	0.000003	0.00005	0.00001
2007	0.146	0.145	0.000001	0.00002	0.00002
2008	0.165	0.164	0.000001	0.00002	0.00002
2009	0.118	0.117	0.000001	0.00002	0.00003
2010	0.120	0.119	0.000001	0.00002	0.00003
2011	0.185	0.183	0.000002	0.00003	0.00006
2012	0.160	0.159	0.000001	0.00002	0.00006
2013	0.159	0.158	0.000001	0.00002	0.00006
2014	0.181	0.180	0.000001	0.00002	0.00006
2015	0.170	0.169	0.000001	0.00002	0.00006
2016	0.177	0.176	0.000001	0.00002	0.00006
2017	0.182	0.181	0.000001	0.00002	0.00006
2018	0.168	0.167	0.000001	0.00002	0.00006
2019	0.182	0.181	0.000001	0.00002	0.00005
2020	0.169	0.168	0.000001	0.00002	0.00006
2021	0.170	0.169	0.000001	0.00002	0.00006
2022	0.155	0.154	0.000001	0.00002	0.00006
Trend					
1990 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*
2005 - 2022	*-1.6%*	*-1.6%*	*-7.2%*	*-3.2%*	*312.1%*
2021 - 2022	*-8.9%*	*-8.9%*	*-9.9%*	*-9.3%*	*<0.1%*

3.2.7.3.2 Methodological issues

3.2.7.3.2.1 Choice of methods

For estimating the GHG emissions (CO_2, CH_4, N_2O) the 2006 IPCC Guidelines Tier 1 approach[106] has been applied:

Equation 2.1: GHG emissions from stationary combustion (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Emissions_{GHG,\,fuel}[kt] = Fuel\ Consumption_{fuel}[TJ] \times Emission\ Factor_{GHG,\,fuel}\left[\frac{\mathrm{kg}}{\mathrm{TJ}}\right] * 10^{-6}}$$

Equation 2.2: Total emissions by greenhouse gas (2006 IPCC GL, Vol. 2, Chap. 2)

$$\boldsymbol{Emissions_{GHG}[kt_{CO2\ equivalent}] = \sum_{fuel} emissions_{\mathrm{CO2,\,fuel}}\ [kt] + \sum_{fuel} emissions_{\mathrm{CH4,\,fuel}}[kt] \times GWP_{CH4} + \sum_{fuel} emissions_{\mathrm{N2O,\,fuel}}[kt] \times GWP_{N2O}}$$

Where:

Emissions $_{GHG}$	= emissions of GHG (kt $_{CO2\ equivalent}$)
Emissions $_{GHG,\ fuel}$	= emissions of a given GHG by type of fuel (kt GHG)
Fuel consumption $_{fuel}$	= amount of fuel combusted (TJ)
Emission factor $_{GHG,\ fuel}$	= default emission factor of a given GHG by type of fuel (kg gas/TJ) For CO_2, it includes the carbon oxidation factor, assumed to be 1.
10^{-6}	= conversion from kg to kt (≡ divided by 1.000.000)
GHG	= CO_2, CH_4, N_2O
GWP	= Global warming potential for CO_2, CH_4, N_2O according to the IPCC 5AR
Fuel	= liquid fuels, solid fuels, gaseous fuels, other fossil fuel, biomass, peat

The method applied is not in line with the decision tree, as the category 1.A.4.cii Agriculture/ Forestry/ Fishing/ Fish Farms is a key category. See here the chapter planned improvements.

3.2.7.3.2.2 Choice of activity data

The following fuels are used for electricity production:

Liquid fuels:
- Liquefied Petroleum Gases
- Other kerosene
- Gas/Diesel Oil (Non-bio gas/diesel oil)
- Motor Gasoline (Non-biogasoline)
- Petroleum Coke
- Other Oil - Other Petroleum Products

Biomass
- Wood/ Wood Waste/ Fuelwood

Fuel consumption used for estimating the GHG emissions for the years 1990 - 2022 were taken from EUROSTAT but were prepared by Albanian Institute of Statistics (INSTAT). The fuel consumption is presented in the following table. Explanation for fluctuations is provided in chapter ‘Category description’ above.

[106] Source: 2006 IPCC Guidelines, Volume 2: Energy, Chapter 2: Stationary Combustion - 2.3.1 Methodological issues - Choice of method

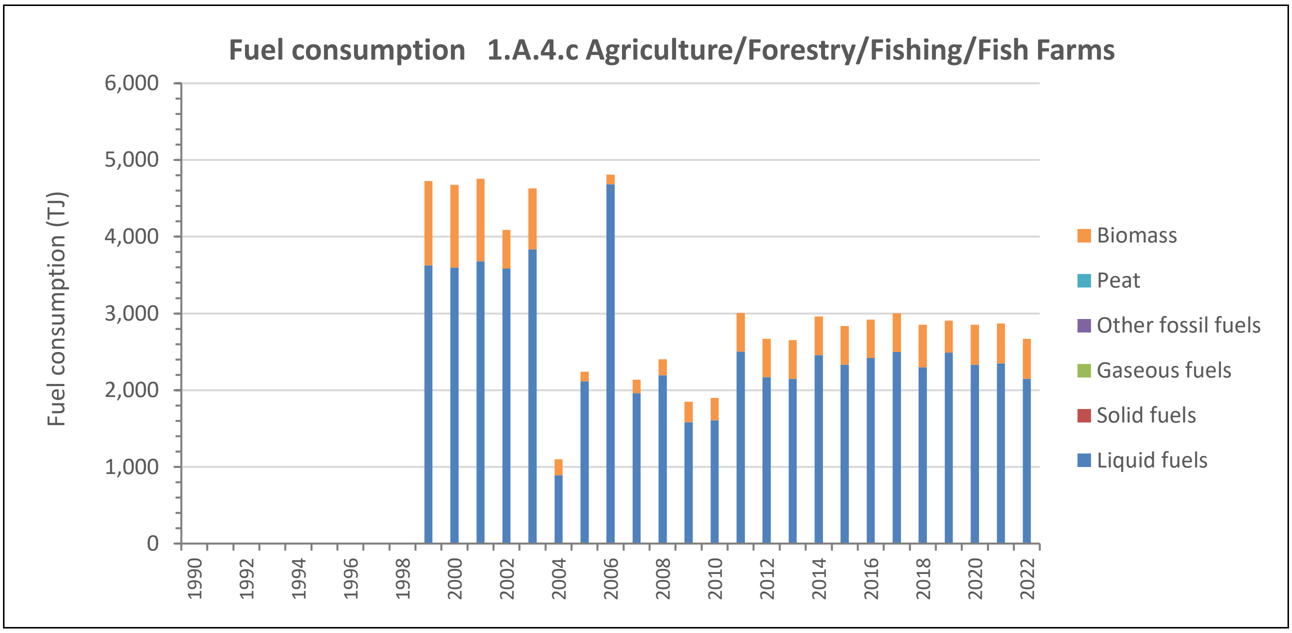


Figure 3-67 Activity data for CRT category 1.A.4.cii Agriculture/Forestry/Fishing/Fish Farms for the period 1990-2022

Table 3-158 Activity data for CRT category 1.A.4.c Agriculture/Forestry/Fishing/Fish Farms for the period 1990-2022

Activity data 1.A.4.b	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
1990	IE	IE	NO	NO	NO	NO	IE
1991	IE	IE	NO	NO	NO	NO	IE
1992	IE	IE	NO	NO	NO	NO	IE
1993	IE	IE	NO	NO	NO	NO	IE
1994	IE	IE	NO	NO	NO	NO	IE
1995	IE	IE	NO	NO	NO	NO	IE
1996	IE	IE	NO	NO	NO	NO	IE
1997	IE	IE	NO	NO	NO	NO	IE
1998	IE	IE	NO	NO	NO	NO	IE
1999	4,724.69	3,627.69	NO	NO	NO	NO	1,097.00
2000	4,676.77	3,596.77	NO	NO	NO	NO	1,080.00
2001	4,754.37	3,682.37	NO	NO	NO	NO	1,072.00
2002	4,089.41	3,586.41	NO	NO	NO	NO	503.00
2003	4,629.65	3,834.65	NO	NO	NO	NO	795.00
2004	1,101.44	891.44	NO	NO	NO	NO	210.00
2005	2,240.32	2,114.32	NO	NO	NO	NO	126.00
2006	4,808.32	4,682.32	NO	NO	NO	NO	126.00
2007	2,138.38	1,962.38	NO	NO	NO	NO	176.00
2008	2,403.78	2,194.78	NO	NO	NO	NO	209.00
2009	1,847.60	1,583.60	NO	NO	NO	NO	264.00
2010	1,901.21	1,608.21	NO	NO	NO	NO	293.00
2011	3,006.82	2,504.82	NO	NO	NO	NO	502.00
2012	2,670.85	2,168.85	NO	NO	NO	NO	502.00
2013	2,651.61	2,149.61	NO	NO	NO	NO	502.00

Activity data 1.A.4.b	Total fuels (incl. biomass)	Liquid fuels	Solid fuels	Gaseous fuels	Other fossil fuels	Peat	Biomass
	TJ						
2014	2,960.28	2,458.28	NO	NO	NO	NO	502.00
2015	2,834.20	2,332.20	NO	NO	NO	NO	502.00
2016	2,919.87	2,418.87	NO	NO	NO	NO	501.00
2017	3,003.07	2,500.65	NO	NO	NO	NO	502.42
2018	2,850.63	2,297.97	NO	NO	NO	NO	552.66
2019	2,906.14	2,491.39	NO	NO	NO	NO	414.75
2020	2,850.82	2,331.62	NO	NO	NO	NO	519.20
2021	2,869.75	2,350.57	NO	NO	NO	NO	519.18
2022	2,668.51	2,149.32	NO	NO	NO	NO	519.20
Trend							
1990 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
2005 - 2022	*19.1%*	*1.7%*	*NA*	*NA*	*NA*	*NA*	*312.1%*
2021 - 2022	*-7.0%*	*-8.6%*	*NA*	*NA*	*NA*	*NA*	*0.0%*

In energy statistics, production, transformation and consumption of solid, liquid, gaseous and renewable fuels are specified in physical units, e.g. in tonnes or cubic meters. To convert these data to energy units, in this case terajoules, requires calorific values. The emission calculations are bases on net calorific values. In the following table the applied net calorific values (NCVs) for conversion to energy units in Sub-category 1.A.4.c.ii Agriculture/Forestry/Fishing/Fish Farms - Off-road.

Table 3-159 Net calorific values (NCVs) applied for conversion to energy units in sub-category 1.A.4.c. Agriculture/Forestry/Fishing/Fish Farms - Off-road

Fuel	Fuel type	Net calorific value (NCV)					
		NCV	unit	type	NCV	unit	type
Liquefied Petroleum Gases (LPG)	liquid	47.311	TJ/Gg	CS	47.3	TJ/Gg	D
Other Kerosene	liquid	43.0	TJ/Gg	CS	43.8	TJ/Gg	D
Gas/Diesel Oil (Non-bio)	liquid	43.292	TJ/Gg	CS	47.3	TJ/Gg	D
Motor Gasoline (Non-biogasoline)	liquid	44.799	TJ/Gg	CS	44.3	TJ/Gg	D
Petroleum Coke	liquid	31.987	TJ/Gg	CS	32.5	TJ/Gg	D
Other oil products n.e.c.	liquid	44.799	TJ/Gg	CS	40.2	TJ/Gg	D
Wood/ Fuelwood	biomass	#	TJ/Gg	CS	15.6	TJ/Gg	D
					for comparison		
Source		Eurostat (2023): Complete energy balances (Code: nrg_bal_c)			2006 IPCC guidelines, Vol. 2, Chapter 1, Table 1.2		
Note:							
D Default		CS Country specific			PS Plant specific		

3.2.7.3.2.3 Choice of emission factors

Default emission factors for greenhouse gases were taken from IPCC 2006 Guidelines and are presented in the following table.

Table 3-160 GHG Emission factor TIER 1 for CRT category 1.A.4.c.ii Agriculture/Forestry/Fishing/Fish Farms - Off-road

Fuel	Fuel type	CO_2 (kg/TJ)		CH_4 (kg/TJ)		N_2O (kg/TJ)		Source
		EF	type	EF	type	EF	type	
LPG	liquid	63 100	D	5	D	0.1	D	**2006 IPCC Guidelines Vol. 2, Chap. 2 (2.3.2.1)** **Table 2.5** Default emission factors for stationary combustion in residential and agriculture/ forestry/ fishing/ fishing farms
Other Kerosene	liquid	71 900	D	10	D	0.6	D	
Gas/Diesel Oil	liquid	74 100	D	3	D	0.6	D	
Motor Gasoline (Non-biogasoline)	liquid	69 300	D	10	D	0.6	D	
Petroleum Coke	liquid	97 500	D	3	D	0.6	D	
Other oil products n.e.c.	liquid	73 300	D	10	D	0.6	D	
Wood/Wood waste	biomass	112 000	D	300	D	4	D	
Note: D Default	CS Country specific		PS Plant specific		IEF Implied emission factor			

3.2.7.3.3 Uncertainties and time-series consistency

The uncertainties for activity data and emission factors used for CRT category 1.A.4.cii Agriculture/Forestry/ Fishing/Fish Farms - Off-road are presented in the following table.

Table 3-161 Uncertainty for CRT category 1.A.4.cii Agriculture/Forestry/Fishing/Fish Farms - Off-road.

Uncertainty	Liquid fuels			Biomass			Reference
	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	2006 IPCC GL, Vol. 2, Chap. 2 (2.4.2)
Activity data (AD)	5%	5%	5%	20%	20%	20%	Table 2.15 and Table 3.1
Emission factor (EF)	1%			5%			Table 2.13
		150%			150%		Table 2.12
			220%			220%	Table 2.14
Combined Uncertainty (U)	5%	150%	220%	21%	151%	221%	$U_{total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

The time-series are considered to be consistent as the same methodology is applied to the whole period. Activity data are considered to be consistent as national and international data were always compared.

3.2.7.3.4 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed out:

⇒ Checked of calculations by spreadsheets

- consistent use of energy balance data (energy statistic questionnaires),
- documented sources,
- use of units,
- strictly defined interfaces between spreadsheets/calculation modules,

- unique structure of sheets which do the same,
- record keeping, use of write protection,
- unique use of formulas, special cases are documented/highlighted,
- quick-control checks for data consistency through all steps of calculation.

⇒ cross-checked from different sources:

- National statistic published by INSTAT and
- Energy statistics of UN statistics[107] and data published by International Energy Agency (IEA)[108]

⇒ time series consistency - plausibility checks of dips and jumps.

3.2.7.3.5 Category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category 1.A.4.cii *Agriculture/ Forestry/Fishing/Fish Farms - Off-road*

Table 3-162 Recalculations done in CRT category 1.A.4.c.ii Agriculture/Forestry/Fishing/Fish Farms - Off-road.

GHG source & sink category	Revisions of data	Type of revision	Type of improvement
1.A.4.c	Revision of NCV	AD	Accuracy

3.2.7.3.6 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 3-163 Planned improvements for CRT category 1.A.4.c.ii Agriculture/Forestry/Fishing/Fish Farms - Off-road.

GHG source & sink category	Planned improvement	Type of improvement		Priority
1.A.4	Split of fuel consumption to relevant categories	EF	Transparency	high
1.A.4.c	Further investigation of on fuel used (solid, liquid fuels, other fossil fuels, biomass,) and allocation in energy balance	AD	Transparency	High
1.A.4.c	Further investigation of on fuel used combustion technologies (stoves, boilers, etc.) for non-CO2 emissions	AD	Transparency	Low
1.A.4.c	Survey on fuel used and relevant characteristics: Waste – biomass fraction / non-biomass fraction	AD	Completeness	medium
1.A.4.c	Improving the time-series of fuel consumption	AD	Consistency	High

[107] United Nations - Department of Economic and Social Affairs - Statistics Division Statistics - Energy Statistics https://unstats.un.org/unsd/energystats/

[108] Data and statistics - Data tools - Data tables Energy data by category, indicator, country or region https://www.iea.org/data-and-statistics/data-browser?country=WORLD&fuel=Energy%20supply&indicator=TESbySource

3.2.8 Non-Specified (CRT category 1.A.5)

This section describes GHG emissions resulting from fuel combustion that are not specified elsewhere. Include emissions from fuel delivered to the military in the country and delivered to the military of other countries that are not engaged in multilateral operations.

IPCC code	Description	
1.A.5.a	Stationary	Emissions from fuel combustion in stationary sources that are not specified elsewhere.
1.A.5.b	Mobile	Emissions from vehicles and other machinery, marine and aviation (not included in 1.A.4c.ii or elsewhere).
1.A.5.b.i	Mobile (aviation component)	All remaining aviation emissions from fuel combustion that are not specified elsewhere. Include emissions from fuel delivered to the country's military as well as fuel delivered within that country but used by the militaries of other countries that are not engaged in multilateral operations.
1.A.5.b.ii	Mobile (water-borne component)	All remaining water-borne emissions from fuel combustion that are not specified elsewhere. Include emissions from fuel delivered to the country's military as well as fuel delivered within that country but used by the militaries of other countries that are not engaged in multilateral operations.
1.A.5.b.iii	Mobile (Other)	All remaining emissions from mobile sources not included elsewhere.
1.A.5.c	Multilateral Operations (Memo item[109])	Emissions from fuels used in multilateral operations pursuant to the Charter of the United Nations. Include emissions from fuel delivered to the military in the country and delivered to the military of other countries.

GHG emissions/ removals	CO_2						CH_4						N_2O					
Estimated	Liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass	liquid	solid	gaseous	Other fossil fuel	Peat	biomass
1.A.5.a	NE	NE	NE	NE	NO	NE	NE	NE	NE	NE	NO	NE	NE	NE	NE	NE	NO	NE
1.A.5.b	NE	NO	NO	NO	NO	NO	NE	NO	NO	NO	NO	NO	NE	NO	NO	NO	NO	NO
1.A.5.b.i	NE	NO	NO	NO	NO	NO	NE	NO	NO	NO	NO	NO	NE	NO	NO	NO	NO	NO
1.A.5.b.ii	NE	NO	NO	NO	NO	NO	NE	NO	NO	NO	NO	NO	NE	NO	NO	NO	NO	NO
1.A.5.b.iii	NE	NO	NO	NO	NO	NO	NE	NO	NO	NO	NO	NO	NE	NO	NO	NO	NO	NO
1.A.5.c	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Key Category	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

A '✓' indicates: emissions from this sub-category have been estimated.
Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential

LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF

The national energy statistics currently do not provide information regarding the use of fuels in the different CRT subcategories.

[109] Not included in National Total

3.2.8.1 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 3-164 Planned improvements for CRT category 1.A.5 *Non-Specified*.

GHG source & sink category	Planned improvement	Type of improvement		Priority
1.A.5	Investigation which of the activities included in 1.A.5 are occurrent in Albania	AD	Transparency	high
1.A.5	Survey on fuel used by military: annual amount of fuel consumption by fuel type	AD	Transparency Accuracy Completeness	high

3.3 Fugitive emissions from fuels (CRT category 1.B)

This section describes GHG emissions resulting from the extraction, processing and delivery of fossil fuels to the point of final use, also known as fugitive emissions. Both GHG emissions from surface and underground mining activities are accounted for.

Methane (CH_4) is produced naturally in the process of coal formation and thus is considered the most important fugitive emission for coal mining and handling.

Furthermore, methane and CO_2 emitted during mining from breakage of coal and associated strata and leakage from the pit floor and highwall.

Fugitive emissions of CH_4 and CO_2 from the production, transmission and distribution of oil and natural gas are estimated based on the quantity reported in the energy statistics.

3.3.1 Solid Fuels (CRT category 1.B.1)

This section describes GHG emissions resulting from the fugitive CH_4 emissions from coal mining and handling activities in underground and surface mines.

IPCC code	Description	Occurrent			Not occurrent (NO)
		Estimated	Not estimated (NE)	Included elsewhere (IE)	
1.B.1.a	Coal mining and handling				
1.B.1.a.i	Underground mines				
1.B.1.a.i.1	Mining				✓
1.B.1.a.i.2	Post-mining seam gas emissions				✓
1.B.1.a.i.3	Abandoned underground mines				✓
1.B.1.a.i.4	Flaring of drained methane or conversion of methane to CO_2				✓
1.B.1.a.ii	Surface mines				
1.B.1.a.ii.1	Mining	✓			
1.B.1.a.ii.2	Post-mining seam gas emissions	✓			
1.B.1.b	Uncontrolled combustion and burning coal dumps		✓		
1.B.1.c	Solid fuel transformation				
	Coke production				✓
	Charcoal production		✓		

3.3.1.1 Coal mining and handling - Underground mines (CRT category 1.B.1.a.i)

Methodological issues

Choice of methods

For estimating the GHG emissions based on coal production activity data from underground coal mining and post-mining, the 2006 IPCC Guidelines method for has been applied *(2006 IPCC GL, Vol. 2, Chap. 4)*[110]:

TIER 2 Surface mining emissions of CH4
TIER 1 Surface mining emissions of CO2, CH4 Post-mining mining emissions

Equation 4.1.6 (updated): General equation for estimating fugitive emissions from surface coal mining

$$CH_4 \textbf{emissions} = \boldsymbol{Surface\ mining\ emissions\ of\ CH_4 +\ Post - mining\ mining\ emissions\ of\ CH_4}$$

$$CO_2 \textbf{emissions} = \boldsymbol{Surface\ mining\ emissions\ of\ CO_2 +\ Post - mining\ mining\ emissions\ of\ CO_2}$$

Equation 4.1.7 (updated): TIER 1 Global average method – surface mines – methane

$$\boldsymbol{CH_4\ emissions} = CH_4 \textbf{emission factor } \times \boldsymbol{Surface\ coal\ production}\ \times \boldsymbol{Conversion\ factor}$$

Where:

CH4 Emissions	= methane emissions for mining activities (kt)
Surface coal production	= amount of coal produced (tonnes)
CH4 Emission factor	= methane emission factor (m^3 $tonne^{-1}$)
Unites conversion factor	= density of lignite - conversion factor by type of gas (kt/m^3)

Equation 4.1.7A (new): TIER 1 Global average method – surface mines – methane

$$\boldsymbol{CO_2\ emissions} = CO_2 \textbf{ emission factor } \times \boldsymbol{Surface\ coal\ production}\ \times \boldsymbol{Conversion\ factor}$$

Where:

CO2 Emissions	= carbon dioxide emissions for mining activities (kt)
Surface coal production	= amount of coal produced (tonnes)
CO2 Emission factor	= carbon dioxide emission factor (m^3 $tonne^{-1}$)
Unites conversion factor	= density of lignite - conversion factor by type of gas (kt/m^3)

Equation 4.1.8: TIER 1 Global average method – post-mining emissions – surface mines

$$\boldsymbol{CH_4\ emissions} = CH_4 \textbf{emission factor } \times \boldsymbol{Surface\ coal\ production}\ \times \boldsymbol{Conversion\ factor}$$

Where:

CH4 Emissions	= methane emissions for post-mining activities (kt)
Surface coal production	= amount of coal produced (tonnes)
CH4 Emission factor	= methane emission factor (m^3 $tonne^{-1}$)
Unites conversion factor	= density of lignite - conversion factor by type of gas (kt/m^3)

Unites conversion factor - Density

This is the density of CH4 and converts volume of CH4 to mass of CH4. The density is taken at 20˚C and 1 atmosphere pressure and has a value of 0.67×10^{-6} kt m^{-3}

[110] *Vol. 2, Chap. 4, 2019 Refinement to the 2006 IPCC Guidelines*

Choice of activity data

National production data for lignite were taken from INSTAT.

Choice of emission factors

The following emissions factors were applied.

Coal mining - *Surface mines*		Emission factors Mining (m³/t)	Emission factors Post-Mining (m³/t)	Source
CS EF CH4		0.3	0.1	
IPCC default	Low CH4	0.3	0	2019 Refinement to the 2006 IPCC GL, Vol. 2, Chap.4, p. 4.25/4.26
	Average CH4	1.2	0.1	
	High CH4	2.0	0.2	
IPCC default	Low CO2	0.01	NE	
	Average CO2	0.44	NE	
	High CO2	0.94	NE	

The country specific CH4 emission factor for mining activities is based on the genesis of Albanian lignite.
Post mining activities: For CH4, the IPCC average is applied. For CO2, the IPCC average is applied.

3.3.1.2 Uncertainties and time-series consistency

The uncertainties for activity data and emission factors used for CRT category 1.B.1 are presented in the following table.

Table 3-165 Uncertainty for CRT category 1.B.1 CH_4 emissions from Solid fuels

Uncertainty	CH_4 Surface Mining		CO2 Surface Mining		Source
	Mining	Post-mining	Mining	Post-mining	
Activity data (AD)					2019 Refinement to the 2006 IPCC GL, Vol. 2, Chap.4, TABLE 4.1.4 (UPDATED)
Emission factor (EF)					
Combined Uncertainty (U)	200%	50%	-67% to +200%	NA	$U_{total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

The time-series are considered to be consistent as the same methodology is applied to the whole period. Activity data are considered to be consistent as national and international data were always compared.

3.3.1.3 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed:

⇒ Checked of calculations by spreadsheets

- consistent use of energy balance data (energy statistic questionnaires),
- documented sources,
- use of units,

  - strictly defined interfaces between spreadsheets/calculation modules,
  - unique structure of sheets which do the same,
  - record keeping, use of write protection,
  - unique use of formulas, special cases are documented/highlighted,
  - quick-control checks for data consistency through all steps of calculation.

⇒ cross-checked from different sources:

- National statistic published by INSTAT and
- Energy statistics of UN statistics[111] and data published by International Energy Agency (IEA)[112]

⇒ time series consistency - plausibility checks of dips and jumps..

3.3.1.4 Category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category 1.B.1 *CH_4 emissions from Solid fuels*.

Table 3-166 Recalculations done since submission 2017 CRT category 1.B.1 CH_4 emissions from Solid fuels

GHG source & sink category	Revisions of data	Type of revision	Type of improvement
1.B.1	Application of CS emissions factor	AD	Accuracy
1.B.1	Application of Guidance provided by 2019 Refinement to the 2006 IPCC GL	EMI	Accuracy

3.3.1.5 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 3-167 Planned improvements for CRT category 1.B.1 CH_4 emissions from Solid fuels

GHG source & sink category	Planned improvement	Type of improvement		Priority
1.B.1.a.i.2, 1.B.1.a.i.2	Survey on post-mining activities (surface and underground mining)	AD	accuracy	medium
1.B.1.a.i.3 & 1.B.1.a.i.4	Survey on Abandoned underground mines and on flaring of drained methane	AD	accuracy	medium
1.B.1.b	Uncontrolled combustion and burning coal dumps	AD	accuracy	medium

[111] United Nations - Department of Economic and Social Affairs - Statistics Division Statistics - Energy Statistics https://unstats.un.org/unsd/energystats/

[112] Data and statistics - Data tools - Data tables Energy data by category, indicator, country or region https://www.iea.org/data-and-statistics/data-browser?country=WORLD&fuel=Energy%20supply&indicator=TESbySource

3.3.2 Oil and Natural Gas (CRT category 1.B.2)

This section describes the fugitive GHG emissions from oil and gas systems except contributions from fuel combustion. Oil and natural gas systems consist of infrastructure required to produce, collect, process or refine and deliver natural gas and petroleum products to market. The scope of the inventory includes all relevant processes from the well head, or oil and gas source, to the final sales point to the consumer.

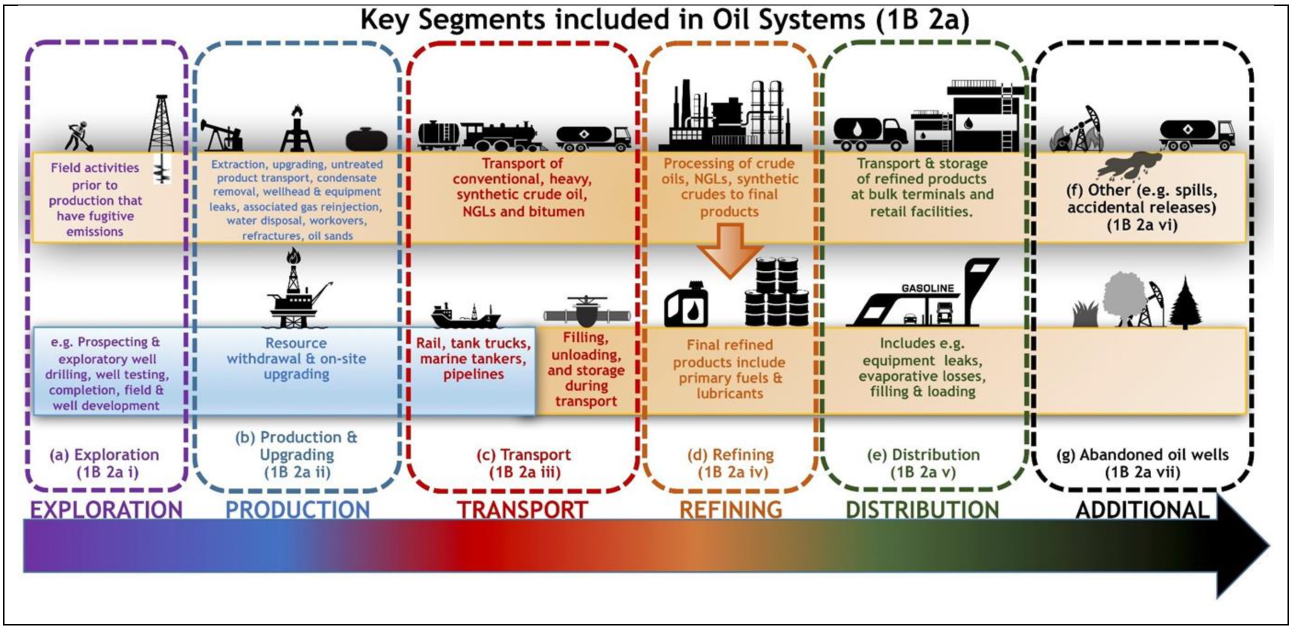


Figure 3-68 Key segments included in oil and natural gas systems

Source: 2019 Refinement to the 2006 IPCC GL, Chapter 4: Fugitive Emissions, Figure 4.2.0, page 4.36[113]

In the following table is the status of reporting of sources of CRT category 1.B.2 Oil and natural gas provided.

Table 3-168 Status of reporting and key category of CRT category 1.B.2

IPCC code	Description		CH_4		CO_2		NMVOC		N_2O	
			Estimated	Key Category	Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
1.B.2.a	**Oil**									
1.B.2.a.i	Exploration	Leaks	NA		NA		NA		NA	
		Venting	✓							
		Flaring	✓							
1.B.2.a.ii	Production and upgrading	Leaks	✓		NA		NE		NA	
		Venting	✓							
		Flaring	✓							
1.B.2.a.iii	Transport	All	✓		✓		✓		NA	
1.B.2.a.iv	Refining/storage	Leaks	✓		✓		✓		✓	
		Venting	NO							
		Flaring	NO							
1.B.2.a.v	Distribution of oil products	All	NA		NA		✓		NA	
1.B.2.a.vi	Other									
1.B.2.a.vi.1	Abandoned wells	All	NE		NE		NE		NE	
1.B.2.a.vi.2	Other	All	NE		NE		NE		NE	
1.B.2.b	**Natural gas**									

[113] https://www.ipcc-nggip.iges.or.jp/public/2006gl/french/pdf/2_Volume2/V2_4_CH4_Fugitive_Emissions.pdf

IPCC code	Description		CH_4		CO_2		NMVOC		N_2O	
			Estimated	Key Category	Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
1.B.2.b.i	Exploration	Leaks	NA		NA		NA		NA	
		Venting	✓							
		Flaring	✓							
1.B.2.b.ii	Production and gathering	All	✓		✓		✓		✓	
1.B.2.b.iii	Processing	All	✓		✓		✓		✓	
1.B.2.b.iv	Transmission and storage	All	✓		✓		✓		NA	
1.B.2.b.v	Distribution	All	✓		✓		✓		NA	
1.B.2.b.vi	Other									
1.B.2.b.vi.1	Gas post-meter	All	NE		NE		NE		NE	
1.B.2.b.vi.2	Abandoned wells	All	NE		NE		NE		NE	
1.B.2.b.vi.3	Other	All	NE		NE		NE		NE	
1.B.2.c.	**Venting and flaring**									
1.B.2.c.i.	Venting									
1.B.2.c.i.1.	Oil		✓		✓		✓		✓	
1.B.2.c.i.2.	Gas		✓		✓		✓		✓	
1.B.2.c.i.3.	Combined		NO		NO		NO		NO	
1.B.2.c.ii.	Flaring									
1.B.2.c.ii.1.	Oil		✓		✓		✓		✓	
1.B.2.c.ii.2.	Gas		✓		✓		✓		✓	
1.B.2.c.ii.3.	Combined		NO		NO		NO		NO	
1.B.2.d.	**Other**									
1.B.2.d.	Other	All	NO		NO		NO		NO	

All: sum of leak, venting and flaring	A '✓' indicates: emissions from this category have been estimated. Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF	

Category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category 1.B.2.

Table 3-169 Recalculations done since last submission in CRT category 1.B.2 Oil and Natural Gas

GHG source & sink category	Revisions of data	Type of revision	Type of improvement
1.B.2	Application of Guidance provided by 2019 Refinement to the 2006 IPCC Guidelines	method	Accuracy

3.3.2.1 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 3-170 Planned improvements for CRT category 1.B.2 Oil and Natural Gas

GHG source & sink category	Planned improvement	Type of improvement		Priority
1.B.2	Survey on Abandoned wells and accidents	AD	Completeness	medium

3.3.3 Carbon dioxide Transport and Storage (CRT category 1.C)

This section describes GHG emissions resulting from carbon dioxide transport, injection and geological storage (CCGS) only.

All these activities are not existing in Albania.

4 Industrial Processes and Product Use (IPPU) (CRT sector 2)

4.1 Sector Overview

In the Sector *Industrial Processes and Product Use (IPPU),* emissions originating from industrial processes, from the use of greenhouse gases in products, and from non-energy uses of fossil fuel carbon are considered. Emissions from this sector comprise emissions from the following subcategories:

- 2.A Mineral Industry
- 2.B Chemical Industry
- 2.C Metal Industry
- 2.D Other Production
- 2.E Production of HFC/PFC and SF6
- 2.F Consumption of HFC/PFC and SF6
- 2.G Other product manufacture and use
- 2 H Other

Greenhouse gas emissions are produced from a wide variety of industrial activities. The main emission sources are releases from industrial processes that chemically or physically transform materials like

- Cement and Lime industry in category 2.A Mineral Industry,
- Iron and steel from scraps in category 2.C Metal Industry,

In the following table, an overview of the IPCC sub-categories included in this chapter is given and is provided information on the status of emission estimates of all subcategories. A „✓" indicates that emissions from this sub-category have been estimated.

Table 4-1 Overview of categories of CRT sector 2 *Industrial Processes and Product Use (IPPU) and* status of estimation.

IPCC Code	CRT category	CO_2	CH_4	N_2O	HFC	PFC	SF6	NF3
2.A	**Mineral Industry**	✓	NA	NA	NA	NA	NA	NA
2.B	**Chemical Industry**	✓	NA	NA	NA	NA	NA	NA
2.C	**Metal Industry**	✓	✓	NO	NO	✓	NO	NA
2.D	**Other Production**	✓	NA	NA	NA	NA	NA	NA
2.E	**Production of HFC/PFC and SF6**	✓	NA	NA	NO	NO	NO	NO
2.F	**Consumption of HFC/PFC and SF6**	NE	NA	NA	NE	NE	NE	NE
2.G	**Other Product Manufacture and Use**	NE	NO	✓	NA	NA	NE	NA
2.H	**Other**	NA	NO	NA	NA	NA	NA	NA

** Only 2.G.1.b Refrigeration and Stationary Air Conditioning*

Other Industries of the CRT sector *Industrial Processes and Product Use (IPPU)*, such as primary aluminium production, electronic industries (e.g. semiconductor), or production of Electrical Equipment are not existing in Albania.

During these processes, many different greenhouse gases, including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs), can be produced.

The so-called F-gases hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs), sulfur hexafluoride (SF6) and

Other halogenated gases are oftentimes used in products such as refrigerators, foams or aerosol cans as well as electrical equipment.

Due to lack of data and resources GHG emissions from the use of greenhouse gases (HFC, PFC) and Other halogenated gases used in products were not estimated for all subcategories in this inventory cycle (2.F Consumption of HFC/PFC and SF6).

4.1.1 Emission trend

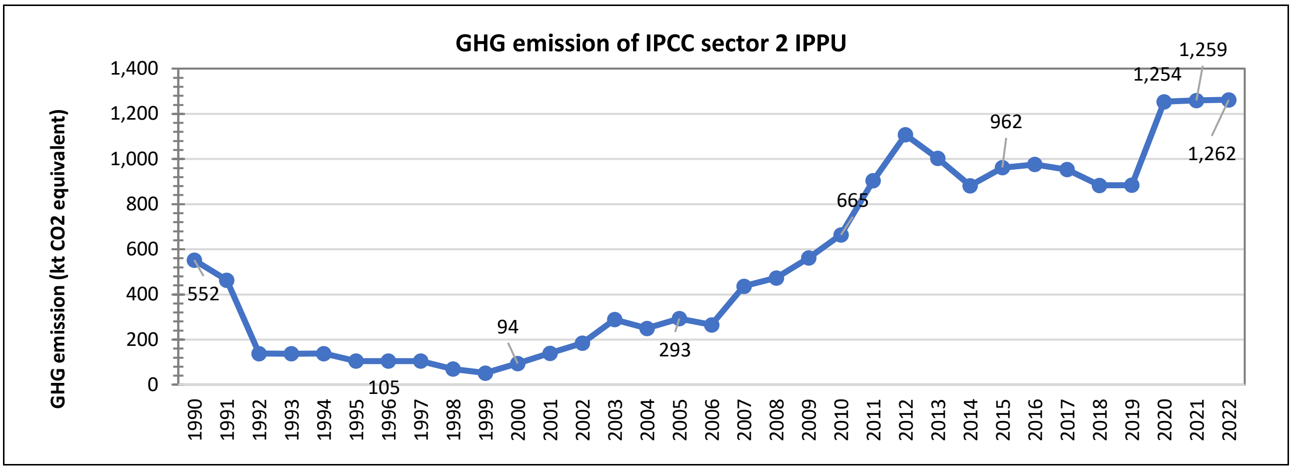


Figure 4-1 Trend of GHG emissions from CRT sector 2 IPPU: 1990 – 2022

In 2022 greenhouse gas emissions from sector *Industrial Processes and Other Product Use* amounted to 1,262.44 kt CO_2 equivalent.

The most important sub-categories of this sector are 2.A *Mineral industry* (mainly cement production). N_2O does occur from 2.G.3 N2O from Product Uses.

In 2005 greenhouse gas emissions from sector *Industrial Processes and Other Product Use* amounted to 293.00 kt CO_2 equivalent. The overall trend in GHG emissions from *Industrial Processes and Other Product Use* is an increase of 330.8% from 2005 to 2022 due to intensive cement production.

In 1990 greenhouse gas emissions from sector *Industrial Processes and Other Product Use* amounted to 551.48 kt CO_2 equivalent.

The general trend is marked by significant dips and jumps mostly due to unstable cement production.

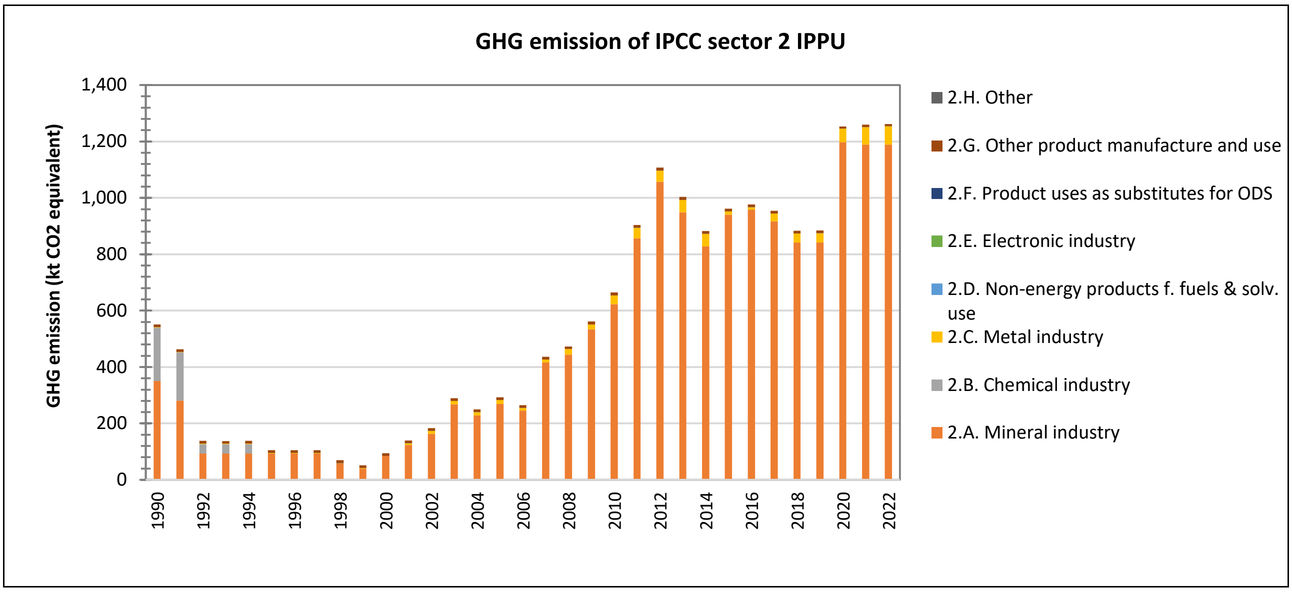


Figure 4-2 Trend of GHG emissions of CRT sector 2 IPPU by category for the period 1990 – 2022

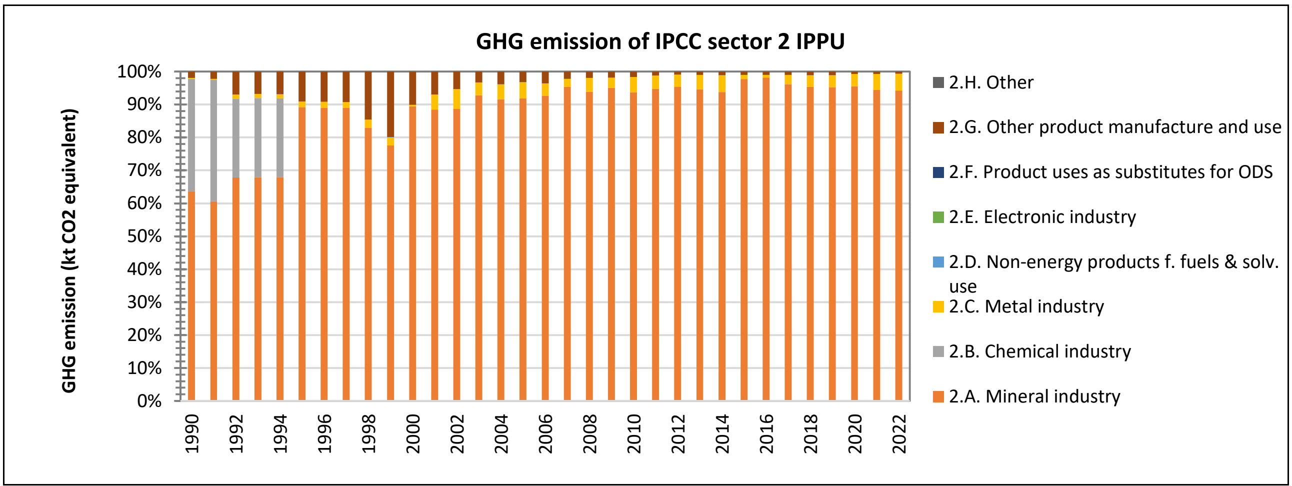


Figure 4-3 Trend and share GHG emissions of CRT sector 2 IPPU by category for the period 1990 – 2022

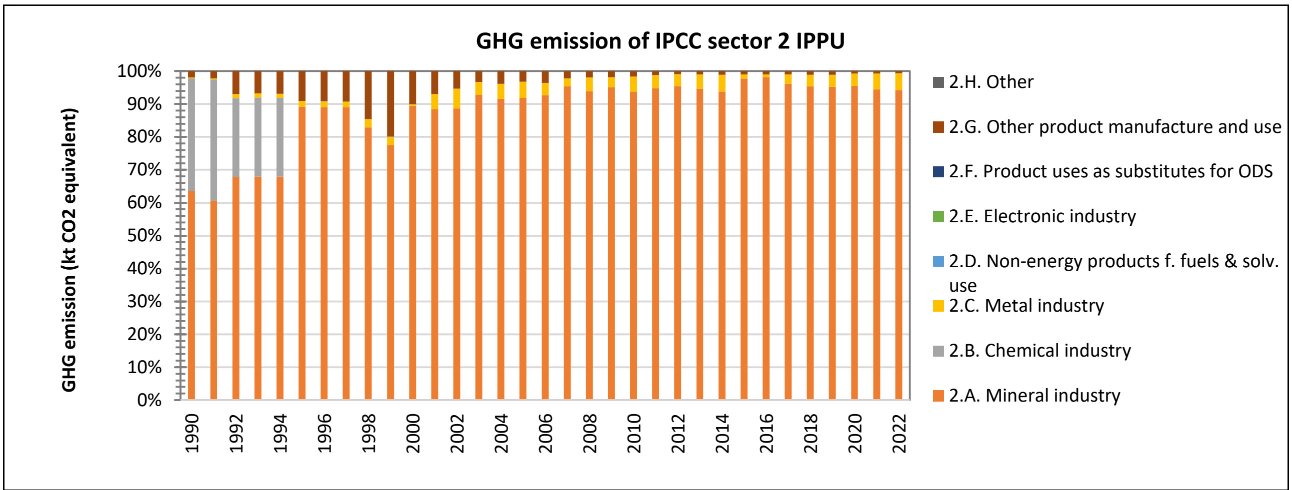


Figure 4-4 Trend of emissions from CRT sector 2 IPPU in index form (base year = 100) by category

Table 4-2 GHG Emissions from CRT category 2 IPPU by sub-categories for the period 1990-2022

GHG emissions	2 Industrial Processes and Other Product Use (IPPU)	2.A Mineral industry	2.B Chemical industry	2.C Metal industry	2.D Non-energy products from fuels and solvent use	2.E Electronic industry	2.F Product uses as substitutes for ODS	2.G Other product manufacture and use	2.H Other
	kt CO_2 equivalent								
1990	**551.48**	351.00	188.34	1.77	0.01	NA	NE	10.36	NO
1991	**463.63**	280.80	171.14	1.77	0.01	NA	NE	9.92	NO
1992	**137.93**	93.60	33.03	1.77	0.01	NA	NE	9.53	NO
1993	**137.66**	93.60	33.03	1.77	0.01	NA	NE	9.26	NO
1994	**137.84**	93.60	33.03	1.77	0.01	NA	NE	9.44	NO
1995	**104.91**	93.60	NO	1.77	0.01	NA	NE	9.53	NO

GHG emissions	2 Industrial Processes and Other Product Use (IPPU)	2.A Mineral industry	2.B Chemical industry	2.C Metal industry	2.D Non-energy products from fuels and solvent use	2.E Electronic industry	2.F Product uses as substitutes for ODS	2.G Other product manufacture and use	2.H Other
	kt CO_2 equivalent								
1996	**105.12**	93.60	NO	1.85	0.01	NA	NE	9.66	NO
1997	**105.09**	93.60	NO	1.77	0.01	NA	NE	9.72	NO
1998	**69.33**	57.49	NO	1.77	0.01	NA	NE	10.07	NO
1999	**51.87**	40.25	NO	1.28	0.01	NA	NE	10.33	NO
2000	**94.16**	84.24	NO	0.40	0.01	NA	NE	9.51	NO
2001	**139.66**	123.55	NO	6.42	0.01	NA	NE	9.67	NO
2002	**183.76**	162.86	NO	11.24	0.01	NA	NE	9.65	NO
2003	**289.01**	268.16	NO	11.24	0.01	NA	NE	9.59	NO
2004	**249.96**	228.85	NO	11.48	0.01	NA	NE	9.62	NO
2005	**293.00**	269.10	NO	14.45	0.01	NA	NE	9.45	NO
2006	**264.98**	245.70	NO	9.87	0.01	NA	NE	9.40	NO
2007	**436.36**	416.05	NO	10.92	0.01	NA	NE	9.38	NO
2008	**473.08**	443.93	NO	20.07	0.01	NA	NE	9.07	NO
2009	**561.62**	533.79	NO	17.74	0.01	NA	NE	10.08	NO
2010	**664.62**	622.71	NO	31.31	0.01	NA	NE	10.60	NO
2011	**904.22**	856.71	NO	37.25	0.01	NA	NE	10.25	NO
2012	**1 107.36**	1 056.86	NO	40.14	0.01	NA	NE	10.36	NO
2013	**1 003.23**	949.17	NO	44.15	0.01	NA	NE	9.90	NO
2014	**882.14**	827.48	NO	44.96	0.01	NA	NE	9.70	NO
2015	**961.66**	939.80	NO	12.04	0.01	NA	NE	9.81	NO
2016	**976.36**	958.52	NO	8.03	0.01	NA	NE	9.80	NO
2017	**953.77**	916.98	NO	27.17	0.01	NA	NE	9.62	NO
2018	**883.51**	842.10	NO	31.76	0.01	NA	NE	9.64	NO
2019	**884.52**	842.10	NO	32.56	0.01	NA	NE	9.85	NO
2020	**1 253.88**	1 198.04	NO	47.37	0.01	NA	NE	8.47	NO
2021	**1 259.71**	1 189.15	NO	62.11	0.01	NA	NE	8.45	NO
2022	**1 262.44**	1 189.15	NO	64.95	0.01	NA	NE	8.34	
Trend									
1990 - 2022	*128.9%*	*238.8%*	*NA*	*3577.2%*	*-15.0%*	*NA*	*NA*	*-19.5%*	*NA*
2005 - 2022	*330.9%*	*341.9%*	*NA*	*349.4%*	*-7.5%*	*NA*	*NA*	*-11.7%*	*NA*
2021 - 2022	*0.2%*	*0.0%*	*NA*	*4.6%*	*-1.3%*	*NA*	*NA*	*-1.3%*	*NA*

Table 4-3 CO_2 Emissions from CRT category 2 IPPU by sub-categories for the period 1990-2022

CO_2 emissions	2 Industrial Processes and Other Product Use (IPPU)	2.A Mineral industry	2.B Chemical industry	2.C Metal industry	2.D Non-energy products from fuels and solvent use	2.E Electronic industry	2.F Product uses as substitutes for ODS	2.G Other product manufacture and use	2.H Other
	kt								
1990	**541.11**	351.00	188.34	1.76	0.01	NA	NA	NA	NO
1991	**453.71**	280.80	171.14	1.76	0.01	NA	NA	NA	NO
1992	**128.39**	93.60	33.03	1.76	0.01	NA	NA	NA	NO
1993	**128.39**	93.60	33.03	1.76	0.01	NA	NA	NA	NO
1994	**128.39**	93.60	33.03	1.76	0.01	NA	NA	NA	NO
1995	**95.37**	93.60	NO	1.76	0.01	NA	NA	NA	NO
1996	**95.45**	93.60	NO	1.84	0.01	NA	NA	NA	NO
1997	**95.37**	93.60	NO	1.76	0.01	NA	NA	NA	NO
1998	**59.26**	57.49	NO	1.76	0.01	NA	NA	NA	NO
1999	**41.54**	40.25	NO	1.28	0.01	NA	NA	NA	NO
2000	**84.65**	84.24	NO	0.40	0.01	NA	NA	NA	NO
2001	**129.96**	123.55	NO	6.40	0.01	NA	NA	NA	NO
2002	**174.07**	162.86	NO	11.20	0.01	NA	NA	NA	NO
2003	**279.37**	268.16	NO	11.20	0.01	NA	NA	NA	NO
2004	**240.30**	228.85	NO	11.44	0.01	NA	NA	NA	NO
2005	**283.51**	269.10	NO	14.40	0.01	NA	NA	NA	NO
2006	**255.55**	245.70	NO	9.84	0.01	NA	NA	NA	NO
2007	**426.94**	416.05	NO	10.88	0.01	NA	NA	NA	NO
2008	**463.94**	443.93	NO	20.00	0.01	NA	NA	NA	NO
2009	**551.48**	533.79	NO	17.68	0.01	NA	NA	NA	NO
2010	**653.92**	622.71	NO	31.20	0.01	NA	NA	NA	NO
2011	**893.84**	856.71	NO	37.12	0.01	NA	NA	NA	NO
2012	**1 096.87**	1 056.86	NO	40.00	0.01	NA	NA	NA	NO
2013	**993.17**	949.17	NO	44.00	0.01	NA	NA	NA	NO
2014	**872.29**	827.48	NO	44.80	0.01	NA	NA	NA	NO
2015	**951.81**	939.80	NO	12.00	0.01	NA	NA	NA	NO
2016	**966.53**	958.52	NO	8.00	0.01	NA	NA	NA	NO
2017	**944.06**	916.98	NO	27.08	0.01	NA	NA	NA	NO
2018	**873.76**	842.10	NO	31.65	0.01	NA	NA	NA	NO
2019	**874.55**	842.10	NO	32.45	0.01	NA	NA	NA	NO
2020	**1 245.24**	1 198.04	NO	47.20	0.01	NA	NA	NA	NO
2021	**1 251.05**	1 189.15	NO	61.89	0.01	NA	NA	NA	NO
2022	**1 253.87**	1 189.15	NO	64.72	0.01	NA	NA	NA	NO
Trend									
1990 - 2022	*131.7%*	*238.8%*	*NA*	*3577.2%*	*-15.0%*	*NA*	*NA*	*NA*	*NA*
2005 - 2022	*342.3%*	*341.9%*	*NA*	*349.4%*	*-7.5%*	*NA*	*NA*	*NA*	*NA*
2021 - 2022	*0.2%*	*0.0%*	*NA*	*4.6%*	*-1.3%*	*NA*	*NA*	*NA*	*NA*

Table 4-4 CH_4 Emissions from CRT category 2 IPPU by sub-categories for the period 1990-2022

CH_4 emissions	2 Industrial Processes and Other Product Use (IPPU)	2.A Mineral industry	2.B Chemical industry	2.C Metal industry	2.D Non-energy products from fuels and solvent use	2.E Electronic industry	2.F Product uses as substitutes for ODS	2.G Other product manufacture and use	2.H Other
	kt								
1990	**0.0002**	NO	NO	0.000	NA	NA	NA	NE	NO
1991	**0.0002**	NO	NO	0.000	NA	NA	NA	NE	NO
1992	**0.0002**	NO	NO	0.000	NA	NA	NA	NE	NO
1993	**0.0002**	NO	NO	0.000	NA	NA	NA	NE	NO
1994	**0.0002**	NO	NO	0.000	NA	NA	NA	NE	NO
1995	**0.0002**	NO	NO	0.000	NA	NA	NA	NE	NO
1996	**0.0002**	NO	NO	0.000	NA	NA	NA	NE	NO
1997	**0.0002**	NO	NO	0.000	NA	NA	NA	NE	NO
1998	**0.0002**	NO	NO	0.000	NA	NA	NA	NE	NO
1999	**0.0002**	NO	NO	0.000	NA	NA	NA	NE	NO
2000	**0.0001**	NO	NO	0.000	NA	NA	NA	NE	NO
2001	**0.0008**	NO	NO	0.001	NA	NA	NA	NE	NO
2002	**0.0014**	NO	NO	0.001	NA	NA	NA	NE	NO
2003	**0.0014**	NO	NO	0.001	NA	NA	NA	NE	NO
2004	**0.0014**	NO	NO	0.001	NA	NA	NA	NE	NO
2005	**0.0018**	NO	NO	0.002	NA	NA	NA	NE	NO
2006	**0.0012**	NO	NO	0.001	NA	NA	NA	NE	NO
2007	**0.0014**	NO	NO	0.001	NA	NA	NA	NE	NO
2008	**0.0025**	NO	NO	0.003	NA	NA	NA	NE	NO
2009	**0.0022**	NO	NO	0.002	NA	NA	NA	NE	NO
2010	**0.0039**	NO	NO	0.004	NA	NA	NA	NE	NO
2011	**0.0046**	NO	NO	0.005	NA	NA	NA	NE	NO
2012	**0.0050**	NO	NO	0.005	NA	NA	NA	NE	NO
2013	**0.0055**	NO	NO	0.006	NA	NA	NA	NE	NO
2014	**0.0056**	NO	NO	0.006	NA	NA	NA	NE	NO
2015	**0.0015**	NO	NO	0.002	NA	NA	NA	NE	NO
2016	**0.0010**	NO	NO	0.001	NA	NA	NA	NE	NO
2017	**0.0034**	NO	NO	0.003	NA	NA	NA	NE	NO
2018	**0.0040**	NO	NO	0.004	NA	NA	NA	NE	NO
2019	**0.0041**	NO	NO	0.004	NA	NA	NA	NE	NO
2020	**0.0059**	NO	NO	0.006	NA	NA	NA	NE	NO
2021	**0.0077**	NO	NO	0.008	NA	NA	NA	NE	NO
2022	**0.0081**	NO	NO	0.008	NA	NA	NA	NE	NO
Trend									
1990 - 2022	*3577.2%*	*NA*	*NA*	*3577.2%*	*NA*	*NA*	*NA*	*NA*	*NA*
2005 - 2022	*349.4%*	*NA*	*NA*	*349.4%*	*NA*	*NA*	*NA*	*NA*	*NA*
2021 - 2022	*4.6%*	*NA*	*NA*	*4.6%*	*NA*	*NA*	*NA*	*NA*	*NA*

Table 4-5 Emissions of N_2O from CRT category 2 IPPU by sub-categories

N_2O emissions	2 Industrial Processes and Other Product Use (IPPU)	2.A Mineral industry	2.B Chemical industry	2.C Metal industry	2.D Non-energy products from fuels and solvent use	2.E Electronic industry	2.F Product uses as substitutes for ODS	2.G Other product manufacture and use	2.H Other
	kt								
1990	**0.04**	NO	NO	NO	NO	NA	NA	0.04	NO
1991	**0.04**	NO	NO	NO	NO	NA	NA	0.04	NO
1992	**0.04**	NO	NO	NO	NO	NA	NA	0.04	NO
1993	**0.03**	NO	NO	NO	NO	NA	NA	0.03	NO
1994	**0.04**	NO	NO	NO	NO	NA	NA	0.04	NO
1995	**0.04**	NO	NO	NO	NO	NA	NA	0.04	NO
1996	**0.04**	NO	NO	NO	NO	NA	NA	0.04	NO
1997	**0.04**	NO	NO	NO	NO	NA	NA	0.04	NO
1998	**0.04**	NO	NO	NO	NO	NA	NA	0.04	NO
1999	**0.04**	NO	NO	NO	NO	NA	NA	0.04	NO
2000	**0.04**	NO	NO	NO	NO	NA	NA	0.04	NO
2001	**0.04**	NO	NO	NO	NO	NA	NA	0.04	NO
2002	**0.04**	NO	NO	NO	NO	NA	NA	0.04	NO
2003	**0.04**	NO	NO	NO	NO	NA	NA	0.04	NO
2004	**0.04**	NO	NO	NO	NO	NA	NA	0.04	NO
2005	**0.04**	NO	NO	NO	NO	NA	NA	0.04	NO
2006	**0.04**	NO	NO	NO	NO	NA	NA	0.04	NO
2007	**0.04**	NO	NO	NO	NO	NA	NA	0.04	NO
2008	**0.03**	NO	NO	NO	NO	NA	NA	0.03	NO
2009	**0.04**	NO	NO	NO	NO	NA	NA	0.04	NO
2010	**0.04**	NO	NO	NO	NO	NA	NA	0.04	NO
2011	**0.04**	NO	NO	NO	NO	NA	NA	0.04	NO
2012	**0.04**	NO	NO	NO	NO	NA	NA	0.04	NO
2013	**0.04**	NO	NO	NO	NO	NA	NA	0.04	NO
2014	**0.04**	NO	NO	NO	NO	NA	NA	0.04	NO
2015	**0.04**	NO	NO	NO	NO	NA	NA	0.04	NO
2016	**0.04**	NO	NO	NO	NO	NA	NA	0.04	NO
2017	**0.04**	NO	NO	NO	NO	NA	NA	0.04	NO
2018	**0.04**	NO	NO	NO	NO	NA	NA	0.04	NO
2019	**0.04**	NO	NO	NO	NO	NA	NA	0.04	NO
2020	**0.03**	NO	NO	NO	NO	NA	NA	0.03	NO
2021	**0.03**	NO	NO	NO	NO	NA	NA	0.03	NO
2022	**0.03**	NO	NO	NO	NO	NA	NA	0.03	NO
Trend									
1990 - 2022	*-19.5%*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*-19.5%*	*NA*
2005 - 2022	*-11.7%*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*-11.7%*	*NA*
2021 - 2022	*-1.3%*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*-1.3%*	*NA*

4.2 Mineral Industry (CRT category 2.A)

The CRT category 2.A comprises the process-related carbon dioxide (CO_2) emissions resulting from the use of carbonate raw materials such as limestone and dolomite in the production and use of a variety of mineral industry products. As described in the 2006 IPCC Guidelines, Vol. 3, Chap 1, there are two broad pathways for release of CO_2 from carbonates:

(1) Calcination, and
(2) acid-induced release of CO_2.

Ad (1): The primary process resulting in the release of CO_2 is the calcination of carbonate compounds, during which, through heating, a metallic oxide is formed. A typical calcination reaction, here shown for the mineral calcite or calcium carbonate, would be:

$$CACO_3 + \text{heat} \rightarrow CaO + CO_2$$

Ad (2): Acid-induced release of CO_2 as a result of small quantities of carbonate being present as an impurity in an acidification process to upgrade a non-carbonate material. The formation of CO_2 can be via an equation such as:

$$CACO_3 + H_2SO_4 \rightarrow CaSO4 + H_2O + CO_2$$

In the following table, an overview of the IPCC sub-categories included in this chapter is given and is provided information on the status of emission estimates of all subcategories. A „✓" indicates that emissions from this sub-category have been estimated. None sub-category is key category.

Table 4-6 Overview of sub-categories of category 2.A. *Mineral Industry* and status of estimation.

IPCC Code	CRT category	CO_2		CH_4		N_2O	
2.A	**Mineral Industry**	**Estimated**	**Key Category**	**Estimated**	**Key Category**	**Estimated**	**Key Category**
2.A.1	Cement production	NO	-	NA	-	NA	-
2.A.2	Lime production	✓	-	NA	-	NA	-
2.A.3	Glass Production	NO	-	NA	-	NA	-
2.A.4	Other Process Uses of Carbonates	NO	-	NA	-	NA	-
2.A.4.a	Ceramics	NO	-	NA	-	NA	-
2.A.4.b	Other Uses of Soda Ash	NO	-	NA	-	NA	-
2.A.4.c	Non Metallurgical Magnesia Production	NO	-	NA	-	NA	-
2.A.4.d	Other	NO	-	NA	-	NA	-
2.A.5	Other	NO	-	NA	-	NA	-

4.2.1 Cement production (CRT category 2.A.1)

4.2.1.1 Category description

CRT code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.A.1	Cement production	✓	LA 2022	NA	-	NA	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere. NE -not estimated. NA -not applicable. C – confidential							
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF							

This chapter includes the CO_2 emissions estimations from cement production. Process-related CO_2 emissions are released during clinker production. Cement Production is a key source with regards to CO_2 emissions.

As described in the 2006 IPCC Guidelines, in the cement CO2 is produced during the production of clinker, a nodular intermediate product that is then finely ground, along with a small proportion of calcium sulfate[114] into hydraulic (typically portland) cement. During the production of clinker, limestone, which is mainly calcium carbonate (CaCO3), is heated, or calcined, to produce lime (CaO) and CO2 as a by-product. The CaO then reacts with silica (SiO2), alumina (Al2O3), and iron oxide (Fe2O3) in the raw materials to make the clinker minerals (chiefly calcium silicates). The proportion in the raw materials of carbonates other than CaCO3 is generally very small. The basic chemistry of the cement manufacturing process begins with decomposition of calcium carbonate at about 900 ˚C to leave calcium oxide (CaO) and liberated gaseous carbon dioxide (CO2); this process is known as calcination.

$$CaCO_3 + heat \rightarrow CaO + CO_2$$ … typical calcination reaction

$$CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + H_2O + CO_2$$ … acid-induced release of CO_2

The other carbonates. if present. exist mainly as impurities in the primary limestone raw material. A small amount of MgO (typically 1-2%) in the clinker-making process is desirable as it acts as a flux. but much more than this amount can lead to problems with the cement.

The production of clinker takes place in a kiln system in which the minerals of the raw mix are transformed at high temperatures into new minerals with hydraulic properties. The fine particles of the raw mix move from the cool end to the hot end of the kiln system and the combustion gases move the other way from the hot end to the cold end. After calcination the clinkering process follows, in which the calcium oxide reacts at a high temperature (typically 1.400–1.500 ˚C) with silica, alumina, and ferrous oxide to form the silicates, aluminates and ferrites of calcium that constitute the clinker. The clinker is then rapidly cooled.

The cement industry is highly energy intensive. According to the IPCC guidelines, the combustion (energy) related emissions from fuel consumption are accounted for in the IPCC Sector 1.A.2.f.

[114] calcium sulfate - gypsum (CaSO4·2H2O or anhydrite (CaSO4)

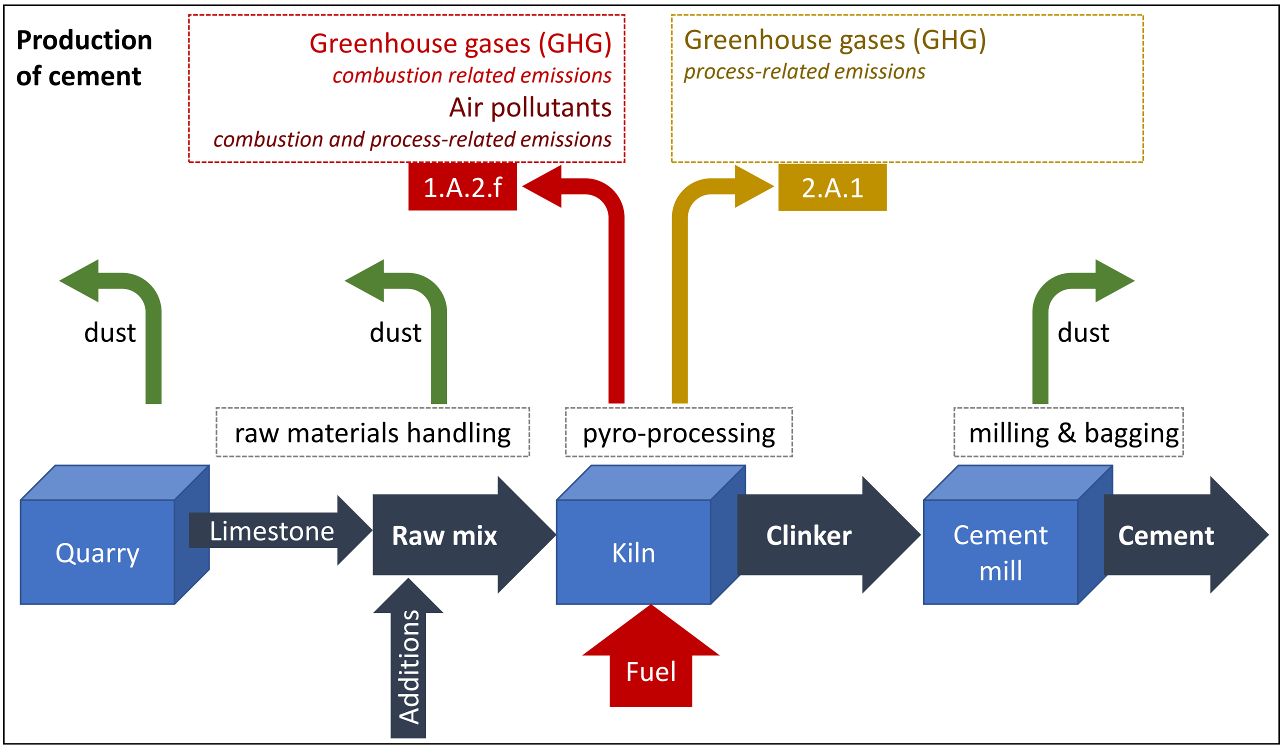


Figure 4-5 Schematic illustration of cement production and allocation of emissions

Currently, there are four cement plants in Albania: (1) Plant at Boka e Kuqe, Burizane, (2) Balldre plant, Lezhe, (3) Fushe Kruje plant and (4) Elbasan cement plant. The annual production is about 2,503 ktons (in 2021). The cements manufactured in Albania are mainly ordinary Portland cements.

Table 4-7 Operating Cement companies in Albania, production capacities and additions used

	Name	Location	Starting	Annual capacity	Additions used	Product
1	Antea Cement Sh.A.	Plant at Boka e Kuqe, Burizane	1978	1500 t	###	CEM I / 42.5 R: Portland Cement with 95 – 100% Clinker. CEM II / A-LL 42.5 R: Portland Limestone Cement with 80 - 94% Clinker. CEM II / B-LL 32.5 R: Portland with 65 - 79% Clinker.
2	Colacem Albania Sh.p.k.	Balldre plant, Lezhe	2009	500 t	###	CEM II/A-LL 42,5 R – PORTLAND: 80 - 94% Clinker. CEM II/B-LL 32,5 R – PORTLAND: 65 - 79% Clinker.
3	Fushe Kruje Cement Factory, Sh.p.k.	Fushe Kruje plant	1966	1330 t	###	###
4		Elbasan cement plant	1996	300 t	###	###

The Cement production was responsible for 351 kt CO_2 emissions in 1990 and for 1171.40 kt CO_2 emissions in 2022, which is an increase of 234% in the period 1990 – 2022, compared to 2005, CO_2 emissions increased by 335.3% from 269.10 kt. The strongly increasing emissions are a consequence of the high demand for cement. Increased number of (small) households and economic development are the drivers of the growing construction industry. Indeed, the production of clinker decreased by 5.99% in 2003. 7.5% in 2010 and 18.4% in 2022, which influenced the production of cement that decreased by 7.5% in 2003. 9.3% in 2010 and 23% in 2022. The significant increase in cement production after 2020 is a result of the suspension of the restrictions due to the corona pandemic.

An overview of the cement production (CRT category 2.A.1) related CO_2 emissions is provided in the following figure and table.

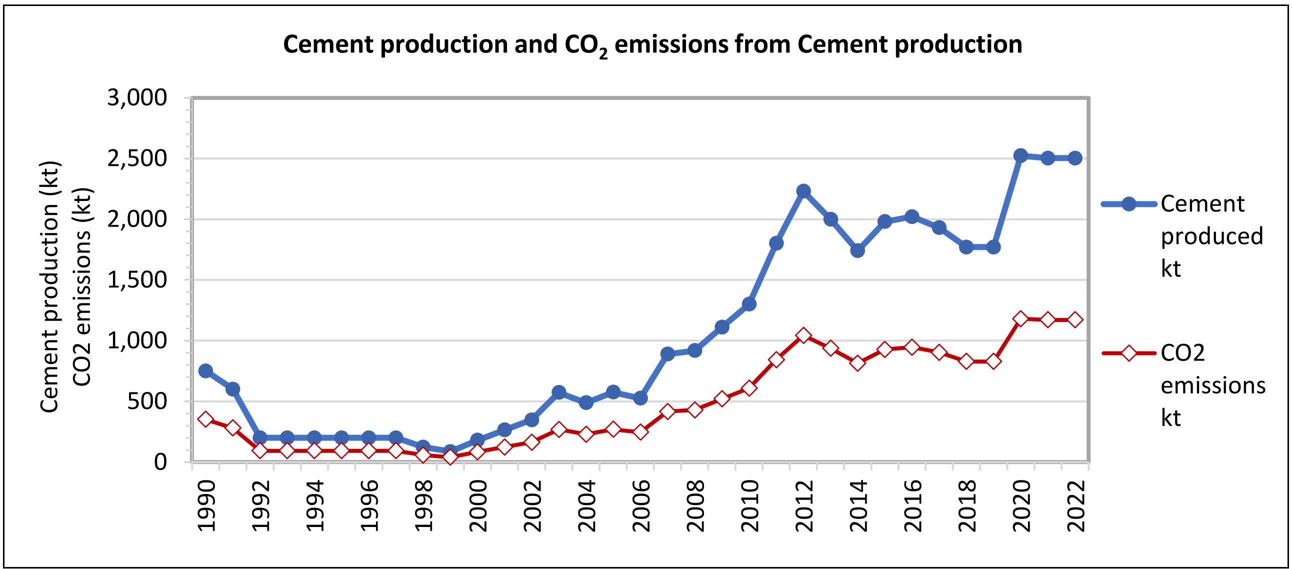


Figure 4-6 Production of Cement and CO_2 emissions from CRT category 2.A.1 Cement production

Table 4-8 Activity data and CO_2 emissions from Cement production (CRT category 2.A.1)

Years	Cement production	Source	Clinker in Cement	Clinker production	CO_2 emission
	kt		%	kt	kt
1990	750.00	US Geological Survey (several years): The Mineral Industry of Albania [115]	90%	675	351.00
1991	600.00			540	280.80
1992	200.00			180	93.60
1993	200.00			180	93.60
1994	200.00			180	93.60
1995	200.00			180	93.60
1996	200.00			180	93.60
1997	200.00			180	93.60
1998	122.84			111	57.49
1999	86.00			77	40.25
2000	180.00			162	84.24
2001	264.00			238	123.55
2002	348.00			313	162.86
2003	573.00			516	268.16
2004	489.00			440	228.85
2005	575.00			518	269.10
2006	525.00			473	245.70
2007	889.00			800	416.05
2008	918.00			826	429.62

[115] US Geological Survey (several years): https://www.usgs.gov/centers/national-minerals-information-center/europe-and-central-eurasia#al

Years	Cement production	Source	Clinker in Cement	Clinker production	CO_2 emission
	kt		%	kt	kt
2009	1,110.00	US Geological Survey (several years): The Mineral Industry of Albania		999	519.48
2010	1,300.00			1,170	608.40
2011	1,800.00			1,620	842.40
2012	2,230.00			2,007	1043.64
2013	2,000.00			1,800	936.00
2014	1,740.00			1,566	814.32
2015	1,980.00			1,782	926.64
2016	2,020.00			1,818	945.36
2017	1,930.00			1,737	903.24
2018	1,770.00			1,593	828.36
2019	1,770.00			1,593	828.36
2020	2,522.00			2,270	1,180.30
2021	2,503.00			2,253	1171.40
2022	2,503.00	As of 2021		2,253	1171.40
Trend					
1990 – 2022	233.7%		NA	233.7%	233.7%
2005 – 2022	335.3%		NA	335.3%	335.3%
2021 - 2022	0.0%		NA	0.0%	0.0%

4.2.1.2 Methodological issues

In the following is provided the decision tree and the decision (highlighted) for Tier 2 method for estimating CO_2 emissions from CRT category 2.A.1 *Cement production.*

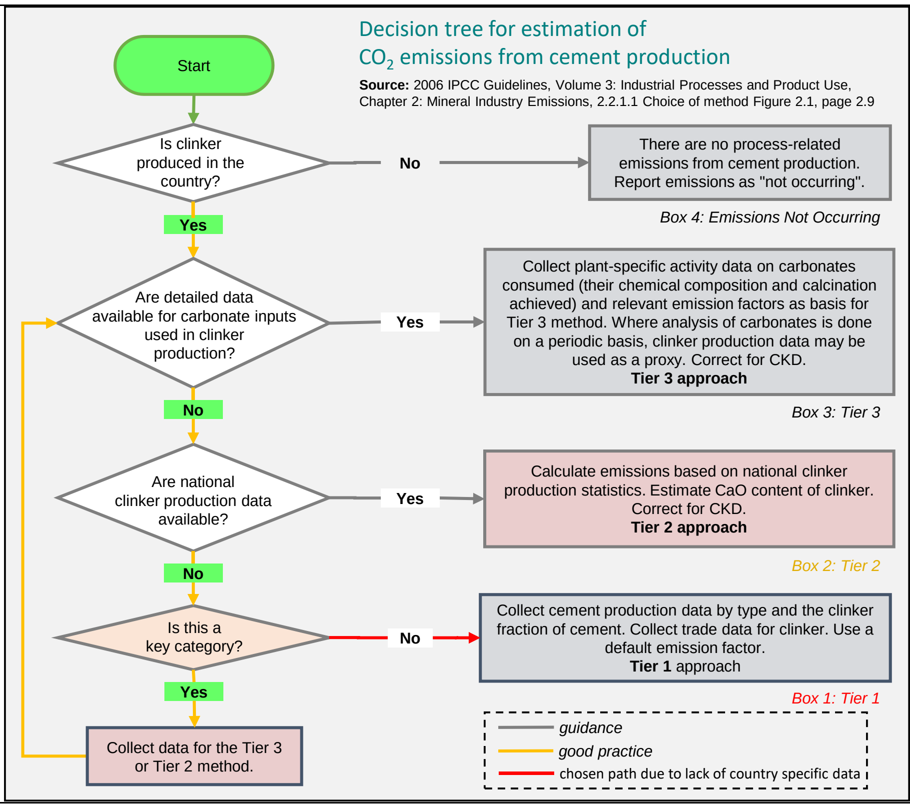


Figure 4-7 Decision tree for estimating GHG emission from CRT category 2.A.1 Cement production

The method is not in line with the decision tree, as the category 2.A.1 *Cement production* is not a key category.

4.2.1.2.1 Choice of methods

The 2006 IPCC Guidelines Tier 1 approach[116] has been applied: CO_2 emissions are based on clinker production estimates inferred from cement production data, correcting for imports and exports of clinker.

Equation 2.1: Tier 1 - Emissions based on cement production (2006 IPCC GL. Vol. 3. Chap. 2.2.1.1*)*

$$\boldsymbol{CO_2\ emissions} = \left[\sum_i (\boldsymbol{Mass_{ci}}\ \boldsymbol{x}\ \boldsymbol{ClFrac}_{\ \boldsymbol{cl\ i}}) - \boldsymbol{Imp} + \boldsymbol{Exp}\right] \boldsymbol{x}\ \boldsymbol{EE_{cl\ i}}$$

Where:

CO_2 Emissions	= emissions of CO_2 from cement production (tonnes)
$Mass_{cli}$	= weight (mass) of cement produced of type (tonnes)
$CFlrac_{cl\ I}$	= clinker fraction of cement of type (fraction %)
Im	= imports for consumption of clinker (tonnes)
Ex	= exports of clinker (tonnes)
$EF_{cl\ i}$	= emission factor for clinker, tonnes CO_2/tonne clinker

4.2.1.2.2 Choice of activity data

Plant specific data or statistical data from INSTAT for production, import and export were not available. Therefore, activity data used for estimation of the CO_2 emissions were taken from US Geological Survey (several years) The Mineral Industry of Albania[117].

No CO_2 emissions were recovered.

4.2.1.2.3 Choice of emission factors

The default clinker emission factor EF_{clc} of the 2006 IPCC Guidelines[118] was applied. In Tier 1, it is *good practice* to

- use a default CaO content for clinker of 65%;
- assume that 100 percent of the CaO is from calcium carbonate material; and
- incorporate a 2 percent correction factor for CKD.

Equation 2.42: Emissions factor for clinker (2006 IPCC GL. Vol. 3. Chap. 2)

For the default CaO composition, 1 tonne of clinker contains 0.65 tonnes CaO from CaCO3.

This carbonate is 56.03% CaO and 43.97% CO_2 by weight.

$$\begin{aligned}\boldsymbol{Emission\ factor_{clc}} &= CaO\ composition\ \boldsymbol{x}\ CKD\ correction \\ &= \left(\frac{0.65}{0.5603}\right) \text{x } 0.4397\ \mathbf{x}\ \text{ CKD correction} \\ &= 1.1601 \text{ tonnes } \mathrm{CaCO_3} \text{ (unrounded) x } 0.4397\ \mathbf{x}\ \text{ CKD correction} \\ &= 0.5101 \text{ tonnes } \mathrm{CO_2} \text{ (unrounded) } \boldsymbol{x}\ 1.02 \\ &= 0.52 \text{ tonnes } \mathrm{CO_2} \text{ / tonne clinker}\end{aligned}$$

[116] Source: 2006 IPCC Guidelines, Volume 3: IPPU, Chapter 2: Mineral Industry Emissions, Section 2.2 Cement Production

[117] US Geological Survey (several years): https://www.usgs.gov/centers/national-minerals-information-center/europe-and-central-eurasia#al

[118] 2006 IPCC GL. Vol 3. IPPU, Chap. Chapter 2: Mineral Industry Emissions. sub-chap 2.2.1.2. (p. 2.12)

4.2.1.3 Uncertainty assessment and time-series consistency

The uncertainties for activity data and emission factors used for CRT category 2.A.1 *Cement production* are presented in the following table.

Table 4-9 Uncertainty for CRT category 2.A.1 Cement production.

Uncertainty	CO_2	Reference
Activity data (AD)	10%	2006 IPCC GL. Vol. 3. Chap.2. Table 2.3 Default uncertainty values for cement production
Emission factor (EF)	25%	
Combined Uncertainty (U)	27%	$U_{total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

The time-series are consistent as the same methodology is applied to the whole period. Activity data are consistent as the dataset was taken from US Geological Survey (several years): The Mineral Industry of Albania.

4.2.1.4 Source-specific QA/QC and verification

The following source-specific QA/QC activities were performed:

⇒ Checked of calculations by spreadsheets
- documented sources.
- use of units.
- record keeping; use of write protection.
- strictly defined interfaces between spreadsheets/calculation modules.
- unique structure of sheets which do the same.
- unique use of formulas; special cases are documented/highlighted.
- quick-control checks for data consistency through all steps of calculation.

⇒ time series consistency
- plausibility checks of dips and jumps.
- yearly public trend repeated values.

⇒ cross-checked from different sources:
- INSTAT (several years): Results on Industrial Production Survey - PRODCOM [119]
- INSTAT (1991): Statistical Yearbook of Albania, 1991. [120]
- International production statistics of UN statistics[121]
- US Geological Survey (several years): The Mineral Industry of Albania.[122]

4.2.1.5 Category-specific recalculations including explanatory information and justifications.

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category 2.A.1 *Cement production*.

[119] https://www.instat.gov.al/media/12615/results-on-industrial-prouction-survey.pdf

[120] https://www.instat.gov.al/en/publications/books/1991/statistical-yearbook-of-albania-1991/

[121] United Nations - Department of Economic and Social Affairs - Statistics Division Statistics - Energy Statistics https://unstats.un.org/unsd/energystats/

[122] US Geological Survey (several years): https://www.usgs.gov/centers/national-minerals-information-center/europe-and-central-eurasia#al

Table 4-10 Recalculations done in CRT category 2.A.1 Cement production

GHG source & sink category	Revisions of data	Type of revision	Type of improvement
2.A.1	Revision of cement production data in national statistics	AD	Accuracy
2.A.1	Revision of share if clinker in cement	AD	Accuracy

4.2.1.6 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 4-11 Planned improvement for CRT category 2.A.1 Cement production

GHG source & sink category	Planned improvement	Type of improvement		Priority
2.A.1	Application of TIER 2 or higher methodology	M	Accuracy	high
2.A.1	Revision of activity data (1990-2022): improvement of time series consistency by collection of plant specific activity data from all cement plants • Production of clinker • Production of cement per type • Clinker fraction • CaO composition of clinker and the MgO content • CaO content of the raw material inputs	AD	Accuracy Transparency Completeness Consistency Compatibility	high
2.A.1	Revision of activity data (1990-2022): improvement of time series consistency • for imports for consumption of clinker • exports of clinker	AD	Accuracy Transparency Compatibility	high
2.A.1	Investigation on amount of cement kiln dust (CKD) which is recycled or not returned to the kiln	AD	Accuracy Transparency	High
2.A.1	Percentage share in cement kiln dust (CKD) which is recycled	AD	Accuracy Transparency Compatibility	Medium
2.A.1	Cross-check of national and international data sources	AD	Accuracy Transparency	Medium

4.2.2 Lime production (CRT category 2.A.2)

4.2.2.1 Source category description

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.A.2	Lime production	✓	LA1990	NA	-	NA	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NE -not estimated, NA -not applicable, C – confidential							
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF							

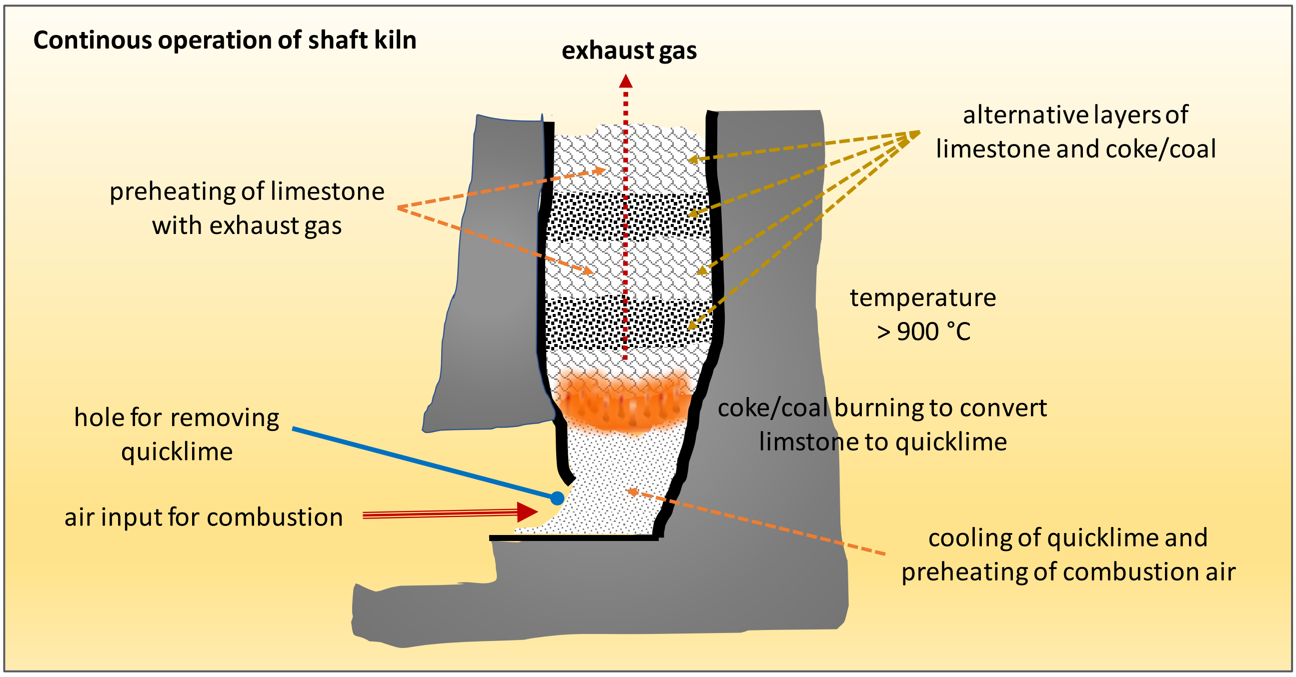


Figure 4-8 Illustration of a shaft kiln for lime production

This chapter includes the CO_2 emissions estimations from lime production. Process-related CO_2 emissions are released during (quick-)lime production. Calcium oxide (CaO), also called as quicklime, is formed by heating limestone to decompose the carbonates. This is usually done in shaft or rotary kilns at high temperatures and the process releases CO_2. Depending on the product requirements (e.g., metallurgy, pulp and paper, construction materials, effluent treatment, water softening, pH control, and soil stabilisation), primarily high calcium limestone (calcite) is utilized in accordance with the following reaction:

$$CaCO_3 \text{ (high-purity limestone)} + \text{heat} \rightarrow CaO \text{ (quicklime)} + CO_2$$

Lime production is not a key source. Emissions from lime production are estimated since 2008. Data for 1990-2007 were not available.

An overview of the lime production (CRT category 2.A.2) related CO_2 emissions is provided in the following figure and table.

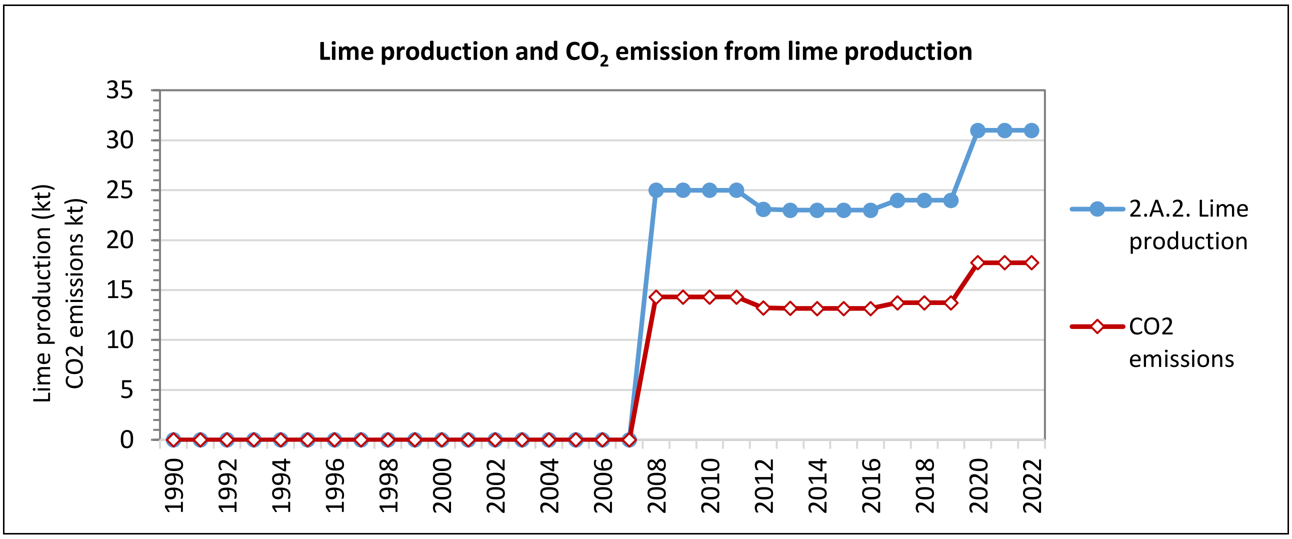


Figure 4-9 CO_2 emissions and lime production from CRT category 2.A.2 Lime production 1990-2022

Table 4-12 Activity data (AD), CO_2 emission factors (EF) and CO_2 emissions from Lime production (CRT category 2.A.2)

Year	Lime production	Source	Share of lime type		CO_2 emissions
			high calcium lime	dolomitic lime	
	tonnes		%		kt
1990	NE	US Geological Survey (several years): The Mineral Industry of Albania [123]	100	0	NE
1991	NE		100	0	NE
1992	NE		100	0	NE
1993	NE		100	0	NE
1994	NE		100	0	NE
1995	NE		100	0	NE
1996	NE		100	0	NE
1997	NE		100	0	NE
1998	NE		100	0	NE
1999	NE		100	0	NE
2000	NE		100	0	NE
2001	NE		100	0	NE
2002	NE		100	0	NE
2003	NE		100	0	NE
2004	NE		100	0	NE
2005	NE		100	0	NE
2006	NE		100	0	NE
2007	NE		100	0	NE
2008	25.00		100	0	14.31
2009	25.00		100	0	14.31
2010	25.00		100	0	14.31
2011	25.00		100	0	14.31
2012	23.10		100	0	13.22

[123] US Geological Survey (several years): https://www.usgs.gov/centers/national-minerals-information-center/europe-and-central-eurasia#al

Year	Lime production	Source	Share of lime type		CO_2 emissions
			high calcium lime	dolomitic lime	
	tonnes		%		kt
2013	23.01	US Geological Survey (several years): The Mineral Industry of Albania	100	0	13.17
2014	23.00		100	0	13.16
2015	23.00		100	0	13.16
2016	23.00		100	0	13.16
2017	24.00		100	0	13.74
2018	24.00		100	0	13.74
2019	24.00		100	0	13.74
2020	31.00		100	0	17.74
2021	31.00		100	0	17.74
2022	31.00	As of 2021	100	0	17.74
Trend					
1990 – 2022	NA				NA
2005 – 2022	NA				NA
2021 - 2022	0.0%				0.0%

4.2.2.2 Methodological issues

4.2.2.2.1 Choice of methods

As is the case for emissions from cement production, there are three basic methodologies for estimating emissions from lime production: an output-based approach that uses default values (Tier 1), an output-based approach that estimates emissions from CaO and CaO·MgO production and country-specific information for correction factors (Tier 2) and an input-based carbonate approach (Tier 3).

The 2006 IPCC Guidelines Tier 1 approach[124] has been applied:

Equation: Tier 1 - Emissions based on national lime production data

(2006 IPCC Guidelines, Vol. 3, Chapter 2, sub-chapter 2.3.1.1)

$$CO_2\ emissions = Mass_{lime} \times Emission\ \mathrm{Factor}_{\mathrm{lime}}$$

based on

Equation 2.6: Tier 2 - Emissions based on national lime production data by type

$$CO_2\ emissions = \sum_i Mass_{lime,\mathrm{i}} \times Emission\ \mathrm{Factor}_{\mathrm{lime,i}} \times CF_{LKD,\mathrm{i}} \times C_{H,\mathrm{i}}$$

Where:

CO_2 Emissions	= emissions of CO_2 from lime production (tonnes)
$Mass_{lime}$	= weight (mass) of lime produced (tonnes)
EF_{lime}	= emission factor for lime (tonnes CO_2/tonne lime) (see Equation 2.9)
$CF_{Lkd,i}$	= emissions correction factor for Lime Kiln Dust (CKD) (dimensionless)
$C_{h,i}$	= correction factor for hydrated lime of the type i of lime (dimensionless)

[124] Source: 2006 IPCC Guidelines, Volume 3: Industrial Processes and Product Use, Chapter 2: Mineral Industry Emissions, Sub-chapter 2.3.1.1 Lime Production - Choice of method

According to 2006 IPCC Guidelines, Vol. 3, Chap. 2.3.1.1, the Tier 1 method is based on applying a default emission factor to national level lime production data. Country-specific information on lime production by type (e.g., high calcium lime, dolomitic lime, or hydraulic lime) is not necessary for *good practice* in Tier 1. It is not necessary for *good practice* to account for LKD in Tier 1.

4.2.2.2.2 Choice of activity data

For lime production, plant specific data or statistical data from INSTAT for production, import and export were not available. Therefore, activity data used for estimation of the CO_2 emissions were taken from US Geological Survey (several years) The Mineral Industry of Albania[125].

It is assumed that 100 % of production is high calcium lime.

No CO_2 emissions were recovered.

4.2.2.2.3 Choice of emission factors

The default emission factor of 0.753 tonne CO2 / t lime was applied.

Tier 1 is an output-based method and applies an emission factor to the total quantity of lime produced. The emission factor is based on the stoichiometric ratios.

The 2006 IPCC Guidelines Tier 1 approach[126] has been applied:

Equation 2.8: Tier 1 Default emission factor for lime production

(2006 IPCC Guidelines, Vol. 3, Chapter 2, sub-chapter 2.3.1.1)

$$\boldsymbol{EF}_{\boldsymbol{Lime}} = \frac{\boldsymbol{Share}\ \text{high\_calcium}}{\mathbf{100}} \times \boldsymbol{EF}_{\boldsymbol{high\ calcium\ lime}} + \frac{\boldsymbol{Share}\ \text{dolomitic}}{\mathbf{100}} \times \boldsymbol{EF}_{\boldsymbol{dolomitic\ lime}}$$

Where:

EF_{Lime}	= emission factor for lime (tonnes CO_2 / tonne lime)
Share	= default share of produced type of lime (%)
$EF_{high\ calcium\ lime}$	= emission factor for high-calcium lime (tonnes CO_2/tonne CaO)
$EF_{dolomitic\ lime}$	= emission factor for dolomitic lime (tonnes CO_2/tonne CaO·MgO)

Table 4-13 Basic parameters for the calculation of emission factors for lime production

Lime Type	Stoichiometric Ratio		Range of		Share (default)	CO_2 Emission factor (EF)		
	tonnes CO_2 / tonne CaO	tonnes CO_2 / CaO·MgO]	CaO Content	MgO Content		High-calcium lime	Dolomitic lime	Default lime
			%		%	(tonne CO_2 / t lime)		
High-calcium lime	0.785	-	93-98	0.3-2.5	100	0.75	-	-
Dolomitic lime	-	0.913	55-57	38-41	0	-	0.77	-
Default Lime								0.753

Source: Table 2.4 of 2006 IPCC Guidelines, Volume 3: Industrial Processes and Product Use, Chapter 2: Mineral Industry Emissions, sub-chapter 2.3.1.2 - Choice of emission factor (Lime Production)

[125] US Geological Survey (several years): https://www.usgs.gov/centers/national-minerals-information-center/europe-and-central-eurasia#al

[126] 2006 IPCC Guidelines, Volume 3: Industrial Processes and Product Use, Chapter 2: Mineral Industry Emissions, Sub-chapter 2.3.1.1 Lime Production - Choice of method

4.2.2.3 Uncertainties and time-series consistency

The uncertainties for activity data and emission factors used for CRT category 2.A.2 Lime *production* are presented in the following table.

Table 4-14 Uncertainty for CRT category 2.A.2 Lime production.

Uncertainty	CO_2	Reference
Activity data (AD)	10%	
• *Uncertainty in assuming an average CaO in lime*	*8%*	2006 IPCC GL, Vol. 3, Chap.2, Table 2.5 Default uncertainty values for lime production, page 2.25 and sub-chapter 2.3.2.2, page 2.26.
• *Emission factor high calcium lime*	*2%*	2006 IPCC GL, Vol. 3, Chap.2, Table 2.5 Default uncertainty values for lime production, page 2.25 and sub-chapter 2.3.2.1, page 2.25.
• *Emission factor dolomitic lime*	*2%*	
Emission factor (EF)	3%	
Combined Uncertainty (U)	10%	$U_{Total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

The time-series are considered to be consistent as Tier 1 approach is applied to the entire time series.

4.2.2.4 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed:

⇒ Checked of calculations by spreadsheets
  - consistent use of production statistics from INSTAT
  - documented sources,
  - use of units,
  - record keeping; use of write protection,
  - unique use of formulas; special cases are documented/highlighted,
  - quick-control checks for data consistency through all steps of calculation.

⇒ cross-checked from two sources:
  - INSTAT (1991): Statistical Yearbook of Albania, 1991. [127]
  - International production statistics of UN statistics[128]
  - US Geological Survey (several years): The Mineral Industry of Albania.[129]

4.2.2.5 Category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category 2.A.2 *Lime production*.

[127] https://www.instat.gov.al/en/publications/books/1991/statistical-yearbook-of-albania-1991/

[128] United Nations - Department of Economic and Social Affairs - Statistics Division Statistics - Energy Statistics https://unstats.un.org/unsd/energystats/

[129] US Geological Survey (several years): https://www.usgs.gov/centers/national-minerals-information-center/europe-and-central-eurasia#al

Table 4-15 Recalculations done since submission 2017 CRT category 2.C.1 *Iron and Steel Production*

GHG source & sink category	Revisions of data	Type of revision	Type of improvement
2.A.2	No revisions were performed.		

4.2.2.6 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 4-16 Planned improvement for CRT category 2.A.2 Lime production

GHG source & sink category	Planned improvement	Type of improvement		Priority
2.A.2	Analysis of lime types for application Tier 2	AD	Completeness	Medium
2.A.2	Analysis of industries that produce non-marketed, e.g. sugar production, pulp and paper manufacturing facilities, metallurgy, water softeners.	AD	Accuracy Transparency	Medium

4.2.3 Glass Production (CRT category 2.A.3)

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.A.3	Glass production	NO	-	NA	-	NA	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NE -not estimated, NA -not applicable, C – confidential							
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF							

The CRT category 2.A.3 *Glass Production* does not exist in Albania.

4.2.4 Other Process Uses of Carbonates (CRT category 2.A.4)

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.A.4	Other Process Uses of Carbonates	NO	-	NA	-	NA	-
2.A.4.a	Ceramics	NO	-	NA	-	NA	-
2.A.4.b	Other Uses of Soda Ash	NO	-	NA	-	NA	-
2.A.4.c	Non-Metallurgical Magnesia Production	NO	-	NA	-	NA	-
2.A.4.d	Other (please specify)	NO	-	NA	-	NA	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NE -not estimated, NA -not applicable, C – confidential							
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF							

The CRT category 2.A.4 *Other Process Uses of Carbonates* does not exist in Albania.

4.2.5 Other (CRT category 2.A.5)

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.A.3	Other (please specify)	NO	-	NA	-	NA	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NE -not estimated, NA -not applicable, C – confidential							
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF							

The CRT category 2.A.5 *Other* does not exist in Albania.

4.3 Chemical Industry (CRT category 2.B)

The CRT category 2.B comprises the production of various inorganic and organic chemicals. The following tables provides information which of the chemical industries are occurrent in Albania.

Table 4-17 Overview of chemical industries occurring in Albania.

IPCC code	Description	Occurrent		Not occurrent NO
		Estimated	Not estimated (NE)	
2.B.1	Ammonia Production (*including Urea production*)	✓		
2.B.2	Nitric Acid Production		x	
2.B.3	Adipic Acid Production			NO
2.B.4	Caprolactam, Glyoxal and Glyoxylic Acid Production			NO
2.B.5	Carbide Production			NO
2.B.6	Titanium Dioxide Production			NO
2.B.7	Soda Ash Production		x	
2.B.8	Petrochemical and Carbon Black Production			NO
2.B.8.a	Methanol		x	
2.B.8.b	Ethylene		x	
2.B.8.c	Ethylene Dichloride and Vinyl Chloride Monomer			NO
2.B.8.d	Ethylene Oxide			NO
2.B.8.e	Acrylonitrile			NO
2.B.8.f	Carbon Black			NO
2.B.9	Fluorochemical Production			NO
2.B.9.a	By product emissions			NO
2.B.9.b	Fugitive Emissions			NO
2.B.10	Other - Urea	✓		

4.3.1 Ammonia Production (CRT category 2.B.1)

4.3.1.1 Category description

CRT code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.B.1	Ammonia production	✓	LA 1990	NA	-	NA	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere. NE -not estimated. NA -not applicable. C – confidential							
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF							

This chapter includes the process-related CO_2 emissions estimations from ammonia production. Combustion re-related GHG emissions are allocated in 1.A.2.c Chemical industry. Ammonia production is a key source with regards to CO_2 emissions.

As presented in the 2006 Guidelines, the process of ammonia production is based on the ammonia synthesis loop (also referred to as the Haber-Bosch process) reaction of nitrogen (derived from process air) with hydrogen to form anhydrous liquid ammonia. The hydrogen is derived from feedstock as natural gas (conventional steam reforming route). Anhydrous ammonia produced by catalytic steam reforming of natural gas (mostly CH_4) involves the following reactions with carbon dioxide produced as a by-product:

Primary steam reforming	$CH_4 + H2O \rightarrow CO + 3H_2$
	$CO + H2O \rightarrow CO_2 + H_2$
Secondary air reforming	$CH_4 + air \rightarrow CO + 2H_2 + 2N_2$
Overall reaction	$0.88\ CH_4 + 1.26\ Air + 1.24H_2O \rightarrow 0.88CO_2 + N_2 + 3H_2$
Ammonia synthesis	$N_2 + 3H_2 \rightarrow 2NH_3$
Secondary reformer Process gas shift conversion	$CO + H_2O \rightarrow CO_2 + H_2$

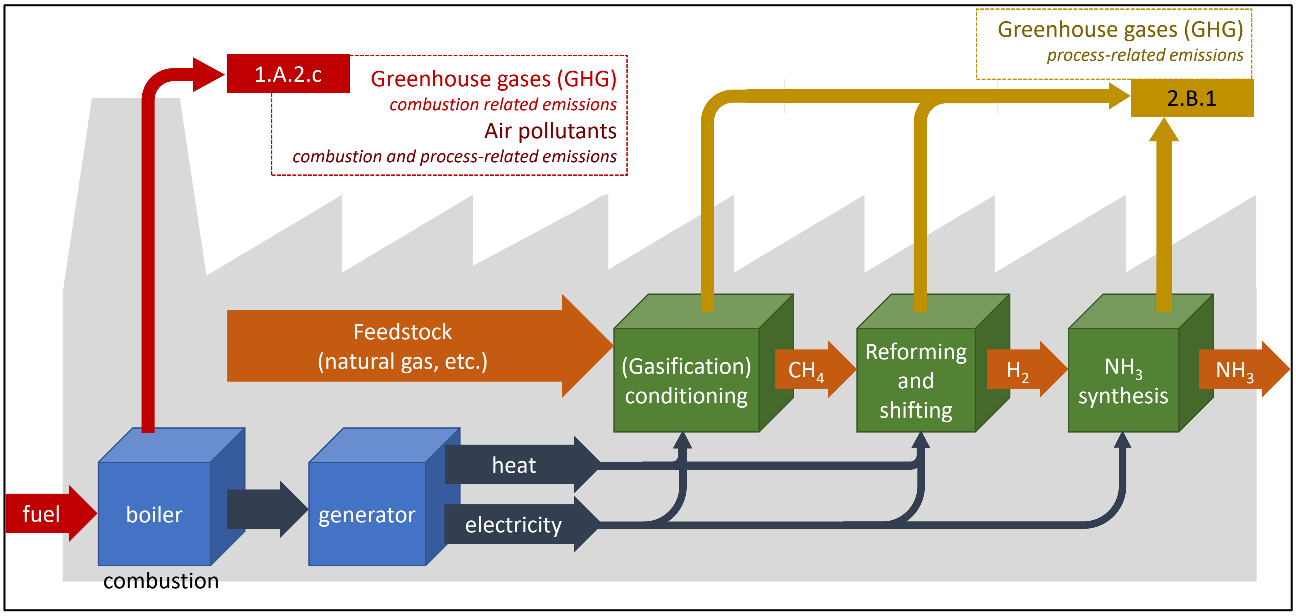


Figure 4-10 Schematic illustration of Ammonia production and allocation of emissions

According to the 2006 IPCC Guidelines, the processes that affect CO_2 emissions associated with ammonia production are:

- carbon monoxide shift at two temperatures using iron oxide, copper oxide and/or chromium oxide catalyst for conversion to carbon dioxide;
- carbon dioxide absorption by a scrubber solution of hot potassium carbonate, mono-ethanolamine (MEA). Sulfinol (alkanol amine and tetrahydrothiophene dioxide) or others;
- methanation of residual CO_2 to methane with nickel catalysts to purify the synthesis gas.

The urea production process consists of two main equilibrium reactions, with incomplete conversion of the reactants. This is described in chapter 4.3.11.

As presented in the study from 1992, all indigenously produced nitrogen fertilizers are from a single site located at Fier, south of Tirana.[130]

The production of ammonia, Nitric Acid and urea stopped in 1994.

Table 4-18 Nitrogen Fertilizer Production Plant at Fier, Albania

Plant	Name	Starting	Annual capacity	Design Fuel and Feedstock
1	Partial Oxidation Ammonia Unit Nitrlc Acid Unit Prilled Ammonium Nitrate (High-Denslty) Unit	1967	110,000 (Prilled ammonium nitrate)	Straight-run Petroleum Naphtha. Changed to natural gas in 1971 and to NG and/or gasoline in 1991.
2	Steam Reforming Ammonia Unit Total Recycle Urea (Prilled) Unit	1976	85,000 (Prilled urea)	Natural Gas
3	Steam Reforming Ammonia Unit Total Recycle Urea (Prilled) Unit	1990	100,000 (Prilled urea)	Natural Gas

Total emissions of CO_2 from ammonia production were 188.34 kt CO_2 in 1990. The amount of CO_2 recovered for urea production is already deducted. The fertilizer plant was closed in 1994.

CO_2 emissions from Urea production are allocated under CRT category 2.B.10.

An overview of the ammonia production (CRT category 2.B.1) related CO_2 emissions is provided in the following figure and table.

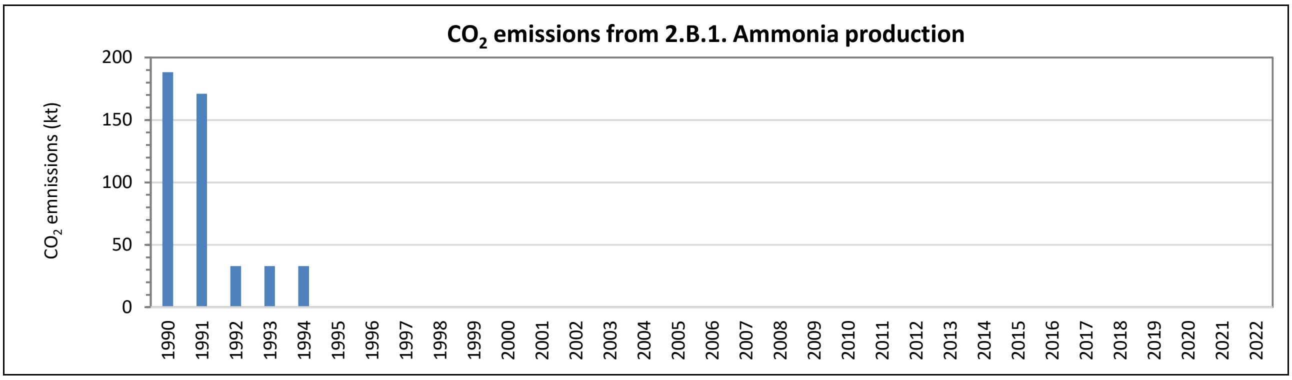


Figure 4-11 CO_2 emissions from CRT category 2.B.1 Ammonia production

[130] International Fertilizer Development Center (IFDC) (1992): Fertilizers in Albania situation, analysis, and recommendations. Funded by United States Agency for International Development (USAID). https://pdf.usaid.gov/pdf_docs/Pnabq665.pdf

Table 4-19 Activity data and CO_2 emissions from Ammonia production (CRT category 2.B.1)

Years	*For comparison*				Activity data				CO_2 emissions
	Ammonium nitrate (AN)				Ammonia production (N content)		Stoichiometric ratio	Ammonia production	
	kt	Source of data	kt	Source of data	kt	Source of activity data		kt	kt
1990	93	INSTAT[131]	30.800	FAO : Fertilizers archive (1991-2009)[132]	100,000	US Geological Survey (1997): The Mineral Industry of Albania [133]	assuming that Ammonia has N content of 82%	121,951	188.34
1991			21.133		80,000			97,561	171.14
1992			11.467		15,000			18,293	33.03
1993			1.800		15,000			18,293	33.03
1994			2.040		15,000			18,293	33.03
1995			NO		NO			NO	NO
⋮			⋮		⋮			⋮	⋮
2022			NO		NO			NO	NO

4.3.1.2 Methodological issues

4.3.1.2.1 Choice of methods

Ammonia production

For estimating the CO_2 emissions, the 2006 IPCC Guidelines Tier 1 approach[134] has been applied:

Equation 3.1: CO_2 emissions from ammonia production – TIER 1 (2006 IPCC GL. Vol. 3. Chap. 3)

$$\boldsymbol{Emissions_{CO_2} = AP \times EF_{CO_2} - R_{CO_2}}$$

$$with \qquad \boldsymbol{EF_{CO_2} = FR \times CCF \times COF \times \frac{44}{12}}$$

Where:

Emissions $_{CO2}$	= CO_2 emission (kg)
AP	= ammonia production (tonnes)
EF_{CO2}	= default CO_2 emission factor (tonnes CO_2/tonne NH3)
FR	= fuel requirement per unit of output (GJ/tonne ammonia produced)
CCF	= carbon content factor of the fuel (kg C/GJ)
COF	= carbon oxidation factor of the fuel, fraction
44/12	= ratio of molecular weight of CO_2 (44) to the molecular weight of carbon (12)
R_{CO2}	= CO_2 recovered for downstream use (urea production) (kg)

[131] INSTAT (1991): Statistical Yearbook of Albania, 1991. https://www.instat.gov.al/en/publications/books/1991/statistical-yearbook-of-albania-1991/

[132] https://www.fao.org/faostat/en/#data/RA

[133] US Geological Survey (several years): https://www.usgs.gov/centers/national-minerals-information-center/europe-and-central-eurasia#al

[134] Source: 2006 IPCC Guidelines, Volume 3: IPPU, Chapter 3: Chemical Industry Emissions – 3.2.2.1 Choice of method

4.3.1.2.2 Activity data

Plant specific data or statistical data from INSTAT for production were not available for all years. Therefore, activity data used for estimation of the CO_2 emissions were taken from US Geological Survey (several years) *The Mineral Industry of Albania*[135]. Data from FAO for ammonium nitrate (AN) production were used for crosscheck. However, big difference in the data set was observed. See here planned improvements.

The activity data are presented in the Figure and Table above.

CO_2 emissions were recovered for production of Urea. (see chapter 4.3.11).

4.3.1.2.3 Emission factors

As no plant-level information is not available, it is *good practice* to use default factors. For the Tier 1 method it is *good practice* to use the highest total fuel requirement per ton of ammonia.

Equation 3.1: CO_2 emissions from ammonia production – TIER 1 (2006 IPCC GL. Vol. 3. Chap. 3)

$$EF_{CO_2} = FR \times CCF \times COF \times \frac{44}{12}$$

Where:

EF_{CO2}	= default CO_2 emission factor (tonnes CO_2/tonne NH3)
FR	= fuel requirement per unit of output (GJ/tonne ammonia produced)
CCF	= carbon content factor of the fuel (kg C/GJ)
COF	= carbon oxidation factor of the fuel, fraction
44/12	= ratio of molecular weight of CO_2 (44) to the molecular weight of carbon (12)

Table 4-20 Default CO_2 emission factor for CRT category 2.B.1 *Ammonia production.*

	Parameter	Unit	Value	Reference
FR	total fuel requirement	GJ(NCV)/tonne NH3	37.5	Table 3.1. 2006 IPCC GL. Vol. 3 IPPU. Chapter 3
CCF	carbon content factor of the fuel	kg C/GJ	15.3	
COF	carbon oxidation factor of the fuel	fraction	1	
con	Conversion factor of carbon in carbon dioxide (44/12)	-	3.67	
EF_{CO2}	**default CO_2 emission factor**	**tonnes CO_2/tonne NH3**	**2.104**	

4.3.1.3 Uncertainty assessment and time-series consistency

The uncertainties for activity data and emission factors used for CRT category 2.B.1 *Ammonia production* are presented in the following table.

Table 4-21 Uncertainty for CRT category 2.B.1 *Ammonia production.*

Uncertainty	N_2O	Reference
Activity data (AD)	5%	2006 IPCC GL. Vol. 3. IPPU Chap. 3.3.3.2
Emission factor (EF)	7%	Table 3.3. 2006 IPCC GL. Vol. 3 IPPU. Chapter 3
Combined Uncertainty (U)	9%	$U_{total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

[135] US Geological Survey (several years): https://www.usgs.gov/centers/national-minerals-information-center/europe-and-central-eurasia#al

The time-series are considered to be consistent.

4.3.1.4 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed out:

⇒ Checked of calculations by spreadsheets
  - documented sources,
  - use of units and conversion factors,
  - strictly defined interfaces between spreadsheets/calculation modules,
  - unique structure of sheets which do the same,
  - record keeping, use of write protection,
  - unique use of formulas, special cases are documented/highlighted,
  - quick-control checks for data consistency through all steps of calculation.

⇒ cross-checked from different sources:
  - INSTAT (1991): Statistical Yearbook of Albania, 1991. [136]
  - International production statistics of UN statistics[137]
  - US Geological Survey (several years): The Mineral Industry of Albania.[138]
  - FAO[139]

⇒ cross checks with other relevant sectors (2.B.2, 2.B.10, 1.A.2.c) are performed to avoid double counting or omissions.

4.3.1.5 Category-specific recalculations including explanatory information and justifications

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category 2.B.1 *Ammonia production.*

Table 4-22 Recalculations done in CRT category 2.B.1 *Ammonia production.*

GHG source & sink category	Revisions of data	Type of revision	Type of improvement
2.B.1	No revisions were performed		

4.3.1.6 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

[136] https://www.instat.gov.al/en/publications/books/1991/statistical-yearbook-of-albania-1991/

[137] United Nations - Department of Economic and Social Affairs - Statistics Division Statistics - Energy Statistics https://unstats.un.org/unsd/energystats/

[138] US Geological Survey (several years): https://www.usgs.gov/centers/national-minerals-information-center/europe-and-central-eurasia#al

[139] FAO – FAOSTAT – Land, Inuts and Sustainability – Inputs - Fertilizers by Product https://www.fao.org/faostat/en/#data/RFB

Table 4-23 Planned improvements for CRT category 2.B.1 *Ammonia production.*

GHG source & sink category	Planned improvement	Type of improvement		Priority
2.B.1	Application of Tier 2 methodology or higher	meth	Accuracy	High
2.B.1	Collection of plant specific activity data: • production capacity data per plant • type and amount of feedstock used	AD	Accuracy	High
2.B.1	Collection of plant specific parameter • fuel requirement per unit of output • carbon content factor of the fuel • carbon oxidation factor of the fuel	EF	Accuracy	High
2.B.1	Collection of information on CO_2 recovery for urea and conversion of ammonium nitrate (AN). Collection of information on NH3 and HNO3 recovery for Ammonia Nitrate production.	AD	Accuracy	Medium
2.B.1	Cross-check with Energy balance for fuel as feedstock – non-energy use to avoid double counting	AD	Accuracy	High

4.3.2 Nitric Acid Production (CRT category 2.B.2)

4.3.2.1 Category description

CRT code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.B.2	Nitric Acid Production	NA	-	NA	-	NE	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere. NE -not estimated. NA -not applicable. C – confidential							
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF							

Nitric acid is used as a raw material mainly in the manufacture of nitrogenous-based fertiliser. As described in the 2006 IPCC Guidelines[140], during the production of nitric acid (HNO3) , nitrous oxide (N_2O) is generated as an unintended by-product of the high temperature catalytic oxidation of ammonia (NH3). The amount of N_2O formed depends, inter alia, on combustion conditions (pressure, temperature) , catalyst composition and age and burner design.

As presented in the study from 1992, all indigenously produced nitrogen fertilizers are from a single site located at Fier, south of Tirana.[141]

The production of ammonia, Nitric Acid and urea stopped in 1994.

Table 4-24 Nitrogen Fertilizer Production Plant at Fier, Albania

Plant	Name	Starting	Annual capacity	Design Fuel and Feedstock
1	Nitric Acid Unit with operating pressure of 3.5 kg/cm^2 (medium pressure plant)	1967	270 mtpd of 53% nitric acid (143 mtpd of 100% HNOJ).	

The CRT category 2.B.2 *Nitric Acid Production* is not estimated due to lack of data.

4.3.2.2 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 4-25 Planned improvements for CRT category 2.B.2 *Nitric Acid Production*

GHG source & sink category	Planned improvement	Type of improvement		Priority
2.B.2	Collection of plant specific activity data • utilization factor • nitric acid production	AD	Completeness	high
2.B.2	Collection of plant-specific measurements: N_2O generation and destruction factors	EF	Accuracy	High
2.B.2	Application of Tier 2 methodology or higher	meth	Accuracy	medium
2.B.2	Collection of information on HNO3 recovery for Ammonia nitrate and nitro phosphate plant production.	EF	Accuracy	medium

[140] Source: 2006 IPCC Guidelines, Volume 3: IPPU, Chapter 3: Chemical Industry Emissions, chapter 3.3 Nitric acid production

[141] International Fertilizer Development Center (IFDC) (1992): Fertilizers in Albania situation, analysis, and recommendations. Funded by United States Agency for International Development (USAID). https://pdf.usaid.gov/pdf_docs/Pnabq665.pdf

4.3.3 Adipic Acid Production (CRT category 2.B.3)

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.B.3	Adipic Acid Production	NO	-	NA	-	NO	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NE -not estimated, NA -not applicable, C – confidential							
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF							

The CRT category 2.B.3 *Adipic Acid Production* does not exist in Albania.

4.3.4 Caprolactam, Glyoxal and Glyoxylic Acid Production (CRT category 2.B.4)

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.B.4	Caprolactam, Glyoxal and Glyoxylic Acid Production	NO	-	NA	-	NO	-
A '✓' indicates emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere NE -not estimated, NA -not applicable, C – confidential							
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF							

The CRT category 2.B.4 *Caprolactam, Glyoxal and Glyoxylic Acid Production* does not exist in Albania.

4.3.5 Carbide Production (CRT category 2.B.5)

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.B.5	Carbide Production	NO	-	NO	-	NA	-
A '✓' indicates emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere NE -not estimated, NA -not applicable, C – confidential							
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF							

The CRT category 2.B.5 *Carbide Production* does not exist in Albania.

4.3.6 Titanium Dioxide Production (CRT category 2.B.6)

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.B.6	Titanium Dioxide Production	NO	-	NA	-	NA	-
A '✓' indicates emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere NE -not estimated, NA -not applicable, C – confidential							
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF							

The CRT category 2.B.6 *Titanium Dioxide Production* does not exist in Albania.

4.3.7 Soda Ash Production (CRT category 2.B.7)

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.B.7	Soda Ash Production	NE	-	NA	-	NA	-
A '✓' indicates emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere NE -not estimated, NA -not applicable, C – confidential							
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF							

The Statistical Yearbook of Albania, 1991 from INSTAT [142] presented a production of soda ash with 23.000 t in 1990. Further information on the trona or the natural soda ash was not available.
Therefore, the CRT category 2.B.7 *Soda Ash Production* is not estimated due to lack of data.

4.3.7.1 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 4-26 Planned improvements for CRT category 2.B.7 *Soda Ash Production*

GHG source & sink category	Planned improvement	Type of improvement		Priority
2.B.7	Collection of plant specific activity data • amount of natural soda ash produced • amount of Trona used • capacity of plant	AD	Completeness	high
2.B.7	Preparation of an input-output analysis	EF	Accuracy	High

[142] https://www.instat.gov.al/en/publications/books/1991/statistical-yearbook-of-albania-1991/

4.3.8 Petrochemical and Carbon Black Production (CRT category 2.B.8)

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.B.8	Petrochemical and Carbon Black Production	NO	-	NO	-	NA	-
2.B.8.a	Methanol	NE	-	NO	-	NA	-
2.B.8.b	Ethylene	NE	-	NO	-	NA	-
2.B.8.c	Ethylene Dichloride and Vinyl Chloride Monomer	NO	-	NO	-	NA	-
2.B.8.d	Ethylene Oxide	NO	-	NO	-	NA	-
2.B.8.e	Acrylonitrile	NO	-	NO	-	NA	-
2.B.8.f	Carbon Black	NO	-	NO	-	NA	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NE -not estimated, NA -not applicable, C – confidential							
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF							

The CRT category 2.B.8 *Petrochemical and Carbon Black Production* does not exist in Albania.

4.3.9 Fluorochemical Production (CRT category 2.B.9)

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.B.9	Fluorochemical Production	NA	-	NA	-	NA	-
2.B.9.a	By product emissions	NA	-	NA	-	NA	-
2.B.9.b	Fugitive Emissions	NA	-	NA	-	NA	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NE -not estimated, NA -not applicable, C – confidential							
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF							

The CRT category 2.B.9 *Fluorochemical Production* does not exist in Albania.

4.3.10 Other - Urea production (CRT category 2.B.10)

4.3.10.1 Category description

CRT code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.B.10	Other						
2.B.10.a.	Hydrogen production	NO	-	NO	-	NO	-
2.B.10.b	Other - Urea production	✓	-	NO	-	NO	-
2.B.10.c	Other – not specified	NO	-	NO	-	NO	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere. NE -not estimated. NA -not applicable. C – confidential							
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF							

This chapter includes the process-related to CO_2 emissions estimations from urea production. Combustion re-related GHG emissions are allocated in 1.A.2.c Chemical industry.

Urea production

Urea is produced commercially from synthetic ammonia and carbon dioxide, mainly in integrated chemical plants in downstream.

The urea production process consists of two main equilibrium reactions, with incomplete conversion of the reactants. The first is carbamate formation: the fast-exothermic reaction of liquid ammonia with gaseous carbon dioxide (CO_2) at high temperature and pressure to form ammonium carbamate (H2N-COONH4):

$$2NH_3 + CO_2 \leftrightarrows H_2N\text{-}COONH_4$$

The second is urea conversion - the slower endothermic decomposition of ammonium carbamate into urea and water:

$$H_2N\text{-}COONH_4 \leftrightarrows (NH_2)_2CO + H_2O$$

The overall conversion of NH3 and CO_2 to urea is exothermic, the reaction heat from the first reaction driving the second.

As presented in the study from 1992, all indigenously produced nitrogen fertilizers are from a single site located at Fier, south of Tirana.[143] The production of ammonia, Nitric Acid and Urea stopped in 1994.

Table 4-27 Nitrogen Fertilizer Production Plant at Fier, Albania

Plant	Name	Starting	Annual capacity	Design Fuel and Feedstock
1	Partial Oxidation Ammonia Unit Nitric Acid Unit Prilled Ammonium Nitrate, High-Denslty Unit	1967	110,000 (Prilled ammonium nitrate)	Straight-run Petroleum Naphtha. Changed to natural gas in 1971 and to NG and/or gasoline in 1991.
2	Steam Reforming Ammonia Unit Total Recycle Urea (Prilled) Unit	1976	85,000 (Prilled urea)	Natural Gas
3	Steam Reforming Ammonia Unit Total Recycle Urea (Prilled) Unit	1990	100,000 (Prilled urea)	Natural Gas

[143] International Fertilizer Development Center (IFDC) (1992): Fertilizers in Albania situation, analysis, and recommendations. Funded by United States Agency for International Development (USAID). https://pdf.usaid.gov/pdf_docs/Pnabq665.pdf

Total emissions of CO_2 from urea production were 0.225 t CO_2 in 1990. The fertilizer plant was closed in 1994.

An overview of the urea production (CRT category 2.B.10) related CO_2 emissions is provided in the following figure and table.

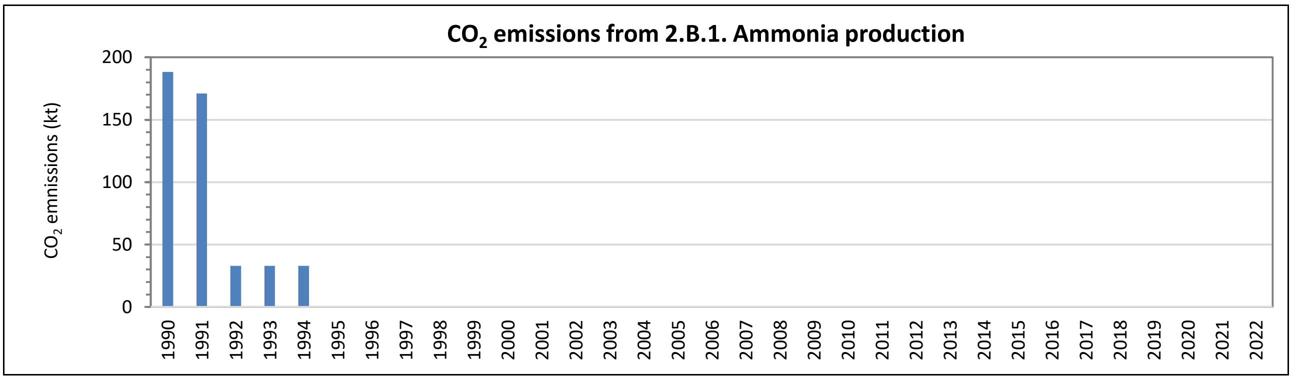


Figure 4-12 CO_2 emissions from CRT category 2.B.10 Urea production

Table 4-28 Activity data and CO_2 emissions from Urea production (CRT category 2.B.10)

Years	*For comparison*				Activity data				CO_2 emissions
	Ammonium nitrate (AN)				Ammonia production (N content)		Stoichiometric ratio	Ammonia production	
	kt	Source of data	kt	Source of data	kt	Source of activity data		kt	kt
1990	93	INSTAT[144]	30.800	FAO : Fertilizers archive (1991-2009)[145]	100,000	US Geological Survey (1997): The Mineral Industry of Albania [146]	assuming that Ammonia has N content of 82%	121,951	188.34
1991			21.133		80,000			97,561	171.14
1992			11.467		15,000			18,293	33.03
1993			1.800		15,000			18,293	33.03
1994			2.040		15,000			18,293	33.03
1995			NO		NO			NO	NO
⋮			⋮		⋮			⋮	⋮
2022			NO		NO			NO	NO

4.3.10.2 Methodological issues

4.3.10.2.1 Choice of methods

For estimating the CO_2 emissions, the 2006 IPCC Guidelines Tier 1 approach[147] has been applied:

Equation 3.1: CO_2 emissions from ammonia production – TIER 1

$$\boldsymbol{Emissions_{CO_2} = AP \times EF_{CO_2}}$$

Where:

Emissions $_{CO2}$	= CO_2 emission for urea production
AP	= urea production (tonnes)
EF_{CO2}	= default CO_2 emission factor for urea production (tonnes CO_2/tonne CO_2)

[144] INSTAT (1991): Statistical Yearbook of Albania, 1991. https://www.instat.gov.al/en/publications/books/1991/statistical-yearbook-of-albania-1991/

[145] https://www.fao.org/faostat/en/#data/RA

[146] US Geological Survey (several years): https://www.usgs.gov/centers/national-minerals-information-center/europe-and-central-eurasia#al

[147] Source: 2006 IPCC Guidelines, Volume 3: IPPU, Chapter 3: Chemical Industry Emissions – 3.2.2.1 Choice of method

4.3.10.2.2 Choice of activity data

Plant specific data or statistical data from INSTAT for production were not available for all years. Therefore, activity data used for estimation of the CO_2 emissions were taken from US Geological Survey (several years) *The Mineral Industry of Albania*[148]. Data from FAO for Urea production were used for crosscheck. However, big difference in the data set was observed. See here planned improvements.

The activity data are presented in the Figure and Table above.

CO_2 emissions were recovered for production of Urea. (see chapter 4.3.1).

4.3.10.2.3 Emission factors

As no plant-level information is not available, it is *good practice* to use default factors. The average of the range provided in the 2006 IPCC guidelines was used.

Table 4-29 Default CO_2 emission factor for CRT category 2.B.10 urea *production.*

	Parameter		Unit	Value			Reference
				low	average	high	
EF_{CO2}		default CO_2 emission factor	tonnes CO_2/ tonne of urea produced	2	**4.5**	7	Box 3.3. 2006 IPCC GL. Vol. 3 IPPU. Chapter 3

4.3.10.3 Uncertainty assessment and time-series consistency

The uncertainties for activity data and emission factors used for CRT category 2.B.10 *Urea production* are presented in the following table.

Table 4-30 Uncertainty for CRT category 2.B.10 *Urea production.*

Uncertainty	N_2O	Reference
Activity data (AD)	7%	2006 IPCC GL, Vol. 3, IPPU Chap. 3.3.3.2
Emission factor (EF)	5%	Table 3.3 2006 IPCC GL, Vol. 3 IPPU, Chapter 3
Combined Uncertainty (U)	9%	$U_{total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

The time-series are considered to be consistent.

4.3.10.4 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed out:

⇒ Checked of calculations by spreadsheets
- documented sources,
- use of units and conversion factors,
- strictly defined interfaces between spreadsheets/calculation modules,
- unique structure of sheets which do the same,
- record keeping, use of write protection,
- unique use of formulas, special cases are documented/highlighted,
- quick-control checks for data consistency through all steps of calculation.

[148] US Geological Survey (several years): https://www.usgs.gov/centers/national-minerals-information-center/europe-and-central-eurasia#al

⇒ cross-checked from different sources:
  - INSTAT (1991): Statistical Yearbook of Albania, 1991. [149]
  - International production statistics of UN statistics[150]
  - US Geological Survey (several years): The Mineral Industry of Albania.[151]
  - FAO[152]

⇒ cross checks with other relevant sectors (2.B.2, 2.B.10, 1.A.2.c) are performed to avoid double counting or omissions.

4.3.10.5 Category-specific recalculations including explanatory information and justifications

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category 2.B.10 *Urea production.*

Table 4-31 Recalculations done since NC in CRT category 2.B.10 *Urea production.*

GHG source & sink category	Revisions of data	Type of revision	Type of improvement
2.B.10	No revisions were done		

4.3.10.6 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 4-32 Planned improvements for CRT category 2.B.10 *Urea production.*

GHG source & sink category	Planned improvement	Type of improvement		Priority
2.B.10	Collection of plant specific activity data • production capacity data per plant • urea production per plant(line	AD	Accuracy Completeness	high
2.B.10	Collection of amount of CO_2 used/recovered for downstream	AD	Accuracy	high

[149] https://www.instat.gov.al/en/publications/books/1991/statistical-yearbook-of-albania-1991/

[150] United Nations - Department of Economic and Social Affairs - Statistics Division Statistics - Energy Statistics https://unstats.un.org/unsd/energystats/

[151] US Geological Survey (several years): https://www.usgs.gov/centers/national-minerals-information-center/europe-and-central-eurasia#al

[152] FAO – FAOSTAT – Land, Inuts and Sustainability – Inputs - Fertilizers by Product https://www.fao.org/faostat/en/#data/RFB

4.4 Metal Industry (CRT category 2.C)

The CRT category 2.C comprises the production of various ferrous and non-ferrous producing industries, where GHG emissions are rising. In Albania steel and Aluminium is produced.

4.4.1 Iron and Steel Production (CRT category 2.C.1)

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.C.1	Iron and Steel Production	√	-	NO	-	NO	-
A '✓' indicates emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere NE -not estimated, NA -not applicable, C – confidential							
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF							

In the early 1990 two iron and steel companies were operating:

The only one steel factory in Albania is Kurum International Elbasan steel plant, which operated in the early 1990 a blast furnace and currently two Electric Arc Furnace (EAF) technology.

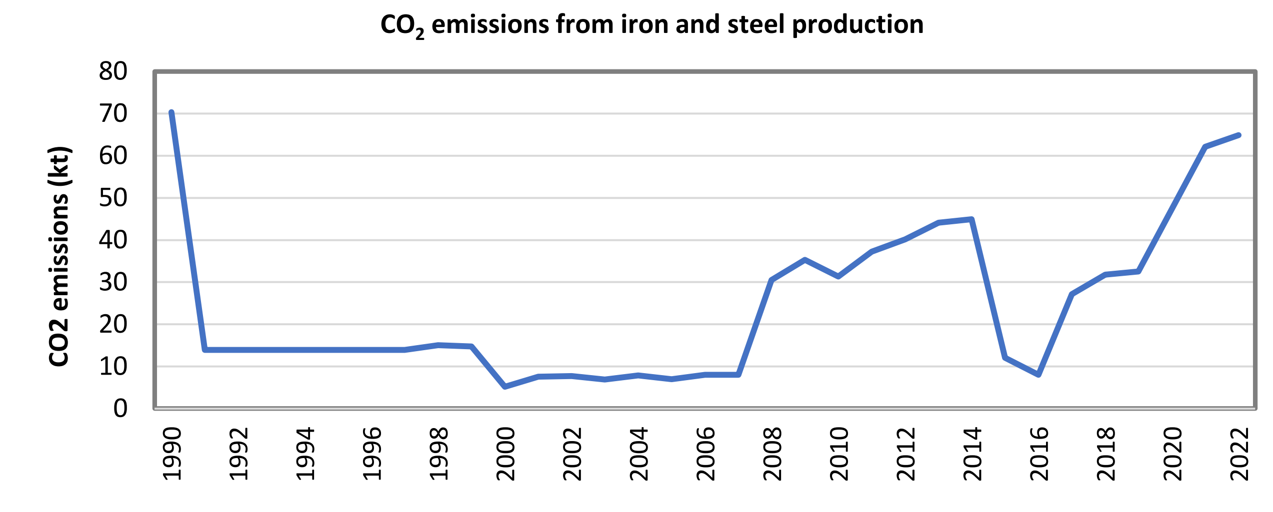


Figure 4-13 CO_2 emissions from CRT category 2.C.1 Iron and Steel production for the period 1990-2022

Table 4-33 Activity data (AD) and CO_2 emissions from Iron and Steel production (CRT category 2.C.1)

Year	Pig iron produced	steel produced	Sourece	CO_2 emissions		
				Iron Production	Electric Arc Furnace (EAF)	Total
	t	t		kt	kt	kt
1990	50000	35,000	US geological Survey (different years)	67.50	2.80	70.30
1991	10000	5,000		13.50	0.40	13.90
1992	10000	5,000		13.50	0.40	13.90
1993	10000	5,000		13.50	0.40	13.90
1994	10000	5,000		13.50	0.40	13.90
1995	10000	5,000		13.50	0.40	13.90
1996	10000	5,000		13.50	0.40	13.90
1997	10000	5,000		13.50	0.40	13.90

Year	Pig iron produced	steel produced	Sourece	CO_2 emissions		
				Iron Production	Electric Arc Furnace (EAF)	Total
	t	t		kt	kt	kt
1998	10000	19,527		13.50	1.56	15.06
1999	10000	15,600		13.50	1.25	14.75
2000	NO	64,700		NO	5.18	5.18
2001	NO	94,100		NO	7.53	7.53
2002	NO	96,600		NO	7.73	7.73
2003	NO	86,117		NO	6.89	6.89
2004	NO	98,026		NO	7.84	7.84
2005	NO	87,000		NO	6.96	6.96
2006	NO	100,000		NO	8.00	8.00
2007	NO	100,000		NO	8.00	8.00
2008	NO	380,000		NO	30.40	30.40
2009	NO	440,000		NO	35.20	35.20
2010	NO	390,000		NO	31.20	31.20
2011	NO	463,620		NO	37.09	37.09
2012	NO	500,000		NO	40.00	40.00
2013	NO	550,000		NO	44.00	44.00
2014	NO	560,000		NO	44.80	44.80
2015	NO	150,000		NO	12.00	12.00
2016	NO	100,000		NO	8.00	8.00
2017	NO	338,480		NO	27.08	27.08
2018	NO	395,656		NO	31.65	31.65
2019	NO	405,597		NO	32.45	32.45
2020	NO	590,000		NO	47.20	47.20
2021	NO	773,668		NO	61.89	61.89
2022	NO	808,983		NO	64.72	64.72
Trend						
1990 – 2022	NA	2211.4%				-7.9%
2005 - 2022	NA	829.9%				829.9%
2021 - 2022	NA	4.6%				4.6%

4.4.1.1 Methodological issues

4.4.1.1.1 Choice of methods

The 2006 IPCC Guidelines Tier 1 approach for

- Pig iron production has been applied.
- Electric Arc furnaces EAFs has been applied.

See chapter (2006 IPCC Guidelines, Vol. 3, Chapter 2, sub-chapter 4.2.1)

4.4.1.1.2 Choice of activity data

There is only electro steel production in Albania. The activity data are provided by USGS Minerals Yearbook[153] and UN data[154].

4.4.1.1.3 Choice of emission factor

The default emission factors of 2006 IPCC Guidelines for iron and steel production have been applied. See chapter (2006 IPCC Guidelines, Vol. 3, Chapter 2, sub-chapter 4.2.2.3, TABLE 4.1)

Iron Production CO_2 EF	Electric Arc Furnace (EAF) CO_2 EF
t / t pig iron produced	**t / t steel produced**
1.35	0.08

4.4.1.2 Uncertainty assessment and time-series consistency

The uncertainties for activity data and emission factors used for CRT category 2.C.1 Iron and steel are presented in the following table.

Table 4-34 Uncertainty for CRT category 2.C.1 Iron and steel.

	Uncertainties	CO2	CH4	Source
2.C.1.a. Steel -	Activity data (AD)	±10%	NA	IPCC 2006, V3_4_Ch4_Metal_Industry, Table 4.4 Uncertainty ranges
	Emission factor (EF)	±25%	NA	
	Combined Uncertainty (U)	**27%**	NA	$U_{total} = \sqrt{U_{AD}^2 + U_{EF}^2}$
2.C.1.b. Pig iron	Activity data (AD)	±10%	NA	IPCC 2006, V3_4_Ch4_Metal_Industry, Table 4.4 Uncertainty ranges
	Emission factor (EF)	±25%	NA	
	Combined Uncertainty (U)	**27%**	NA	$U_{total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

4.4.1.3 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed:

⇒ Checked of calculations by spreadsheets

[153] https://pubs.usgs.gov/myb/vol3/2019/myb3-2019-albania.pdf

[154] https://data.un.org/Data.aspx?d=ICS&f=cmID%3a41120-0

- consistent use of production statistics
- documented sources,
- use of units,
- record keeping; use of write protection,
- unique use of formulas; special cases are documented/highlighted,
- quick-control checks for data consistency through all steps of calculation.

⇒ emission factors check – IEF;

⇒ time series consistency - plausibility checks of dips and jumps.

4.4.1.4 Category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category 2.C.1 *Iron and Steel Production*.

Table 4-35 Recalculations done since submission 20 CRT category 2.C.1 *Iron and Steel Production*

GHG source & sink category	Revisions of data	Type of revision	Type of improvement
2.C.1	No revisions were performed		

4.4.1.5 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 4-36 Planned improvement for CRT category 2.C.1 *Iron and Steel Production*

GHG source & sink category	Planned improvement	Type of improvement		Priority
2.C.1	Reference CH4 emission factor		Transparency	Medium
2.C.1	Estimation of emission from pellet and sinter Production		completeness	high
2.C.1	Estimation of emission from coke Oven		completeness	high
2.C.1	Investigation and collection of plant specific data on the iron and steel production		Accuracy completeness	high
2.C.1	Estimation of higher Tier methodology (key category)		accuracy	high

4.4.2 Ferroalloys Production (CRT category 2.C.2)

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.C.2	Ferroalloys Production	NE	-	NA	-	NA	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NE -not estimated, NA -not applicable, C – confidential							
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF							

The CRT category 2.C.2 *Ferroalloys Production* existed in the period 1990 – 1994 in Albania. Due to lack of (process) data and to avoid double counting with iron and steel industry, this category was not estimated.

4.4.2.1 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 4-37 Planned improvement for CRT category 2.C.2. *Ferroalloys production*

GHG source & sink category	Planned improvement	Type of improvement		Priority
2.C.2	Investigation and collection of plant specific data on the Ferroalloy production including type of ferroalloy		accuracy completeness	high
2.C.2	Estimation of higher Tier methodology		accuracy	high

4.4.3 Aluminium Production (CRT category 2.C.3)

4.4.3.1 Source category description

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.C.3	Aluminium production	NO		NA	-	NA	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NE -not estimated, NA -not applicable, C – confidential							
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF							

IPCC code	Description	HFC		PFC		SF_6	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.C.3	Aluminium production	NO		NO		NA	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NE -not estimated, NA -not applicable, C – confidential							
LA – Level Assessment (in year); TA – Trend Assessment without LULUCF							

The CRT category 2.C.3 *Aluminium Production* does not exist in Albania.

4.4.4 Magnesium Production (CRT category 2.C.4)

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.C.4	Magnesium production	NO	-	NA	-	NA	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NE -not estimated, NA -not applicable, C – confidential							
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF							

The CRT category 2.C.4 *Magnesium Production* does not exist in Albania.

4.4.5 Lead Production (CRT category 2.C.5)

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.C.5	Lead Production	NO	-	NA	-	NA	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NE -not estimated, NA -not applicable, C – confidential							
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF							

The CRT category 2.C.5 *Lead Production* does not exist in Albania.

4.4.6 Zinc Production (CRT category 2.C.6)

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.C.6	Zinc Production	NO	-	NA	-	NA	-
A '✓' indicates emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere NE -not estimated, NA -not applicable, C – confidential							
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF							

The CRT category 2.C.6 *Zinc Production* does not exist in Albania.

4.4.7 Other (CRT category 2.C.7)

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.C.7	Other (please specify)	NO	-	NO	-	NO	-
A '✓' indicates emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere NE -not estimated, NA -not applicable, C – confidential							
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF							

The CRT category 2.C.7 *Other* does not exist in Albania.

4.5 Non-Energy Products from Fuels and Solvent Use (CRT category 2.D)

The CRT category 2.D comprises the non-energy products use such as lubricants, paraffin waxes, and bitumen/asphalt, as well as solvents uses where GHG emissions are arising.

The CRT category 2.D does not cover emissions from the first use of fossil fuels as a product for primary purposes other than

i) combustion for energy purposes	accounted for in CRT category 1.A. Fuel Combustion activities
ii) use as feedstock or reducing agent	accounted for in CRT category 2.B. Chemical industry and in CRT category 2.C. Metal industry

4.5.1 Lubricant Use (CRT category 2.D.1)

Lubricants are mostly used in industrial and transportation applications. Lubricants are produced either at refineries through separation from crude oil or at petrochemical facilities. They can be subdivided into

(a) motor oils and industrial oils, and

(b) greases, which differ in terms of physical characteristics (e.g., viscosity), commercial applications, and environmental fate.

4.5.1.1 Source category description

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.D.1	Lubricant Use	NE	-	NA	-	NA	-
A '✓' indicates emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere NE -not estimated, NA -not applicable, C – confidential							
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF							

The CRT category 2.D.1 *Lubricant Use* will be estimate in the next Inventory cycle.

Table 4-38 Planned improvement for CRT category 2.D.1 *Lubricant Use*

GHG source & sink category	Planned improvement	Type of improvement		Priority
2D1	Collect activity data (production, import and expert statistics)	AD	Completeness	high

4.5.2 Paraffin Wax Use (CRT category 2.D.2)

Waxes are used in a number of different applications. Paraffin waxes are used in applications such as:

- candles,
- corrugated boxes,
- paper coating,
- board sizing,
- food production,
- wax polishes,
- surfactants (as used in detergents),
- etc.

Emissions from the use of waxes derive primarily when the waxes or derivatives of paraffins are combusted during use (e.g., candles), and when they are incinerated with or without heat recovery or in wastewater treatment (for surfactants). In the cases of incineration and wastewater treatment the emissions should be reported in the Energy or Waste Sectors, respectively.

4.5.2.1 Source category description

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.D.2	Paraffin Wax Use	NE	-	NA	-	NA	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NE -not estimated, NA -not applicable, C – confidential							
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF							

4.5.2.2 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 4-39 Planned improvement for CRT category 2.D.2 *Paraffin Wax Use*

GHG source & sink category	Planned improvement	Type of improvement		Priority
2.D.2	Collect activity data (production, import and expert statistics)	EMI	Completeness	High

4.5.3 Solvent Use (CRT category 2.D.3)

This chapter describes the methodology used for calculating air emissions from Solvent Use. Solvents are chemical compounds, which are used to dissolve substances such as paint, glues, ink, rubber, plastic, pesticides or for cleaning purposes (degreasing). After application of these substances or other procedures of solvent use most of the solvents are released into air. Because solvents consist mainly of Non-Methane Volatile Organic Compounds (NMVOC). Besides the sources burning of fossil fuels, particularly for road transport and , energy production and distribution, solvent use is a major source for anthropogenic NMVOC emissions in Albania. Once released into the atmosphere, NMVOCs react with reactive molecules (mainly HO-radicals) or high energetic light to finally form CO_2.

4.5.3.1 Source category description

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.D.3	Solvent Use						
2.D.3.a	Domestic solvent use including fungicides	✓	-	NA	-	NA	-
2.D.3.b	Road paving with asphalt	✓	-	NA	-	NA	-
2.D.3.c	Asphalt roofing	NE	-	NA	-	NA	-
2.D.3.d.i	Coating applications	NE	-	NA	-	NA	-
2.D.3.e.ii	Degreasing	NE	-	NA	-	NA	-
2.D.3.f.iii	Dry cleaning	NE	-	NA	-	NA	-
2.D.3.g.iv	Chemical products	NO	-	NA	-	NA	-
2.D.3.h.v	Printing	NE	-	NA	-	NA	-
2.D.3.i.vi	Other solvent and product use	NE	-	NA	-	NA	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NE -not estimated, NA -not applicable, C – confidential							
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF							

The subcategory 2.D.3 *Solvent Use* has high contribution to national total NMVOC emissions but is only a small source of CO_2 and GHG respectively.

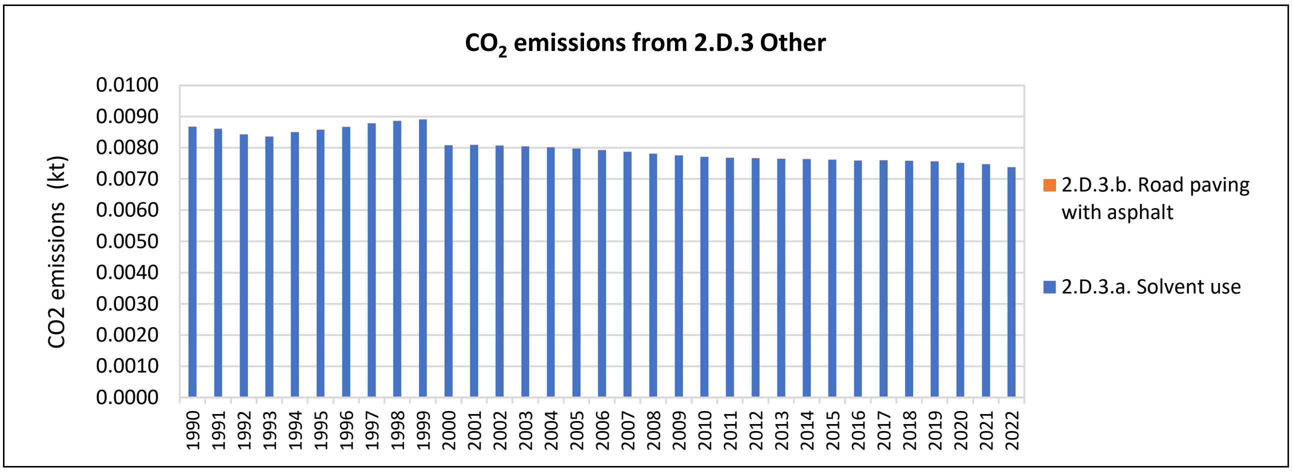


Figure 4-14 GHG emissions for CRT category 2.D.3 Solvent use for the period 1990-2022

Table 4-40 CO2 Emissions from Solvent Use (CRT category 2.D.3)

Year	CO_2 emissions		
	2.D.3. Other	2.D.3.a. Solvent use	2.D.3.b. Road paving with asphalt
	(kt)		
1990	0.00868	0.00868	<0.00001
1991	0.00861	0.00861	<0.00001
1992	0.00842	0.00842	<0.00001
1993	0.00836	0.00836	<0.00001
1994	0.00850	0.00850	<0.00001
1995	0.00858	0.00858	<0.00001
1996	0.00867	0.00867	<0.00001
1997	0.00878	0.00878	<0.00001
1998	0.00886	0.00886	<0.00001
1999	0.00891	0.00891	<0.00001
2000	0.00807	0.00807	<0.00001
2001	0.00809	0.00809	<0.00001
2002	0.00807	0.00807	<0.00001
2003	0.00804	0.00804	<0.00001
2004	0.00801	0.00801	<0.00001
2005	0.00797	0.00797	<0.00001
2006	0.00793	0.00793	<0.00001
2007	0.00787	0.00787	<0.00001
2008	0.00781	0.00781	<0.00001
2009	0.00775	0.00775	<0.00001
2010	0.00771	0.00771	<0.00001
2011	0.00768	0.00768	<0.00001
2012	0.00766	0.00766	<0.00001
2013	0.00765	0.00765	<0.00001
2014	0.00764	0.00764	<0.00001

Year	CO_2 emissions		
	2.D.3. Other	2.D.3.a. Solvent use	2.D.3.b. Road paving with asphalt
	(kt)		
2015	0.00762	0.00762	<0.00001
2016	0.00759	0.00759	<0.00001
2017	0.00760	0.00759	<0.00001
2018	0.00758	0.00758	<0.00001
2019	0.00756	0.00756	<0.00001
2020	0.00752	0.00751	<0.00001
2021	0.00747	0.00747	<0.00001
2022	0.00738	0.0074	<0.00001
Trend			
1990 - 2022	*-15.0%*	*-15.0%*	*28.4%*
2005 - 2022	*-7.5%*	*-7.5%*	*-22.1%*
2021 - 2022	*-1.3%*	*-1.3%*	*-34.6%*

4.5.3.2 Methodological issues

4.5.3.2.1 Choice of methods

The 2006 IPCC Guidelines Tier 1 approach has been applied.

As described in the 2006 IPCC Guidelines, Vol. 1, Chap. 7 (7.2.1.5 Carbon emitted in gases other than CO_2) and Vol. 3, Chap. 5 (5.5 Solvent use) Most of the carbon emitted in the form of non-CO_2 species eventually oxidized to CO_2 in the atmosphere and this amount can be estimated from the emissions estimates of the non-CO_2 gases.is the default fossil carbon content fraction of NMVOC 60 percent by mass.

Equation Calculating CO_2 inputs to the atmosphere from emissions of carbon-containing compounds

$$\text{From NMVOC: } Inputs_{CO2} = Emissions_{NMVOC} \bullet C \bullet 44/12$$

Where

$Inputs_{CO2}$ = CO_2 emissions (Gg)

$Emissions_{NMVOC}$ = estimation of NMVOC (Gg)

C = fraction carbon in NMVOC by mass (default = 0.6)

44/12 = conversion factor from C to CO_2

4.5.3.3 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 4-41 Planned improvements for CRT category 2.D.3 Solvent use.

GHG source & sink category	Planned improvement	Type of improvement		Priority
2.D.3	Analysis of subcategories which are occurring in Albania	AD	Accuracy Transparency	High / Medium
2.D.3	Investigation of data on production, import and export of the solvents and solvent containing products for the recent years and for pillar years (e.g. 1990, 1995, 2000, 2005. 2010)	AD	Accuracy Transparency	High / Medium

4.5.4 Other (CRT category 2.D.4)

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.D.4	Other	NE	-	NA	-	NA	-
A '✓' indicates emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere NE -not estimated, NA -not applicable, C – confidential							
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF							

The CRT category 2.D.4 *Other* does not exist in Albania.

4.6 Electronics Industry (CRT category 2.E)

This section describes GHG emissions resulting from gases used in manufacturing different types of electronic devices, the process used (or more roughly, process type (e.g., CVD or etch)), the brand of process tool used, and the implementation of emission reduction technology.

All these activities are not existing in Albania.

4.6.1 Integrated Circuit or Semiconductor (CRT category 2.E.1)

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.E.1	Integrated Circuit or Semiconductor	NA	-	NA	-	NA	-

IPCC code	Description	HFC		PFC		SF_6		NF_3	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.E.1	Integrated Circuit or Semiconductor	NO	-	NO	-	NO	-	NO	-

A '✓' indicates emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere NE -not estimated, NA -not applicable, C – confidential

LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF

The CRT category 2.E.1 *Integrated Circuit or Semiconductor* does not exist in Albania.

4.6.2 TFT Flat Panel Display (CRT category 2.E.2)

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.E.3	TFT Flat Panel Display	NA	-	NA	-	NA	-

IPCC code	Description	HFC		PFC		SF_6		NF_3	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.E.3	TFT Flat Panel Display	NO	-	NO	-	NO	-	NO	-

A '✓' indicates emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere NE -not estimated, NA -not applicable, C – confidential

LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF

The CRT category 2.C.2 *TFT Flat Panel Display* does not exist in Albania.

4.6.3 Photovoltaics (CRT category 2.E.3)

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.E.3	Photovoltaics	NA	-	NA	-	NA	-

IPCC code	Description	HFC		PFC		SF_6		NF_3	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.E.3	Photovoltaics	NO	-	NO	-	NO	-	NO	-
A '✓' indicates emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere NE -not estimated, NA -not applicable, C – confidential									
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF									

The CRT category 2.C.3 *Photovoltaics* does not exist in Albania.

4.6.4 Heat Transfer Fluid (CRT category 2.E.4)

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.E.4	Heat Transfer Fluid	NA	-	NA	-	NA	-

IPCC code	Description	HFC		PFC		SF_6		NF_3	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.E.4	Heat Transfer Fluid	NO	-	NO	-	NO	-	NO	-
A '✓' indicates emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere NE -not estimated, NA -not applicable, C – confidential									
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF									

The CRT category 2.E.4 *Heat Transfer Fluid* does not exist in Albania.

4.6.5 Other (CRT category 2.E.5)

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.E.5	Other	NA	-	NA	-	NA	-

IPCC code	Description	HFC		PFC		SF_6		NF_3	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.E.5	Other	NO	-	NO	-	NO	-	NO	-
A '✓' indicates emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere NE -not estimated, NA -not applicable, C – confidential									
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF									

The CRT category 2.F.5 *Other* does not exist in Albania.

4.7 Product Uses as Substitutes for Ozone Depleting Substances (CRT category 2.F)

The CRT category 2.F *Product Uses as Substitutes for Ozone Depleting Substances* (ODS) comprises emissions of HFC, PFC and SF6 from different product in use and applications.

IPCC code	Description	HFC	PFC	SF_6	NF_3
2.F.1	Refrigeration and Air Conditioning				
2.F.1.a	Refrigeration and Stationary Air Conditioning	NE	NE	NE	NE
2.F.1.b	Mobile Air Conditioning	NE	NE	NE	NE
2.F.2	Foam Blowing Agents	NE	NE	NE	NE
2.F.3	Fire Protection	NE	NE	NE	NE
2.F.4	Aerosols	NE	NE	NE	NE
2.F.5	Solvents	NE	NE	NE	NE
2.F.6	Other Application	NE	NE	NE	NE
A '✓' indicates emissions from this sub-category have been estimated. Notation keys: IE - included elsewhere NE - not estimated, NA - not applicable, C – confidential					

4.7.1 General remarks related to F-gases

HFC and PFC as Substitutes for ODS – so called F-gases

(A) refrigeration and air-conditioning are by far the main application

HFC and partially PFC are used in fire suppression, aerosols, solvents, foam etc.

⇒ see tables below

(B) F-gases occur as pure substances or as blends.

⇒ see tables below

(C) emissions arise from:

- production (by-product, fugitive)
  - Manufacturing or assembly emissions
    - Leaks at filling
  - Intended release during use of products
- during use (intended, leakage)
  - Prompt emissions (< 2 years after being charged into a product)
    - as aerosols or propellants
  - Leaks during use / operation of products
  - Container losses
- Release at the end of life of products / decommissioning

(D) F-gases are traded products (no formation in processes)

(E) development of long-lived banks makes the calculation difficult.

Table 4-42 Main application areas for HFCs and PFCs as ODS substitutes.

Chemical	Refrigeration and Air Conditioning	Fire Suppression and Explosion Protection	Aerosols		Solvent Cleaning	Foam Blowing	Other Applications	In Albania occurent
			Propellants	Solvents				
HFC-23	X	X						
HFC-32	X							
HFC-125	X	X						x
HFC-134a	X	X	X			X	X	x
HFC-143a	X							x
HFC-152a	X		X			X		x
HFC-227ea	X	X	X			X	X	x
HFC-236fa	X	X						x
HFC-245fa				X		X		
HFC-365mfc				X	X	X		
HFC-43-10mee				X	X			
PFC-14 (CF_4)		X						
PFC-116 (C_2F_6)							X	
PFC-218 (C_3F_8)								
PFC-31-10 (C_4F_{10})		X						
PFC-51-14 (C_6F_{14})					X			
R-404A	X							x
R-407C	X							x
R-410A	X							x
R-417A	X							x
R-422B	X							x
R-507A	X							x

Remarks Main application areas for HFCs and PFCs as ODS substitutes: Several applications use HFCs and PFCs as components of blends. The other components of these blends are sometimes ODSs and/or non-greenhouse gases. Several HFCs, PFCs and blends are sold under various trade names; only generic designations are used in this chapter.

Other applications include sterilization equipment, tobacco expansion applications, plasma etching of electronic chips (PFC-116) and as solvents in the manufacture of adhesive coatings and inks.

PFC-14 (chemically CF_4) is used as a minor component of a proprietary blend. Its main use is for semiconductor etching.

PFC-51-14 is an inert material, which has little or nil ability to dissolve soils. It can be used as a carrier for other solvents or to dissolve and deposit disk drive lubricants. PFCs are also used to test that sealed components are hermetically sealed.

Source:modified 2006 IPCC Guidelines, Volume 3: Industrial Processes and Product Use, Chapter 7: Emissions of Fluorinated Substitutes for Ozone Depleting Substances. Table 7.1. Page 7.1.

Table 4-43 ASHRE name and chemical formula of HFCs, PFCs, CFCs and other refrigerants

PFC (fully fluorinated hydrocarbons)		
ASHRAE name	**chemical formula**	**name**
R 14	CF_4	perfluormethan
R 116	C_2F_6	perfluorethan
R 218	C3F8	perfluorpropan
RC 318	C4F8	perfluorcyclobutane
R 3110	C4F10	perfluorbutan
HFCs (partly fluorinated hydrocarbons)		
ASHRAE name	**Chemical formula**	**name**
R 23	CHF3	trifluormethan
R 32	CH2F2	difluormethan
R 41	CH3F	fluormethan
R 43 10mee	C5H2F10	dekaflouropentan
R 125	CHF2CF3	pentafluoroethan
R 134a	CF3CHF	tetrafluorethan
R 143a	CF3CH3	trifluorethan
R 152a	CHF2CH3	difluorethan
R 227ea	CF3CFHCF3	heptafluoropropan
R 236fa	C3H2F6	hexafluoropropan
R 245ea	CF3CH2CF2H	pentafluoropropan
ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers		

CFCs (chlorofluorocarbons)		
ASHRAE name	**Chemical formula**	
R 11	CCl3F	trichlorflourmethan
R 12	CCl2F2	dichlordiflourmethan
R 13	CClF3	chlortriflourmethan
R 22	CHClF2	chlordiflourmethan
R 113	CClF2CCl2F	trichlortriflourethan
R 114	CClF2CClF2	dichlortetraflourethan
R 115	CClF2CF3	chlorpentaflourethan
R 123	CHCl2CF3	dichlortriflourethan
R 124	CHClFCF3	chlortriflourethan
R 141b	CCl2FCH3	dichlorflourethan
R 142b	CClF2CH3	chlordiflourethan
Other refrigerants		
ASHRAE name	**Chemical formula**	**name**
R 12B1	CBrClF2	halon 1221
R 13B1	CBrF3	halon 1301
R 50	CH_4	methane
R 290	C3H8	propane
RC 318	C4F8	perfluorocyclobutane
R 600a	CH3CH(CH3)2	iso-butane
R 717	NH3	ammonia
R 718	H2O	water
R1270		propene

4.7.2 Refrigeration and Air Conditioning (CRT category 2.F.1)

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.F.1	Refrigeration and Air Conditioning	NA	-	NA	-	NA	-

IPCC code	Description	HFC		PFC		SF_6		NF_3	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.F.1	Refrigeration and Air Conditioning				-				-
2.F.1.a	Refrigeration and Stationary Air Conditioning	NE		NE		NE		NE	
2.F.1.b	Mobile Air Conditioning	NE		NE		NE		NE	
A '✓' indicates emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere NE -not estimated, NA -not applicable, C – confidential									
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF									

4.7.2.1 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 4-44 Planned improvements for CRT category 2.F.1 Refrigeration and Air Conditioning.

GHG source & sink category	Planned improvement	Type of improvement		Priority
2.F.1	To collect time series activity data (use available UNIDO study data) or other relevant sources	AD	Completeness	High

Table 4-45 Relevant commodity relevant to CRT category 2.F.1 Refrigeration and Air Conditioning

Commodity	HS-Code	Name of Commodity
Air-condition	**8415**	**Air conditioning machines; comprising a motor driven fan and elements for changing the temperature and humidity, including those machines in which the humidity cannot be separately regulated**
	841510	Air conditioning machines; comprising a motor-driven fan and elements for changing the temperature and humidity, of a kind designed to be fixed to a window, wall, ceiling or floor, self-contained or "split-system"
	841520	Air conditioning machines; comprising a motor driven fan and elements for changing the temperature and humidity, of a kind used for persons, in motor vehicles
	841581	Air conditioning machines; containing a motor driven fan, other than window or wall types, incorporating a refrigerating unit and a valve for reversal of the cooling/heat cycle (reversible heat pumps)
	841582	Air conditioning machines; containing a motor driven fan, other than window or wall types, incorporating a refrigerating unit
	841583	Air conditioning machines; containing a motor driven fan, other than window or wall types, not incorporating a refrigerating unit
	841590	Air conditioning machines; with motor driven fan and elements for temperature control, parts thereof

Commodity	HS-Code	Name of Commodity
Refrigerators	**8418**	**Refrigerators, freezers and other refrigerating or freezing equipment, electric or other; heat pumps other than air conditioning machines of heading no. 8415**
	841810	Refrigerators and freezers; combined refrigerator-freezers, fitted with separate external doors, electric or other
	841821	Refrigerators; for household use, compression-type, electric or other
	841829	Refrigerators; household, electric or not, other than compression-type
	841830	Freezers; of the chest type, not exceeding 800l capacity
	841840	Freezers; of the upright type, not exceeding 900l capacity
	841850	Furniture incorporating refrigerating or freezing equipment; for storage and display, n.e.c. in item no. 8418.1, 8418.2, 8418.3 or 8418.4 (chests, cabinets, display counters, show-cases and the like)
	841861	Heat pumps; other than air conditioning machines of heading no. 8415
	841869	Refrigerating or freezing equipment; n.e.c. in heading no. 8418
	841891	Refrigerating or freezing equipment; parts, furniture designed to receive refrigerating or freezing equipment
	841899	Refrigerating or freezing equipment; parts thereof, other than furniture

The CRT category 2.F.1 *Refrigeration and Air Conditioning* is not estimated (NE) due to lack of data.

4.7.3 Foam Blowing Agents (CRT category 2.F.2)

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.F.2	Foam Blowing Agents	NA	-	NA	-	NA	-

IPCC code	Description	HFC		PFC		SF_6		NF_3	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.F.2	Foam Blowing Agents	NE	-	NE	-	NE	-	NE	-

A '✓' indicates emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere NE -not estimated, NA -not applicable, C – confidential

LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF

The CRT category 2.F.2 *Foam Blowing Agents* is not estimated (NE) due to lack of data.

4.7.3.1 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 4-46 Planned improvements for CRT category 2.F.2 Foam Blowing Agents.

GHG source & sink category	Planned improvement	Type of improvement		Priority
2.F.2	To collect time series activity data	AD	Completeness	medium

4.7.4 Fire Protection (CRT category 2.F.3)

IPCC code	Description	HFC		PFC		SF_6		NF_3	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.F.3	Fire Protection	NE	-	NE	-	NE	-	NE	-
A '✓' indicates emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere NE -not estimated, NA -not applicable, C – confidential									
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF									

The CRT category 2.F.3 *Fire Protection* is not estimated (NE) due to lack of data.

4.7.4.1 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 4-47 Planned improvements for CRT category 2.F.3 Fire Protection.

GHG source & sink category	Planned improvement	Type of improvement		Priority
2.F.3	To collect time series activity data	AD	Completeness	medium

4.7.5 Aerosols (CRT category 2.F.4)

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.F.4	Aerosols	NA	-	NA	-	NA	-

IPCC code	Description	HFC		PFC		SF_6		NF_3	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.F.4	Aerosols	NE	-	NE	-	NE	-	NE	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NE -not estimated, NA -not applicable, C – confidential									
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF									

The CRT category 2.F.4 *Aerosols* is not estimated (NE) due to lack of data.

4.7.5.1 Category-specific planned improvements including tracking of those identified in the review process for CRT category 2.F.4 Aerosols

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 4-48 Planned improvements for CRT category 2.F.4 Aerosols.

GHG source & sink category	Planned improvement	Type of improvement		Priority
2.F.4	To collect time series activity data or use similar country scaling principle	AD	Completeness	medium

4.7.6 Solvents (CRT category 2.F.5)

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.F.5	Solvents	NA	-	NA	-	NA	-

IPCC code	Description	HFC		PFC		SF_6		NF_3	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.F.5	Solvents	NE	-	NE	-	NE	-	NE	-

A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NE -not estimated, NA -not applicable, C – confidential

LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF

The CRT category 2.F.5 *Solvents* is not estimated (NE) due to lack of data.

4.7.6.1 Category-specific planned improvements including tracking of those identified in the review process for CRT category 2.F.5 Solvents

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 4-49 Planned improvements for CRT category 2.F.5 Solvents.

GHG source & sink category	Planned improvement	Type of improvement		Priority
2.F.5	Investigation of the use and consumption (by chemical composition) of solvents containing HFC and/or PFC products for (i) Precision Cleaning, (ii) Electronics Cleaning, (iii) Metal Cleaning, (iv) Deposition applications.	AD	Accuracy Transparency Completeness	High
2.F.5	Application of methodology of 2006 IPCC Guidelines, Volume 3: Industrial Processes and Product Use, Chapter 7: Emissions of Fluorinated Substitutes for Ozone Depleting Substances. (7.3 AEROSOLS (PROPELLANTS AND SOLVENTS) Page 7.28.	AD	Accuracy Transparency Completeness Comparability	High

4.7.7 Other Application (CRT category 2.F.6)

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.F.6	Other Application	NA	-	NA	-	NA	-

IPCC code	Description	HFC		PFC		SF_6		NF_3	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.F.6	Other Application	NE	-	NE	-	NE	-	NE	-

A '✓' indicates emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere NE -not estimated, NA -not applicable, C – confidential

LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF

The CRT category 2.F.6 *Other Application* is not estimated (NE) due to lack of data.

4.7.7.1 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 4-50 Planned improvements for CRT category 2.F.6 Other Application.

GHG source & sink category	Planned improvement	Type of improvement		Priority
2.F.6	Investigation of the use and consumption (by chemical composition) of various products containing HFC and/or PFC	AD	Accuracy Transparency Completeness	High
2.F.6	Application of methodology of 2006 IPCC Guidelines, Volume 3: Industrial Processes and Product Use, Chapter 7: Emissions of Fluorinated Substitutes for Ozone Depleting Substances. (7.7 OTHER APPLICATIONS) Page 7.66.	AD	Accuracy Transparency Completeness Comparability	High

4.8 Other Product Manufacture and Use (CRT category 2.G)

The CRT category 2.G *Other Product Manufacture and Use* comprises.

- PFC and SF6 emissions from Electrical Equipment (2.G.1),
- PFC and SF6 emissions from Other Product Uses (2.G.2),
- N_2O emissions from Product Uses (2.G.3).

4.8.1 Electrical Equipment (CRT category 2.G.1)

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.G.1	Electrical Equipment						
2.G.1.a	Manufacture of Electrical Equipment	NA	-	NA	-	NA	-
2.G.1.b	Use of Electrical Equipment	NA	-	NA	-	NA	-
2.G.1.c	Disposal of Electrical Equipment	NA	-	NA	-	NA	-

IPCC code	Description	HFC		PFC		SF_6		NF_3	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.G.1	Electrical Equipment								
2.G.1.a	Manufacture of Electrical Equipment	NO	-	NO	-	NO	-	NO	-
2.G.1.b	Use of Electrical Equipment	NO	-	NO	-	NE	-	NO	-
2.G.1.c	Disposal of Electrical Equipment	NO	-	NO	-	NE	-	NO	-

A '✓' indicates emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere NE -not estimated, NA -not applicable, C – confidential

LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF

Manufacture of Electrical Equipment (CRT category 2.G.1.a)

The CRT category 2.G.1.a *Manufacture of Electrical Equipment* does not exist in Albania.

Use of Electrical Equipment (CRT category 2.G.1.b)

The CRT category 2.G.1.b *Use of Electrical Equipment* is not estimated (NE) due to lack of data.

Use of Electrical Equipment (CRT category 2.G.1.c)

The CRT category 2.G.1.c *Disposal of Electrical Equipment* is not estimated (NE) due to lack of data.

4.8.1.1 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 4-51 Planned improvements for CRT category *2.G.1.a Use of Electrical Equipment*

GHG source & sink category	Planned improvement	Type of improvement		Priority
2.G.1.b	Collection on information on the stock, the age of equipment, and actual data on filled in amounts of SF6 if available from their servicing companies including preparation of questionnaire to power companies and related servicing companies	AD	completeness	High
2.G.1.c	Collection on information (stock, the age of equipment) of decommissioning of electrical equipment including preparation of questionnaire to power companies and related servicing companies	EMI	Completeness	High
2.G.1.c	Investigation regarding import of old electrical Equipment	AD	Transparency	Medium

4.8.2 SF6 and PFCs from Other Product Uses (CRT category 2.G.2)

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.G.2	SF6 and PFCs from Other Product Uses						
2.G.2.a	Military Applications	NA	-	NA	-	NA	-
2.G.2.b	Accelerators						
2.G.2.b.i	University and Research Particle Accelerators	NA	-	NA	-	NA	-
2.G.2.b.ii	Industrial and Medical Particle Accelerators	NA	-	NA	-	NA	-
2.G.2.c	Other	NA	-	NA	-	NA	-

IPCC code	Description	HFC		PFC		SF_6		NF_3	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.G.2	SF6 and PFCs from Other Product Uses								
2.G.2.a	Military Applications	NO	-	NO	-	NE	-	NO	-
2.G.2.b	Accelerators								
2.G.2.b.i	University & Research Particle Accelerators	NO	-	NO	-	NE	-	NO	-
2.G.2.b.ii	Industrial and Medical Particle Accelerators	NO	-	NO	-	NE	-	NO	-
2.G.2.c	Other	NO	-	NO	-	NE	-	NO	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NE -not estimated, NA -not applicable, C – confidential									
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF									

The CRT category 2.G.2 *SF6 and PFCs from Other Product Uses* is not estimated due to lack of data.

4.8.2.1 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 4-52 Planned improvements for CRT category 2.G.2 SF6 and PFCs from Other Product Use.

GHG source & sink category	Planned improvement	Type of improvement		Priority
2.G.2	Analysis of production, import and export of 'other products' containing SF6 and PFCs, e.g. • SF6 and PFCs used in military applications • SF6 used in sound-proof windows • SF6 used in shoes	AD	Transparency Completeness	High
2.G.2	Estimation of SF6 and PFCs emissions from use of 'other products' containing SF6 and PFCs according to 2006 IPCC Guidelines	EF	Completeness	High

4.8.3 N_2O from Product Uses (CRT category 2.G.3)

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.G.3	N_2O from Product Uses						
2.G.3.a	Medical Applications	NA	-	NA	-	✓	-
2.G.3.b	Propellant for pressure and aerosol products	NA	-	NA	-	NE	-
2.G.3.c	Other	NA	-	NA	-	NE	-
A '✓' indicates emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere NE -not estimated, NA -not applicable, C – confidential							
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF							

4.8.3.1 Medical Applications (CRT category 2.G.3.a)

4.8.3.1.1 Category description

CRT code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.G.3	N_2O from Product Uses						
2.G.3.a	Medical Applications	NA	-	NA	-	✓	-
A '✓' indicates emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere NE -not estimated. NA -not applicable. C – confidential							
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF							

This chapter includes emissions estimations of N2O from the use of N2O as medical applications. As presented in the 2006 IPCC Guidelines[155], there are three main areas for application.

Anaesthetic use of N2O	This N2O is used during anaesthesia for two reasons: a) as an anaesthetic and analgesic and as b) a carrier gas for volatile fluorinated hydrocarbon anaesthetics such as isoflurane, sevoflurane and desflurane. The anaesthetic effect of N2O is additive to that of the fluorinated hydrocarbon agents.
Analgesic use of N2O	Inhaled N2O is used to provide pain relief in certain situations. Premixed nitrous oxide and oxygen mixtures are used to provide pain relief in childbirth, and for painful procedures of short duration.
Veterinary use of N2O	N2O is also used during animal anaesthesia. Administration methods are similar to those used in human anaesthesia.

As N2O is used as an anaesthetic, it is presumed that 100% are emitted during the operation.

The trend of N2O emission is generally driven by the decreasing number of population and operations, respectively.

[155] 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 3: Industrial Processes and Product Use, Chapter 8: Other Product Manufacture and Use, 8.4 N2O From Product Uses. https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/3_Volume3/ V3_8_Ch8_Other_Product.pdf

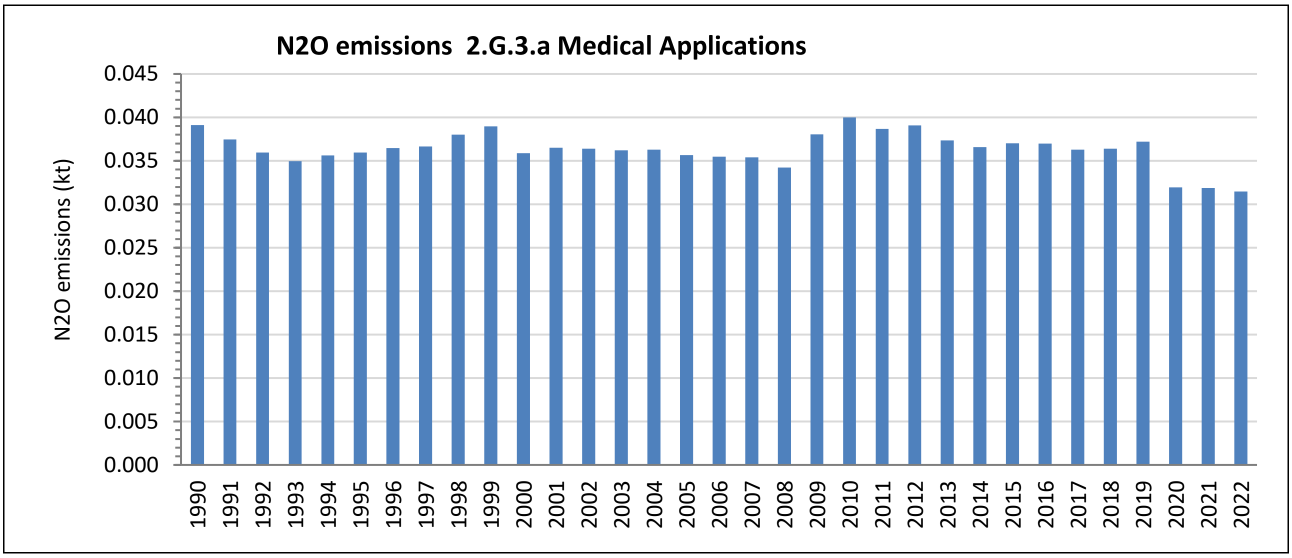


Figure 4-15 GHG emissions from CRT category 2.G.3.a *Medical Applications*

Table 4-53 Activity data and CO_2 emissions from CRT category 2.G.3.a *Medical Applications*

Years	Population	EF	N2O emissions	
	capita	g N2O/ capita	kt	kt CO2 equivalent
1990	3,286,500	11.90	0.0391	10.362
1991	3,259,814	11.49	0.0374	9.922
1992	3,190,103	11.28	0.0360	9.532
1993	3,167,478	11.04	0.0350	9.263
1994	3,220,310	11.06	0.0356	9.440
1995	3,248,836	11.07	0.0360	9.533
1996	3,283,000	11.10	0.0365	9.660
1997	3,324,317	11.03	0.0367	9.717
1998	3,354,341	11.33	0.0380	10.070
1999	3,373,445	11.55	0.0390	10.326
2000	3,058,497	11.73	0.0359	9.510
2001	3,063,318	11.92	0.0365	9.673
2002	3,057,018	11.91	0.0364	9.648
2003	3,044,993	11.89	0.0362	9.594
2004	3,034,231	11.96	0.0363	9.619
2005	3,019,634	11.80	0.0356	9.446
2006	3,003,329	11.81	0.0355	9.397
2007	2,981,755	11.87	0.0354	9.380
2008	2,958,266	11.58	0.0342	9.074
2009	2,936,355	12.96	0.0380	10.081
2010	2,918,674	13.70	0.0400	10.599
2011	2,907,368	13.31	0.0387	10.252
2012	2,903,008	13.46	0.0391	10.357
2013	2,897,770	12.89	0.0374	9.902
2014	2,892,394	12.65	0.0366	9.696
2015	2,885,796	12.83	0.0370	9.809

Years	Population	EF	N2O emissions	
	capita	g N2O/ capita	kt	kt CO2 equivalent
2016	2,875,592	12.86	0.0370	9.801
2017	2,876,591	12.62	0.0363	9.618
2018	2,870,324	12.68	0.0364	9.643
2019	2,862,427	12.99	0.0372	9.855
2020	2,845,955	11.23	0.0320	8.468
2021	2,829,741	11.27	0.0319	8.450
2022	2,793,592	11.27	0.0315	8.342
Trend				
1990 – 2022	*-19.5%*	*NA*	*-19.5%*	*-19.5%*
2010 – 2022	*-11.7%*	*NA*	*-11.7%*	*-11.7%*
2021 - 2022	*-1.3%*	*NA*	*-1.3%*	*-1.3%*

4.8.3.1.2 Methodological issues

4.8.3.1.2.1 Choice of methods

It is *good practice* to estimate N2O emissions from data of quantity of N2O supplied that are obtained from manufacturers and distributors of N2O products according to Equation 8.24 below. Additionally for medical applications, the quantity of N2O usage obtained from the pharmacy department from hospitals based on number and capacity of nitrous oxide cylinders purchased per annum can be used; both information were not available.

Therefore, a simplified Tier 1 approach[156]. of the 2006 IPCC Guidelines for estimating the N2O emissions has been applied:

Equation 8.24: N2O emissions from Medical Applications – TIER 1

$$\boldsymbol{Emissions_{N_2O} = AD \times EF}$$

Where:

Emissions $_{N2O}$ = NO_2 emissions from medical applications (tonne N2O)
AD = consumption of N2O (tonne)
It is presumed that 100% are emitted during reporting years.
EF = emission factor (100%)
It is presumed that 100% are emitted during reporting years.

4.8.3.1.2.2 Activity data

The amount of N2O used in medical applications for estimating the GHG emissions for the period 1990-2022 from manufacturers and importers but also not from all hospitals was not available. An analysis of N2O consumption rate per capita of Annex I submissions 2023[157] was carried. The consumption rate per capita was taken from Annex I EIT (GHG inventory 2023 submission). Population data were taken from INSTAT.

[156] Source: 2006 IPCC Guidelines, Volume 3: IPPU, Chapter 8: Other Product Manufacture and Use – 8.4.2.1 Choice of method
[157] https://unfccc.int/ghg-inventories-annex-i-parties/2023

4.8.3.1.2.3 Emission factors

It is assumed that none of the administered N2O is chemically changed by the body, and all is returned to the atmosphere. An emission factor of 1.0 (dimensionless) was assumed as recommended in 2006 IPCC guidelines[158].

4.8.3.1.3 Uncertainty assessment and time-series consistency

The uncertainties for activity data and emission factors used for CRT category 2.G.3.a *Medical applications* are presented in the following table.

Table 4-54 Uncertainty for CRT category 2.G.3.a *Medical applications*

Uncertainty	NO_2	Reference
Activity data (AD)	30%	Expert judgement based on CCNUCC France 2022
Emission factor (EF)	1%	
Combined Uncertainty (U)	30%	$U_{total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

The time-series are considered to be consistent as the number of population taken from ONS and IEF are used as activity data.

4.8.3.1.4 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed out:

⇒ Checked of calculations by spreadsheets
- documented sources,
- use of units and conversion factors,
- strictly defined interfaces between spreadsheets/calculation modules,
- unique structure of sheets which do the same,
- record keeping, use of write protection,
- unique use of formulas, special cases are documented/highlighted,
- quick-control checks for data consistency through all steps of calculation.

4.8.3.1.5 Category-specific recalculations including explanatory information and justifications

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category 2.G.3.a *Medical applications*.

Table 4-55 Recalculations done since NC in CRT category 2.G.3.a *Medical applications.*

GHG source & sink category	Revisions of data	Type of revision	Type of improvement
2.G.3.a	No revisions were done as emissions were estimated the first time.		

4.8.3.1.6 Category-specific planned improvements including tracking of those identified in the review process

Considering the potential contribution of identified improvements in the total GHG emissions and the

[158] Source: 2006 IPCC Guidelines, Volume 3: IPPU, Chapter 8: Other Product Manufacture and Use – 8.4.2.2 Choice of emission factor

corresponding resources needed to make these improvements effective, developments presented in following table will be explored.

Table 4-56 Planned improvements for CRT category 2.G.3.a *Medical applications.*

GHG source & sink category	Planned improvement	Type of improvement		Priority
2.G.3.a	Collection of amounts of N2O used for/ supplied by • manufacturers and distributors of N2O products; • medical applications: quantity of N2O usage from the pharmacy department in individual hospitals (nitrous oxide cylinders purchased per annum).	AD	Accuracy Transparency Completeness	High

4.8.3.2 Category-specific planned improvements including tracking of those identified in the review process for CRT category 2.G.3 N_2O from Product Uses

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 4-57 Planned improvements for CRT category 2.G.3 N_2O from Product Use.

GHG source & sink category	Planned improvement	Type of improvement		Priority
2.G.3	Estimation of N_2O emissions from the use of products containing N_2O applying Tier 1 of 2006 IPCC Guidelines, Vol. 3, Chapter 8: Other Product Manufacture and Use (N_2O FROM PRODUCT USES)	AD	Accuracy Transparency Completeness Comparability	High

4.8.4 Other (CRT category 2.G.4)

IPCC code	Description	CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.G.4	Other	NA	-	NA	-	NA	-

IPCC code	Description	HFC		PFC		SF_6		NF_3	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.G.4	Other	NO	-	NO	-	NO	-	NO	-

A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NE -not estimated, NA -not applicable, C – confidential

LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF

The CRT category 2.G.4 *Other* does not exist in Albania.

4.9 Other (CRT category 2.H)

The CRT category 2.H *Other* comprises activities withing Pulp and paper as well as Food and drink industry, where GHG emissions are arising. These industries emit only process related GHGs of biogenic origin and those have not been accounted for according to the guidelines.

4.9.1 Pulp and Paper Industry (CRT category 2.H.1)

IPCC code	Description	Fossil CO_2		Biogenic CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.H.1	Pulp and Paper Industry	NA	-	NE	-	NA	-	NA	-
A '✓' indicates emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere NE -not estimated, NA -not applicable, C – confidential									
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF									

The CRT category 2.H.1 *Pulp and Paper Industry* exists in Albania. The pulp and paper industry emit only processes related to GHGs of biogenic origin and those have not been accounted for according to the 2006 IPCC guidelines. Relevant GHG emission from fuel combustion activities in *Pulp and Paper Industry* are reported in CRT category 1.A.2 *Manufacturing Industries and Construction - Pulp, Paper and Print* (CRT category 1.A.2.d).

4.9.2 Food and Beverages Industry (CRT category 2.H.2)

IPCC code	Description	Fossil CO_2		Biogenic CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.H.2	Food and Beverages Industry	NA	-	NE	-	NA	-	NA	-
A '✓' indicates emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere NE -not estimated, NA -not applicable, C – confidential									
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF									

The CRT category 2.D.2 *Food and Beverages Industry* exist in Albania. The Food and Beverages Industry emit only process related GHGs of biogenic origin and those have not been accounted for according to the 2006 IPCC guidelines. Relevant GHG emission from fuel combustion activities in *Food and Beverages Industry* are reported in CRT category 1.A.2 *Manufacturing Industries and Construction - Food Processing, Beverages and Tobacco* (CRT category 1.A.2.e).

4.9.3 Other (CRT category 2.H.3)

IPCC code	Description	Fossil CO_2		Biogenic CO_2		CH_4		N_2O	
		Estimated	Key Category	Estimated	Key Category	Estimated	Key Category	Estimated	Key Category
2.H.3	Other (please specify)	NA	-	NE	-	NA	-	NA	-
A '✓' indicates emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere NE -not estimated, NA -not applicable, C – confidential									
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF									

The CRT category 2.H.3 *Other* does not exist in Albania.

5 Agriculture (CRT sector 3)

This chapter includes information on and description of methodologies used for estimating GHG emissions as well as references to activity data and emission factors reported under CRT sector 3 Agriculture for the period 1990 to 2022.

GHG emissions from this sector comprise emissions from the following categories:

IPCC Code	Description	CO2	CH4	N2O
3.A.1	Enteric Fermentation	NA	✓	NA
3.B.2	Manure Management	NA	✓	✓
3.C	Rice Cultivation	NA	NO	NA
3.D.a	Direct N_2O emissions from managed soils	NA	NA	✓
3.D.b	Indirect N_2O Emissions from managed soils	NA	NA	✓
3.E	Prescribed burning of savannas	NO*	NO	NO
3.F	Field burning of agricultural residues	✓*	✓	✓
3.G	Liming	NE	NA	NA
3.H	Urea application	✓	NA	NA
3.I	Other carbon-containing fertilizers	NO	NA	NA
3.J	Other (please specify)	NO	NA	NA

A '✓' indicates emissions from this sub-category have been estimated.

* CO_2 from biomass burning is not accounted in this categories

Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential

Table 5-1 GHG Emissions from CRT category 3 Agriculture by sub-categories for the period 1990-2022

Table 5-2 CO_2 Emissions from CRT category 3 Agriculture by sub-categories for the period 1990-2022

Table 5-3 CH_4 Emissions from CRT category 3 Agriculture by sub-categories for the period 1990-2022

Table 5-4 N_2O Emissions from CRT category 3 Agriculture by sub-categories for the period 1990-2022

5.1 Agricultural data collected and used

5.1.1 Country-specific issues

Albania has an land area of 28,748 km^2. As stated by the Convention on Biological Diversity Albania is country is well known for its high diversity of ecosystems and habitats. Its territory is comprised of maritime ecosystems, coastal zones, lakes, rivers, evergreen and broadleaf bushes, broadleaf forests, pine forests, alpine and sub-alpine pastures and meadows, and high mountain ecosystems Two biogeographical regions are present in Albania (Mediterranean and The major part of the country belongs to the Mediterranean biogeographical region which is a biodiversity hotspot. Albania is also well known for its rich and complex hydrographic network of rivers, lakes, wetlands, groundwater and seas. Wetland ecosystems are important migration routes for migratory species of wild fauna (3 Ramsar sites of international importance have been designated, namely, Karavasta Lagoon, Butrinti Lake and Shkodra Lake). Albanian lakes and rivers are also important in terms of their contribution to the biological and landscape diversity of the country. About 247 natural lakes of different types and dimensions, and a considerable number of artificial lakes, are located inside the country. The alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands is recognized as a major factor contributing to the loss of biological diversity and ecological function in aquatic ecosystems, including floodplains. Forests cover 36% of the country's territory, and pastures about 15%.[159]

According to FAO Agriculture remains the most important sector in the Albanian economy, measured by its contribution to the country's gross domestic product, employment and macroeconomic stability. Evidenced by the fact that it is the only sector that has continued to grow during the last three years (about 3 per cent), agriculture in Albania has demonstrated a high capacity of adaptation and resistance to different crises, like the (rather prolonged) transition from centralized economy to market economy as well as the more recent economic crisis. Family farming in Albania represents a rural way of working which is, in many ways, deeply rooted in the traditions and the savoir-faire of Albanian farmers. Considering the importance of the agricultural sector in the economy of Albania nowadays, as well as the specific weight of family farming in Albanian agriculture, the main challenge for today consists of modernizing the methods of production and increasing the productivity of family-run farms while preserving as much as possible the benefits of this type of agriculture – such as the intact agro biodiversity and natural resources that characterize most of the agricultural landscape in Albania.[160] Albania lies into three agro-ecological zones:

- **The lowland zone**. This agro-ecological zone lies in Fieri region and includes municipalities of Fieri and Patos. The area starts from Vjosa mouth (north of it) alongside the Adriatic Sea where plains range from 1 to 200 m above sea level. Alluvial soils dominate here and also there are different spots with saline soils.
- **The Intermediate zone.** This zone lies in southern part of Vjosa mouth and include all Vlora region, municipalities of; Vlora, Selenica, Himara, Saranda, Delvina, Konispol and Livadhja. In this area is induced as well the Mallakaster and Roskovec municipalities (Fieri region). This area is between the lowland and mountain zones at altitudes from 100 to 900 m. Here field crops and fruit trees are grown but there is also low forest and shrubs.
- **The Southern Highlands Mountain** zone (Southern Highlands and Northern & Central Mountains) where the summer is warm and the winter is cold, with more than 100 days per year with frost. In this zone forests and pastures dominate. In this zone is included all Gjirokaster region (municipalities;

[159] Available (3 Septembre 2024) on https://www.cbd.int/countries/profile?country=al

[160] Available (5. Septembre 2024) on https://www.fao.org/family-farming/countries/alb/en/

Memaliaj, Tepelene, Permet, Gjirokaster, Kelcyre, Libohove, Dropull) and Kolonja municipality from Korca region.

5.1.2 Sources of data

The original data provider for the national and international agricultural data is the Ministry of Agriculture and Rural Development and Statistical Office of Albania (INSTAT)[161]. The agricultural data used and presented in this inventory are taken from the following national and international sources:

Statistical yearbook [162] The official statistics (several years) of INSTAT provides information on

- usable land area and cultivated land area
- crop production, crop yield of agricultural products
- fruit and vegetable cultivated land area
- fruit area and production by province
- area and production of wheat, barley, maize etc
- annual livestock numbers
- livestock production by type

FAO agricultural data base[163] The FAO agricultural data base (FAOSTAT) provides worldwide harmonized data (FAO AGRICULTURE STATISTICAL SYSTEM 2001).[164] The FAO data base provides data for the entire time series 1990 – 2022, even some data are based on estimates done by FAO.

The results of these QA/QC checks are presented in the following chapters under “Category-specific QA/QC and verification”.

5.1.3 Livestock

According to the 2019 Refinement to the 2006 IPCC Guidelines, the method for estimating methane emission from enteric fermentation requires three basic steps:

Step 1: Divide the livestock population into subgroups and characterize each subgroup (as described in Section 10.2. of Volume 4: AFOLU of the 2006 IPCC Guidelines) and presented in chapter 5.2.2.2

Step 2: Estimate emission factors for each subgroup in terms of kilograms of methane per animal per year.

Step 3: Multiply the subgroup emission factors by the subgroup populations to estimate subgroup emission, and sum across the subgroups to estimate total emission.

[161] Available (5. Septembre 2024) on https://www.instat.gov.al/
[162] Available (3. Januar 2021) on https://www.instat.gov.al/en/publications/books/
[163] Available (3. Januar 2021) on http://www.fao.org/statistics/en/
[164] Available (3. Januar 2021) on http://www.fao.org/faostat/en/#data

Cattle

In **1990**, the total number of **cattle** amounted to 632 600 and in **2022** the total number of cattle amounted to 297 670. In 2022, 87.6 % of the cattle were dairy cows. The number of **cattle** decreased significantly by 52.9 % in the period 1990 – 2022 and decreased by 54.6% in the period 2005 – 2022. The number of **dairy cattle** decreased significantly by -35.7% in the period 1990 – 2022 and decreased by -39.3% in the period 2005 – 2022. However, the dip in 2005 is due to a change in statistical methodology.

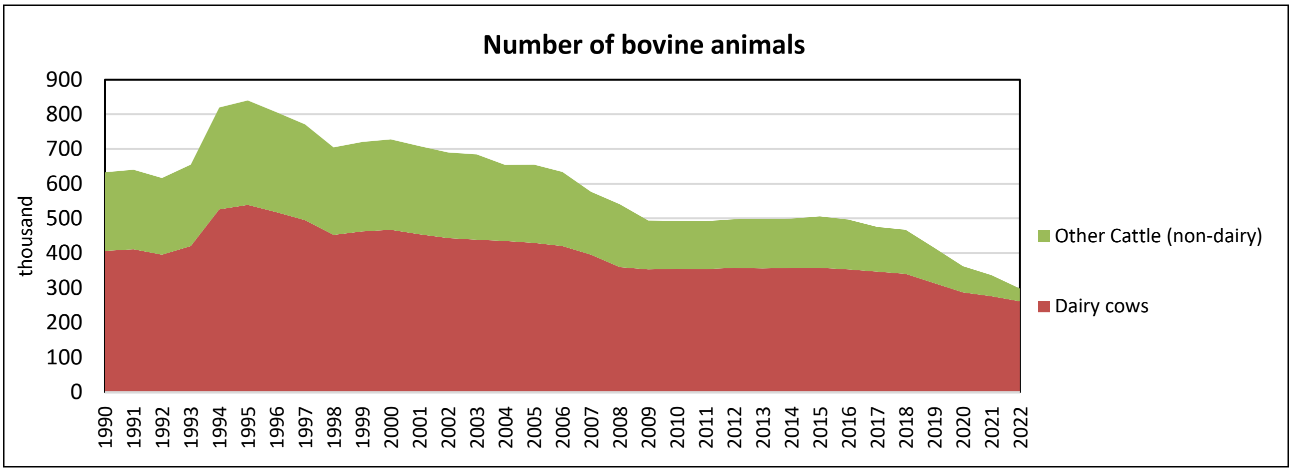


Figure 5-1 Cattle - dairy and non-dairy population for the period of 1990–2022

Sheep

In **1990**, the total number of **sheep** amounted to 1 646 300 and in **2022** the total number of sheep amounted to 1 371 700. In 2022, 79.1 % of the sheep were **dairy breeding ewes**. The number of **sheep** decreased by -16.7% in the period 1990 – 2022 and decreased by -22.1% in the period 2005 – 2022. The number of **dairy breeding ewes** decreased by -12.3% in the period 1990 – 2022 and decreased by -17.3% in the period 2005 – 2022.

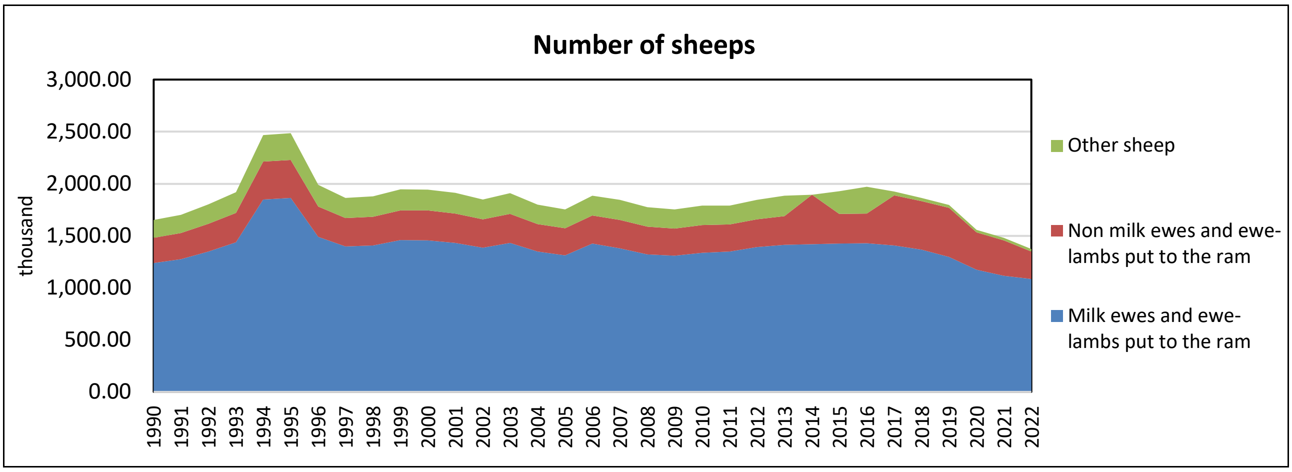


Figure 5-2 Sheep and Goats - population for the period of 1990–2022

Goats

In **1990**, the total number of **goats** amounted to 1 144 000 and in **2022** the total number of goats amounted to 721 560. In 2022, 80% of the goats were **milked goats**. The number of **goats** decreased significantly by -36.9% in the period 1990 – 2022 and decreased by -23.3% in the period 2005 – 2022.

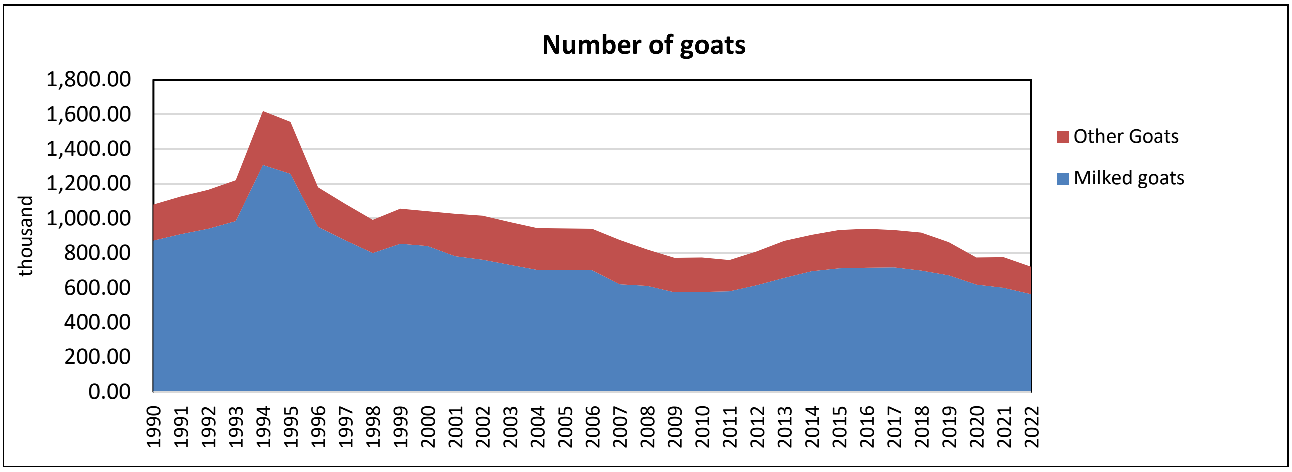


Figure 5-3 Goats - population for the period of 1990–2022

Swine

In **1990**, the total number of **swine** amounted to 219 700 and in **2022** the total number of **swine** amounted to 137 300. In 2022 about 42.3% of the swine were **breeding sows**. The number of **fattening pigs** decreased by -5.8% in the period 1990 – 2022 and -5.0% in the period 2005-2022.

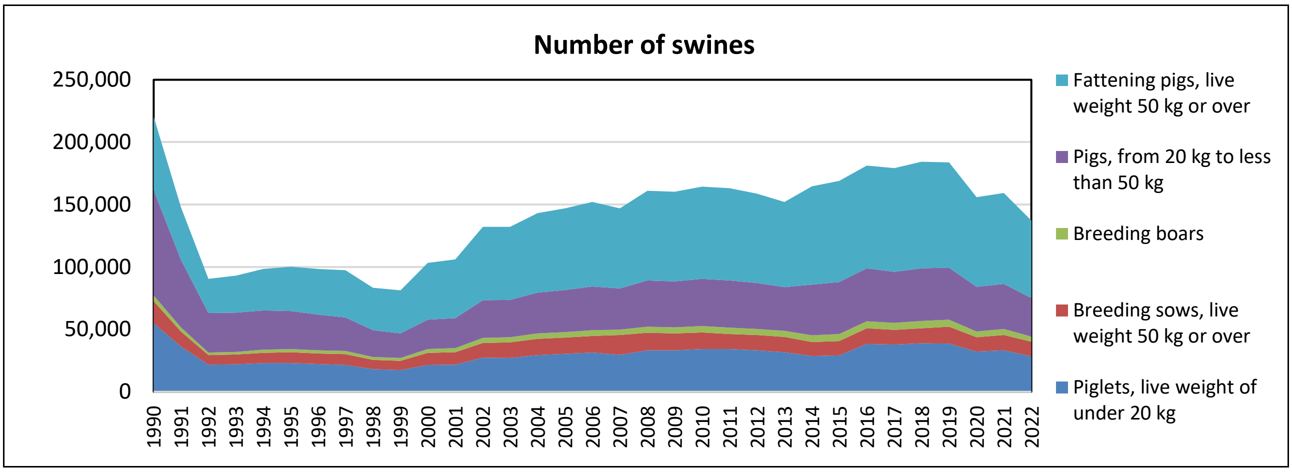


Figure 5-4 Swine - population for the period of 1990–2022

Poultry

In **1990**, the total number of **poultry** amounted to 6 654 450 and in **2022** the total number of poultry amounted to 6 847 510. In 2022, about 70% of the poultry were **hens**. The number of **hens** decreased by -2.9% in the period 1990 – 2022 and increased 6.5% in the period 2005-2022.

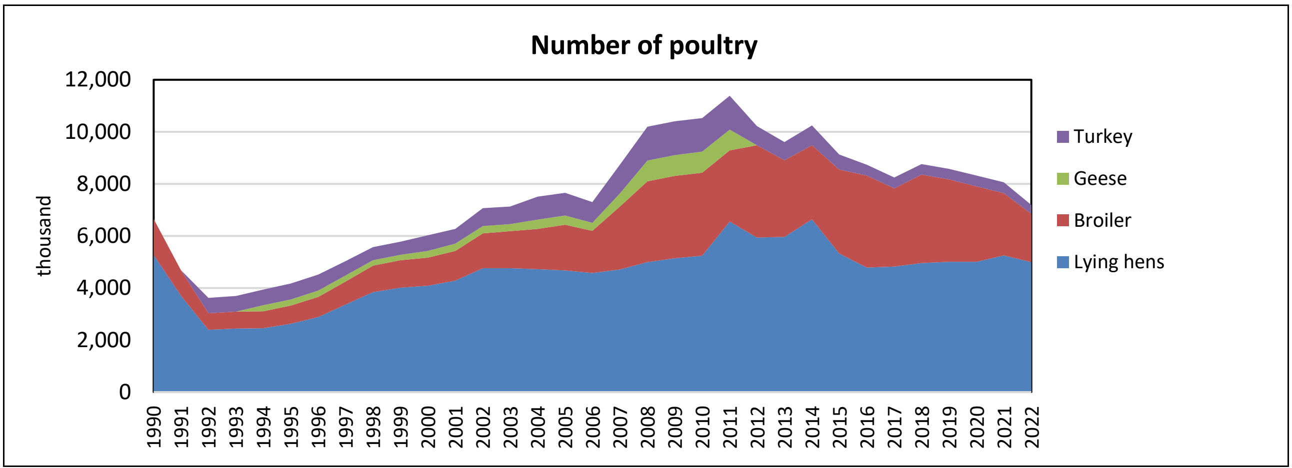


Figure 5-5 Poultry - population for the period of 1990–2022

Horses, Mules, Hinnies and Asses

The number of **horses** include including m**ules and asses.** In **1990**, the total number of **Horses, Mules, Hinnies and Asses** amounted to 181 200 and in **2022** the total number of Horses, Mules and Asses amounted to 65 000. The number of **Horses, Mules, Hinnies and Asses** decreased significantly by -64.1% in the period 1990 – 2022. The decrease can be explained by less use of horses, mules and asses as working animals.

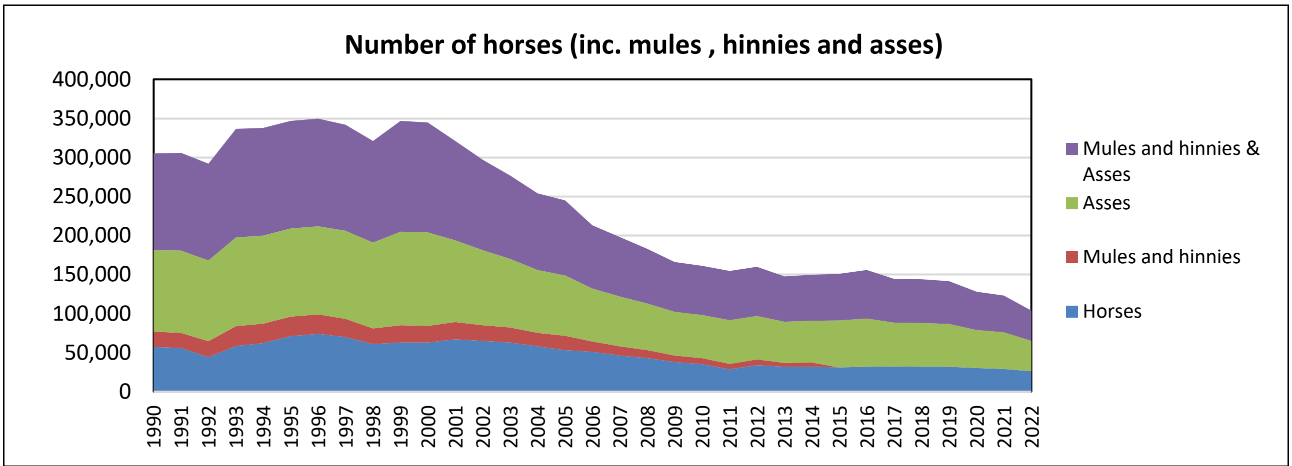


Figure 5-6 Horses (including mules, hinnies and asses) - population for the period of 1990–2022

Table 5-5 Bovine animals: livestock population for the period of 1990–2022

	Live bovine animals (total)		Dairy cows		Other cattle														
							Other Female bovine animals, 1 years old or over			Heifers & Male, less than 1 year old			Calves, less than 1 year old						
							Heifers, 2 years old or over	Male bovine animals, 2 years old or over		Heifers, 1 to less than 2 years old	Male bovine animals, 1 to less than 2 years old		Female calves, less than 1 year old, not for slaughter		Male calves, less than 1 year old, not for slaughter		Bovine animals, less than 1 year old, for slaughter	
1000 heads																			
1990	**632.60**		406.15		226.45		58.21	16.74		59.01	1.09		41.45		31.90		31.90	
1991	**640.00**		410.90		229.10		58.89	16.93		59.70	1.10		41.94		32.27		32.27	
1992	**616.00**		395.49		220.51		56.68	16.30		57.46	1.06		40.37		31.06		31.06	
1993	**654.70**		420.34		234.36		60.24	17.32		61.07	1.12		42.90		33.01		33.01	
1994	**820.00**		526.46		293.54		75.45	21.70		76.49	1.41		53.74		41.35		41.35	
1995	**840.00**	FAOSTAT	539.30	Calculated	300.70	Calculated	77.29	22.23	Calculated	78.35	1.44	Calculated	55.05	Calculated	42.35		42.35	Calculated
1996	**806.00**		517.48		288.52		74.16	21.33		75.18	1.38		52.82		40.64		40.64	
1997	**771.00**		495.00		276.00		70.94	20.40		71.92	1.32		50.52		38.88		38.88	
1998	**705.00**		452.63		252.37		64.87	18.65		65.76	1.21		46.20		35.55		35.55	
1999	**720.00**		462.26		257.74		66.25	19.05		67.16	1.23		47.18		36.30		36.30	
2000	**728.00**		467.40		260.60		66.99	19.26		67.91	1.25		47.71		36.71		36.71	
2001	**708.40**		454.81		253.59		65.18	18.74		66.08	1.22		46.42		35.72		35.72	
2002	**690.00**		443.00		247.00		63.49	18.26		64.36	1.18		45.22		34.79		34.79	
2003	**684.00**		439.00		245.00		62.98	18.11		63.84	1.17		44.85		34.51		34.51	
2004	**654.00**		435.00		219.00		56.29	16.19		57.06	1.05		40.09		30.85		30.85	
2005	**655.00**	INSTAT- SY/FAOSTAT	430.00	INSTAT- SY/FAOSTAT	225.00	Calculated	57.84	16.63	Calculated	58.63	1.08	Calculated	41.19	Calculated	31.69	Calculated	31.69	Calculated
2006	**634.00**		420.00		214.00		55.01	15.82		55.76	1.03		39.18		30.14		30.14	
2007	**577.00**		396.00		181.00		46.53	13.38		47.16	0.87		33.13		25.49		25.49	
2008	**541.00**		360.00		181.00		46.53	13.38		47.16	0.87		33.13		25.49		25.49	
2009	**494.00**	⬇	353.00	⬇	141.00	⬇	36.24	10.42	⬇	36.74	0.68	⬇	25.81	⬇	19.86	⬇	19.86	⬇

	Live bovine animals (total)	Dairy cows	Other cattle	Other Female bovine animals, 1 years old or over		Heifers & Male, less than 1 year old		Calves, less than 1 year old		
				Heifers, 2 years old or over	Male bovine animals, 2 years old or over	Heifers, 1 to less than 2 years old	Male bovine animals, 1 to less than 2 years old	Female calves, less than 1 year old, not for slaughter	Male calves, less than 1 year old, not for slaughter	Bovine animals, less than 1 year old, for slaughter
1000 heads										
2010	**493.00**	355.00	138.00	35.47	10.20	35.96	0.66	25.26	19.44	19.44
2011	**492.00**	354.00	138.00	35.47	10.20	35.96	0.66	25.26	19.44	19.44
2012	**498.02**	357.64	140.38	36.08	10.38	36.58	0.67	25.70	19.77	19.77
2013	**498.13**	356.25	141.88	36.47	10.49	36.97	0.68	25.97	19.98	19.98
2014	**499.70**	357.78	141.92	36.48	10.49	36.98	0.68	25.98	19.99	19.99
2015	**505.78**	357.52	148.26	36.87	10.27	37.33	0.66	26.81	20.23	20.23
2016	**496.96**	353.05	143.91	36.23	10.09	36.68	0.65	26.34	19.88	19.88
2017	**475.22**	346.41	128.81	35.98	3.08	35.72	8.47	23.29	4.99	4.99
2018	**467.33**	339.94	127.39	35.54	3.11	35.28	8.41	22.98	4.99	4.99
2019	**415.60**	313.89	101.71	29.01	1.47	28.79	6.18	19.14	3.14	3.14
2020	**362.59**	287.17	75.42	22.33	1.28	22.13	3.90	13.71	1.25	1.25
2021	**336.80**	275.58	61.22	18.02	1.03	17.86	3.15	11.07	1.01	1.01
2022	**297.67**	260.96	36.71	10.61	0.61	10.52	1.85	41.45	0.59	0.59
Trend										
1990 – 2022	*-52.9%*	*-35.7%*	*-83.8%*	*-81.8%*	*-96.4%*	*-82.2%*	*70.5%*	*-84.3%*	*-98.2%*	*-77.6%*
2005 – 2022	*-54.6%*	*-39.3%*	*-83.7%*	*-81.7%*	*-96.3%*	*-82.1%*	*71.6%*	*-84.2%*	*-98.1%*	*-77.5%*
2020– 2022	*-11.6%*	*-5.3%*	*-40.0%*	*-41.1%*	*-40.8%*	*-41.1%*	*-41.3%*	*-41.1%*	*-41.6%*	*-41.1%*

Table 5-6 Sheep and goats: livestock population for the period of 1990-2022

	Sheep								Goats				
	Sheep (total)		Milk ewes and ewe-lambs put to the ram		Non milk ewes and ewe-lambs put to the ram		Other sheep		Goats - total		Milked goats	Other Goats	
	1000 heads												
1990	1,646.30	INSTAT -SY/FAOSTAT	1,237.02	Calculated	243.25	Calculated	170.93	Calculated	1,144.00	INSTAT- SY/FAOSTAT	871.09	207.81	Calculated
1991	1,696.00		1,274.36		250.60		176.09		1,193.90		909.08	216.87	
1992	1,796.00		1,349.50		265.37		186.47		1,234.20		939.77	224.19	
1993	1,911.80		1,436.51		282.48		198.49		1,293.60		985.00	234.98	
1994	2,460.00		1,848.43		363.48		255.41		1,717.00		1,307.39	311.89	
1995	2,480.00		1,863.46		366.44		257.48		1,650.00		1,256.38	299.72	
1996	1,982.00		1,489.26		292.86		205.78		1,250.00		951.80	227.06	
1997	1,858.00		1,396.09		274.53		192.91		1,148.00		874.13	208.53	
1998	1,872.00		1,406.61		276.60		194.36		1,051.00		800.27	190.91	
1999	1,941.00		1,458.45		286.80		201.52		1,120.00		852.81	203.45	
2000	1,939.00		1,456.95		286.50		201.32		1,104.00		840.63	200.54	
2001	1,905.80		1,432.01		281.60		197.87		1,027.00		782.00	245.00	INSTAT -SY/FAOSTAT
2002	1,844.00		1,385.57		272.47		191.45		1,015.00		761.00	254.00	
2003	1,903.00		1,429.90		281.18		197.58		979.50		731.50	248.00	
2004	1,794.00		1,348.00	INSTAT -SY/FAOSTAT	265.08		186.26		944.00		702.00	242.00	
2005	1,760.00		1,312.00		260.05		182.73		941.00		701.00	240.00	
2006	1,830.00		1,426.00		270.40		190.00		940.00		700.00	240.00	
2007	1,853.00		1,379.00		273.80		192.39		876.00		620.00	256.00	
2008	1,800.00		1,321.00		265.96		186.88		820.00		610.00	210.00	
2009	1,768.00		1,309.00		261.24		183.56		772.00		574.00	198.00	
2010	1,806.00		1,337.00		266.85		187.51		775.00		576.00	199.00	

	Sheep						Goats			
	Sheep (total)	**Milk ewes and ewe-lambs put to the ram**	**Non milk ewes and ewe-lambs put to the ram**		**Other sheep**		**Goats - total**	**Milked goats**	**Other Goats**	
1000 heads										
2011	1,758.00	1,349.00	259.76		182.52		759.00	580.00	179.00	
2012	1,808.80	1,390.27	267.26		187.80		810.13	613.74	196.39	
2013	1,866.39	1,414.29	275.77		193.78		869.18	656.81	212.37	
2014	1,895.80	1,418.74	477.00		0.00		904.21	694.85	209.36	
2015	1,918.35	1,426.20	283.40		217.60		932.36	711.53	220.83	
2016	1,971.93	1,427.98	285.60		258.35		940.81	716.16	224.65	
2017	1,925.51	1,407.28	481.38	INSTAT -SY/FAOSTAT	36.86	NSTAT -SY/FAOSTAT	933.12	717.38	215.74	
2018	1,863.84	1,366.17	467.32		30.36		917.16	699.16	218.00	
2019	1,758.33	1,296.70	472.26		28.64		862.87	670.92	191.95	
2020	1,557.86	1,174.50	357.99		25.37		774.33	618.58	155.75	
2021	1,480.45	1,115.92	340.42		24.11		775.34	599.00	176.34	
2022	1,371.70	1,085.28	264.08		22.34		721.56	562.78	158.78	
Trend										
1990 – 2022	*-16.7%*	*-60.3%*	*-65.9%*		*-71.3%*		*-36.9%*	*-36.9%*	*-23.6%*	
2005 – 2022	*-22.1%*	*-53.0%*	*-29.7%*		*-45.5%*		*-23.3%*	*-23.3%*	*-33.8%*	
2021 – 2022	*-7.3%*	*0.5%*	*-7.5%*		*0.4%*		*-6.9%*	*-6.9%*	*-10.0%*	

Table 5-7 Pigs: livestock population for the period of 1990–2022

	Live swine (total)		Piglets, live weight of under 20 kg		Pigs, from 20 kg to less than 50 kg		Fattening pigs, live weight 50 kg or over		Breeding sows, live weight 50 kg or over		Breeding Boars	
1990	219,700	FAPOSTAT	54,925.0	Calculated	84,434.5	Calculated	58,767.1	Calculated	17,576.0	Calculated	4,600.8	Calculated
1991	147,500		36,277.6		54,373.5		42,033.9		11,992.3		3,227.7	
1992	90,300		21,843.6		31,871.5		27,312.5		7,459.4		2,061.1	
1993	92,800		22,072.5		31,298.5		29,691.5		7,786.9		2,205.5	
1994	98,100		22,935.7		31,547.5		33,102.8		8,359.5		2,423.8	
1995	100,000		22,975.0		30,590.2		35,492.7		8,651.8		2,564.9	
1996	98,000		22,118.5		28,441.5		36,496.7		8,606.5		2,605.9	
1997	97,000		21,500.0		26,630.1		37,820.6		8,645.1		2,670.6	
1998	83,000		18,060.7		21,484.9		33,813.5		7,505.6		2,363.3	
1999	81,000		17,297.5		19,696.8		34,415.2		7,430.3		2,382.6	
2000	103,000		21,578.4		23,431.3		45,563.8		9,582.7		3,126.7	
2001	106,000	INSTAT - Statistical Yearbook	21,777.6		24,113.7		46,890.9		10,000.0	INSTAT - Statistical Yearbook	3,217.8	
2002	132,000		27,222.0	Calculated	30,142.1		58,613.6		12,000.0		4,022.2	
2003	132,000		27,108.6		30,016.6		58,369.4		12,500.0		4,005.5	
2004	143,100		29,513.2		32,679.1		63,546.9		13,000.0		4,360.8	
2005	147,000		30,397.9		33,658.7		65,451.9		13,000.0		4,491.5	
2006	152,000		31,464.1		34,839.3		67,747.6		13,300.0		4,649.0	
2007	146,900		29,762.7		32,955.4		64,084.2		15,700.0		4,397.6	
2008	160,900		33,324.3		36,899.0		71,752.9		14,000.0		4,923.9	
2009	160,300		33,346.9		36,924.1		71,801.7		13,300.0		4,927.2	

	Live swine (total)		Piglets, live weight of under 20 kg		Pigs, from 20 kg to less than 50 kg		Fattening pigs, live weight 50 kg or over		Breeding sows, live weight 50 kg or over		Breeding Boars	
2010	164,300	INSTAT - Statistical Yearbook	34,277.0	Calculated	37,954.0	Calculated	73,804.3	Calculated	13,200.0	INSTAT - Statistical Yearbook	5,064.7	Calculated
2011	163,000		34,254.3		37,928.9		73,755.5		12,000.0		5,061.3	
2012	158,820		33,260.7		36,828.7		71,616.1		12,200.0		4,914.5	
2013	151,940		31,654.6		35,050.3		68,157.9		12,400.0		4,677.2	
2014	172,460		28,529.9		40,465.8		78,688.8		11,360.0		5,399.8	
2015	177,440		29,100.0		41,671.5		81,033.3		11,540.0		5,560.7	
2016	181,020		38,230.9	Calculated	42,332.0	Calculated	82,317.7	Calculated	12,670.0		5,648.9	Calculated
2017	180,090		37,830.0		40,880.0		83,070.0		11,770.0		5,700.0	
2018	184,130		38,830.0		42,040.0		85,260.0		12,120.0		5,890.0	
2019	183,850		38,530.0		41,730.0		84,410.0		13,540.0		5,640.0	
2020	158,400		32,200.0		35,670.0		71,880.0		11,560.0		4,570.0	
2021	159,240		33,310.0		36,090.0		72,790.0		12,220.0		4,820.0	
2022	137,300		28,460.0		30,830.0		62,190.0		11,660.0		4,160.0	
Trend												
1990 - 2022	*-48.2%*		*-48.2%*		*5.8%*		*5.8%*		*-33.7%*		*-9.6%*	
2005 - 2022	*-6.4%*		*-6.4%*		*-5.0%*		*-5.0%*		*-10.3%*		*-7.4%*	
2021 - 2022	*-14.6%*		*-14.6%*		*-14.6%*		*-14.6%*		*-4.6%*		*-13.7%*	

Table 5-8 Sheep: livestock population for the period of 1990–2022

	Poultry – total (1000 heads)		Chickens (broilers) (1000 heads)		Lying hens (1000 heads)	Turkey (1000 heads)	Geese (1000 heads)		Horses & Mules and hinnies & Asses	Horses	Mules and hinnies	Asses	
1990	6,654.4		1,395.4		5,259.0	0.00	0.0		181,200	57,200	19,600	104,400	
1991	4,686.8		982.8		3,704.0	0.00	0.0		180,900	55,800	19,500	105,600	
1992	3,026.7		634.7		2,392.0	592.00	0.0		168,100	44,100	20,400	103,600	
1993	3,095.0		649.0		2,446.0	592.00	0.0		197,500	58,200	25,600	113,700	
1994	3,100.1		650.1		2,450.0	592.00	240.0		200,000	62,000	25,000	113,000	
1995	3,320.3	Calculated	696.3		2,624.0	606.00	240.0		209,000	71,000	25,000	113,000	
1996	3,654.3		766.3		2,888.0	611.00	244.0		212,000	74,000	25,000	113,000	
1997	4,249.0		891.0		3,358.0	562.00	225.0		206,000	70,000	23,000	113,000	
1998	4,857.7		1,018.7		3,839.0	513.00	205.0		191,000	61,000	20,000	110,000	
1999	5,074.0		1,064.0		4,010.0	500.00	200.0		205,000	63,000	22,000	120,000	
2000	5,171.5		1,084.5	FAOSTAT	4,087.0	600.00	250.0	FAOSTAT	204,000	63,000	21,000	120,000	FAOSTAT
2001	5,422.0		1,137.0		4,285.0	570.00	280.0		194,000	67,000	22,000	105,000	
2002	6,104.0		1,348.0		4,756.0	690.00	275.0		181,000	65,000	20,000	96,000	
2003	6,189.7		1,433.7		4,756.0	674.00	270.0		170,000	63,000	19,000	88,000	
2004	6,275.3		1,553.1		4,722.2	879.00	352.0		156,000	58,000	17,000	81,000	
2005	6,431.7		1,760.5		4,671.2	880.00	353.0		149,000	53,000	18,500	77,500	
2006	6,199.6	INSTAT - Statistical Yearbook	1,627.5		4,572.1	800.00	300.0		132,000	51,000	13,000	68,000	
2007	7,135.4		2,423.7		4,711.7	1,100.00	500.0		122,000	46,000	12,000	64,000	
2008	8,100.0		3,100.0		5,000.0	1,300.00	800.0		113,000	43,000	10,000	60,000	
2009	8,313.0		3,175.0		5,138.0	1,300.00	800.0		102,000	38,000	8,000	56,000	
2010	8,436.9		3,192.3		5,244.6	1,300.00	800.0		98,000	35,000	8,000	55,000	

	Poultry – total (1000 heads)		Chickens (broilers) (1000 heads)		Lying hens (1000 heads)	Turkey (1000 heads)	Geese (1000 heads)		Horses & Mules and hinnies & Asses	Horses	Mules and hinnies	Asses	
2011	9,292.0		2,734.0		6,558.0	1,300.00	800.0		91,400	28,400	7,000	56,000	FAOSTAT
2012	9,493.4		3,555.7		5,937.8	726.00	0.0		96,986	33,986	7,000	56,000	
2013	8,907.3		2,942.7		5,964.6	699.00	0.0		89,580	31,580	5,000	53,000	
2014	9,493.4		2,848.0		6,645.4	755.00	0.0		90,727	31,727	5,500	53,500	
2015	8,558.0		3,234.2		5,323.9	574.00	0.0		91,000	31,000	0	60,000	
2016	8,325.6		3,535.3	FAOSTAT	4,790.4	417.00	0.0	FAOSTAT	93,729	31,729	0	62,000	
2017	7,834.6		3,014.2		4,820.4	409.00	0.0		88,258	32,258	0	56,000	
2018	8,362.5		3,399.8		4,962.6	403.00	0.0		87,905	31,905	0	56,000	
2019	8,179.2		3,175.6		5,003.6	404.00	0.0		86,649	31,649	0	55,000	
2020	7,906.7		2,905.5		5,001.2	421.00	0.0		79,000	30,000	0	49,000	
2021	7,651.6		2,402.7		5,248.9	411.00	0.0		76,000	29,000	0	47,000	
2022	6,847.5		1,848.1		4,999.4	346.00	0.0		65,000	26,000	0	39,000	
Trend													
1990 - 2022	*2.9%*		*32.4%*		*-4.9%*	*NA*	*NA*		*-64.1%*	*-54.5%*	*-100.0%*	*-62.6%*	
2005 - 2022	*6.5%*		*5.0%*		*7.0%*	*-60.7%*	*-100.0%*		*-56.4%*	*-50.9%*	*-100.0%*	*-49.7%*	
2021 - 2022	*-10.5%*		*-23.1%*		*-4.8%*	*-15.8%*	*NA*		*-14.5%*	*-10.3%*	*NA*	*-17.0%*	

5.2 Enteric fermentation (CRT category 3.A)

This section describes the estimation of methane emissions resulting from enteric fermentation from livestock. As described in the 2006 IPCC Guidelines (Volume 4, Chapter 10) methane is produced in herbivores (plant eaters) as a by-product of enteric fermentation, a digestive process by which carbohydrates are broken down by micro-organisms into simple molecules for absorption into the bloodstream. The amount of methane that is released depends on the type of digestive tract, age, and weight of the animal, and the quality and quantity of the feed consumed. Ruminant livestock are major sources of methane with moderate amounts produced from non-ruminant livestock:

- main ruminant livestock are cattle, buffalo, goats, sheep, deer and camels,
- non-ruminant livestock are horses, mules and asses;
- monogastric livestock are swine.

Methane is produced by the fermentation of feed within the animal's digestive system. Generally, the higher the feed intake, the higher the methane emission. Although, the extent of methane production may also be affected by the composition of the diet. Feed intake is positively related to animal size, growth rate, and production (e.g., milk production, wool growth, or pregnancy).

To reflect the variation in emission rates among animal species, the population of animals are divided into subgroups, and an emission rate per animal is estimated for each subgroup.

Natural wild ruminants are not considered in the derivation of a country's emission estimate. Emissions should only be considered from animals under domestic management (e.g., farmed deer, elk, and buffalo).

5.2.1 Source category description

IPCC code	description	CO_2		CH_4		N_2O	
		Estimated	Key Category	estimated	Key category	estimated	Key category
3.A.1	**Enteric Fermentation**						
3.A.1.a	Cattle	NA	NA	**Option B**	LA 1990, LA 2022	NA	NA
3.A.1.a.i	Mature dairy cattle	NA	NA	✓ TIER 2		NA	NA
3.A.1.a.ii	Other mature cattle	NA	NA	✓ TIER 2		NA	NA
3.A.1.a.iiI	Growing cattle	NA	NA	✓ TIER 2		NA	NA
3.A.1.a.iv	Other	NA	NA	NO		NA	NA
3.A.2.a	Sheep	NA	NA		-	NA	NA
3.A.2.a.i	Mature Sheep	NA	NA	✓TIER 2		NA	NA
3.A.2.a.ii	Growing Sheep (lambs)	NA	NA	✓TIER 2		NA	NA
3.A.3	Swine	NA	NA	✓ TIER 2	-	NA	NA
3.A.4	Other Livestock						
3.A.4.a	Buffalo	NA	NA	NO	NA	NA	NA
3.A.4.b	Camels	NA	NA	NO	NA	NA	NA
3.A.4.c	Deer	NA	NA	NO	NA	NA	NA
3.A.4.d	Goats	NA	NA	✓ TIER 2	-	NA	NA
3.A.4.e	Horses	NA	NA	✓ TIER 2	-	NA	NA
3.A.4.f	Mules and Asses	NA	NA	✓ TIER 2	IE	NA	NA
3.A.4.g	Poultry	NA	NA	NA	NA	NA	NA
3.A.4.h	Other						
3.A.4.h.i	Rabbit	NA	NA	NA	NA	NA	NA
3.A.4.h.ii	Reindeer	NA	NA	NO	NA	NA	NA

IPCC code	description	CO_2		CH_4		N_2O	
		Estimated	Key Category	estimated	Key category	estimated	Key category
3.A.4.h.iii	Ostrich	NA	NA	NO	NA	NA	NA
3.A.4.h.iv	Fur-bearing animals	NA	NA	NO	NA	NA	NA
3.A.4.h.v	Other	NA	NA	NO	NA	NA	NA
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential							
LA – Level Assessment (in year); TA – Trend Assessment							

In the period 1990 – 2022 the CH_4 emissions decreased by -25.6% and in the period 2005 – 2022 the CH_4 emissions decreased by -30.1% mainly due to decreased number of livestock. In 2022, CH4 emissions from CRT category 3.A Enteric fermentation amounted to 1 118.04 kt CO2 equivalent.

Cattle are the most significant source of methane because of their high numbers, large size and ruminant digestive system, followed by sheep and goats. The significant drop is mainly due to statistical revisions.

An overview of the methane emissions resulting CRT category 3.A *Enteric Fermentation* is provided in the following figure and tables.

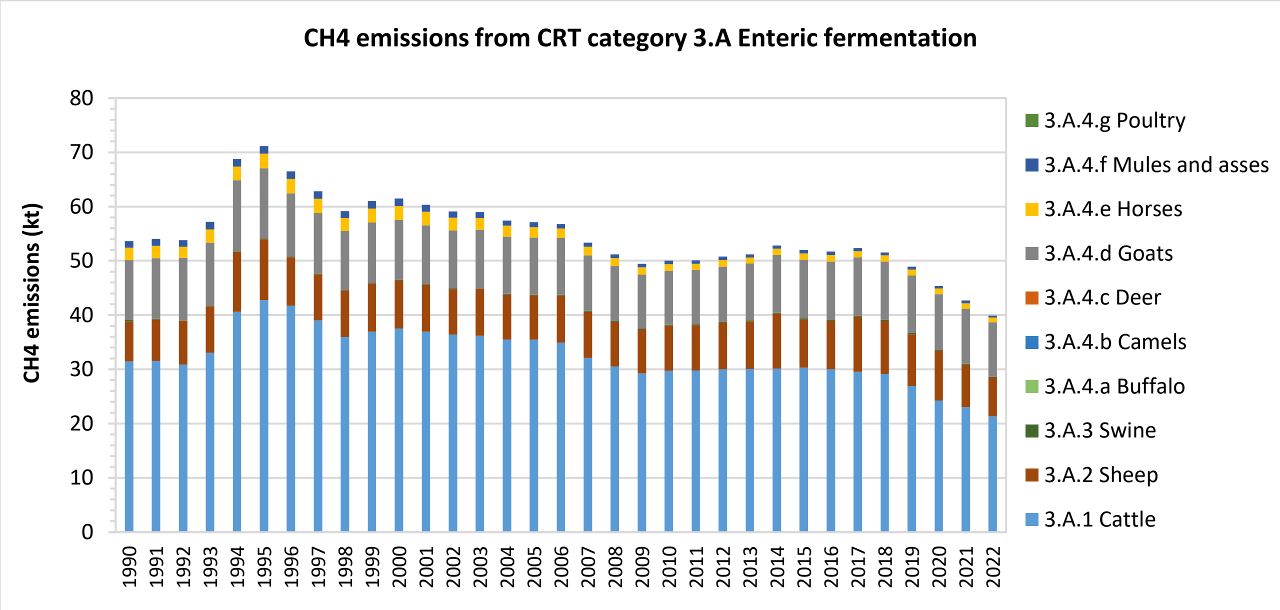


Figure 5-7 CH4 emissions from 3.A Enteric fermentation for the period of 1990–2022

Table 5-9 CH4 Emissions from CRT category 3.A Enteric Fermentation for the period 1990-2022 (I)

CH_4 emissions	3.A.	3.A.1.a	*3.A.1.a.i*	*3.A.1.a.ii*	*3.A.1.a.iii*	3.A.2	3.A.4.a	3.A.4.b
	Enteric Fermentation	Cattle	Mature dairy cattle	Other mature cattle	3.A.1.a.iii. Growing cattle	Sheep	Buffalo	Camels
	kt	kt	kt	kt	kt	kt	kt	kt
1990	**53.65**	31.49	25.65	3.74	2.10	**(kt)**	NO	NO
1991	**54.03**	31.55	25.64	3.78	2.13	7.38	NO	NO
1992	**53.81**	30.86	25.18	3.64	2.05	7.60	NO	NO
1993	**57.16**	33.01	26.96	3.87	2.18	8.10	NO	NO
1994	**68.76**	40.60	33.03	4.84	2.73	8.57	NO	NO
1995	**71.14**	42.74	34.99	4.96	2.79	11.05	NO	NO
1996	**66.49**	41.68	34.24	4.76	2.68	11.24	NO	NO
1997	**62.81**	39.04	31.92	4.55	2.56	9.00	NO	NO
1998	**59.18**	35.96	29.45	4.16	2.34	8.46	NO	NO
1999	**61.04**	36.95	30.30	4.25	2.39	8.56	NO	NO
2000	**61.49**	37.52	30.80	4.30	2.42	8.86	NO	NO
2001	**60.30**	36.91	30.37	4.19	2.36	8.83	NO	NO
2002	**59.13**	36.39	30.02	4.08	2.29	8.71	NO	NO
2003	**58.98**	36.15	29.83	4.04	2.28	8.41	NO	NO
2004	**57.44**	35.46	29.81	3.61	2.03	8.71	NO	NO
2005	**57.15**	35.48	29.67	3.71	2.09	8.31	NO	NO
2006	**56.77**	34.91	29.39	3.53	1.99	8.14	NO	NO
2007	**53.35**	32.09	27.42	2.99	1.68	8.66	NO	NO
2008	**51.19**	30.51	25.84	2.99	1.68	8.52	NO	NO
2009	**49.43**	29.24	25.60	2.33	1.31	8.21	NO	NO
2010	**50.04**	29.69	26.13	2.28	1.28	8.12	NO	NO
2011	**50.09**	29.75	26.30	2.16	1.28	8.33	NO	NO
2012	**50.80**	30.01	26.51	2.20	1.30	8.38	NO	NO
2013	**51.22**	30.09	26.55	2.22	1.32	8.59	NO	NO
2014	**52.83**	30.12	26.58	2.22	1.32	8.78	NO	NO
2015	**51.98**	30.30	26.57	2.37	1.35	10.16	NO	NO
2016	**51.69**	30.00	26.39	2.28	1.33	8.93	NO	NO
2017	**52.36**	29.57	26.10	2.49	0.98	8.91	NO	NO
2018	**51.55**	29.12	25.69	2.46	0.97	10.10	NO	NO
2019	**48.95**	26.91	24.14	1.99	0.78	9.81	NO	NO
2020	**45.38**	24.24	22.18	1.52	0.54	9.58	NO	NO
2021	**42.67**	23.02	21.35	1.23	0.44	9.15	NO	NO
2022	**39.93**	21.36	20.36	0.75	0.26	7.79		
Trend								
1990 - 2022	*-25.6%*	*-32.2%*	*-20.6%*	*-80.0%*	*-87.8%*	*-3.3%*	*NA*	*NA*
2005 - 2022	*-30.1%*	*-39.8%*	*-31.4%*	*-79.9%*	*-87.7%*	*-12.3%*	*NA*	*NA*
2021 - 2022	*-6.4%*	*-7.2%*	*-4.7%*	*-39.5%*	*-41.1%*	*-8.3%*	*NA*	*NA*

Table 5-10 CH4 Emissions from CRT category 3.A Enteric Fermentation for the period 1990-2022 (II)

CH_4 emissions	3.A.	3.A.3	3.A.4.c	3.A.4.d	3.A.4.e	3.A.4.f	3.A.4.g	3.A.1.h
	Enteric Fermentation	Swine	Deer	Goats	Horses	Mules and Asses	Poultry	Other
	kt	kt	kt	kt	kt	kt	kt	kt
1990	**53.65**	**0.22**	NO	11.05	2.27	IE	NA	NO
1991	**54.03**	**0.15**	NO	11.23	2.26	IE	NA	NO
1992	**53.81**	**0.09**	NO	11.48	2.03	IE	NA	NO
1993	**57.16**	**0.09**	NO	11.66	2.44	IE	NA	NO
1994	**68.76**	**0.10**	NO	13.13	2.50	IE	NA	NO
1995	**71.14**	**0.10**	NO	13.02	2.66	IE	NA	NO
1996	**66.49**	**0.10**	NO	11.63	2.71	IE	NA	NO
1997	**62.81**	**0.10**	NO	11.24	2.62	IE	NA	NO
1998	**59.18**	**0.08**	NO	10.88	2.40	IE	NA	NO
1999	**61.04**	**0.08**	NO	11.17	2.55	IE	NA	NO
2000	**61.49**	**0.10**	NO	11.08	2.54	IE	NA	NO
2001	**60.30**	**0.11**	NO	10.83	2.48	IE	NA	NO
2002	**59.13**	**0.13**	NO	10.70	2.33	IE	NA	NO
2003	**58.98**	**0.13**	NO	10.71	2.20	IE	NA	NO
2004	**57.44**	**0.14**	NO	10.53	2.02	IE	NA	NO
2005	**57.15**	**0.15**	NO	10.51	1.91	IE	NA	NO
2006	**56.77**	**0.15**	NO	10.51	1.73	IE	NA	NO
2007	**53.35**	**0.15**	NO	10.23	1.59	IE	NA	NO
2008	**51.19**	**0.16**	NO	10.13	1.47	IE	NA	NO
2009	**49.43**	**0.16**	NO	9.95	1.32	IE	NA	NO
2010	**50.04**	**0.16**	NO	9.96	1.26	IE	NA	NO
2011	**50.09**	**0.16**	NO	10.03	1.14	IE	NA	NO
2012	**50.80**	**0.16**	NO	10.17	1.24	IE	NA	NO
2013	**51.22**	**0.15**	NO	10.47	1.15	IE	NA	NO
2014	**52.83**	**0.17**	NO	10.62	1.16	IE	NA	NO
2015	**51.98**	**0.18**	NO	10.82	1.16	IE	NA	NO
2016	**51.69**	**0.18**	NO	10.79	1.19	IE	NA	NO
2017	**52.36**	**0.18**	NO	10.82	1.14	IE	NA	NO
2018	**51.55**	**0.18**	NO	10.74	1.13	IE	NA	NO
2019	**48.95**	**0.18**	NO	10.60	1.12	IE	NA	NO
2020	**45.38**	**0.16**	NO	10.32	1.03	IE	NA	NO
2021	**42.67**	**0.16**	NO	10.23	0.99	IE	NA	NO
2022	**39.93**	**0.14**		10.04	0.86			
Trend								
1990 - 2022	*-25.6%*	*-37.5%*	*NA*	*-9.1%*	*-62.2%*	*NA*	*NA*	*NA*
2005 - 2022	*-30.1%*	*-6.6%*	*NA*	*-4.5%*	*-55.2%*	*NA*	*NA*	*NA*
2021 - 2022	*-6.4%*	*-13.8%*	*NA*	*-1.9%*	*-13.5%*	*NA*	*NA*	*NA*

5.2.2 Methodological issues

5.2.2.1 Choice of methods

For estimating the CH_4 emissions from livestock the 2006 IPCC Guidelines approach[165] has been applied:

Tier 2 cattle, sheep, swine, goats, horses, mules and asses

It is *good practice* to choose the method for estimating CH_4 emissions from enteric fermentation according to the decision tree.

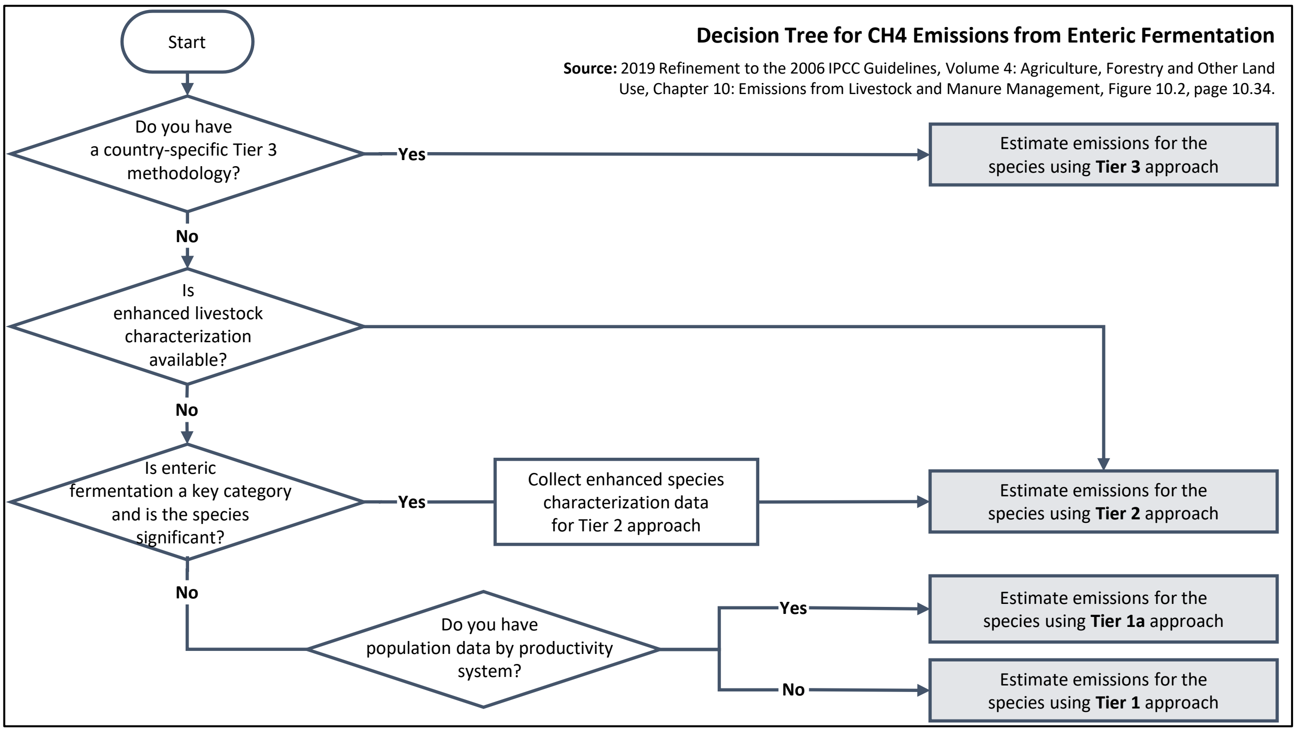


Figure 5-8 Decision Tree for CH_4 Emissions from Enteric Fermentation

Tier 1 approach was applied for the livestock categories goats, camels, horses, mules and asses. Tier 1 is a simplified approach that relies on default emission factors drawn from the literature.

Equation 10.19: CH_4 emissions from enteric fermentation from a livestock category

(2019 Refinement to 2006 IPCC GL, Vol. 4, Chap. 10)[178]

$$\boldsymbol{Emissions_{CH4}} = \sum_T \boldsymbol{Livestock}_{\ \boldsymbol{category}} \times \left(\frac{\boldsymbol{Emission\ Factor_T}}{\boldsymbol{10^6}}\right)$$

Where:

Emissions $_{CH4}$	= CH_4 emissions (Gg CH_4)
Livestock $_{category}$	= number of head of livestock species / category T
Emission factor $_T$	= emission factor for the defined livestock population and, in kg CH_4 head^{-1} yr^{-1}.
T	= species/category of livestock

[165] Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chap. 10 Emissions from Livestock and Manure Management; sub-chapter 10.2.2 Choice of method

Tier 2 approach was applied for the livestock categories cattle. This more complex approach that required detailed country-specific data on gross energy intake and methane conversion factors for specific livestock categories. It is *good practice* to apply Tier 2 method if enteric fermentation is a key source category for the animal category that represents a large portion of the country's total emissions.

Equation 10.19(updated): CH_4 emissions from enteric fermentation from a livestock category (2019 Refinement to 2006 IPCC GL, Vol. 4, Chap. 10)[178]

$$\boldsymbol{Emissions_{CH4}} = \sum_{(T,P)} \boldsymbol{Livestock}\ _{\boldsymbol{category}} \times \left(\frac{\boldsymbol{CS\ Emission\ Factor_T}}{\boldsymbol{10^6}}\right)$$

Where:

Emissions $_{CH4}$	= CH_4 emissions (Gg CH_4)
Livestock $_{category}$	= number of head of livestock species / category T
CS Emission factor $_T$	= country specific emission factor (CS) for the defined livestock population and the productivity system P, in kg CH_4 head^{-1} yr^{-1}.
T	= species/category of livestock
P	= productivity system, either high or low productivity

5.2.2.2 Choice of activity data

As described in Chapters 5.1.2 and 5.1.3 above, the original data provider for the national and international agricultural data is the Ministry of Agriculture and Rural Development and Statistical Office of Albania (INSTAT)[166]. The data are presented in the figures and tables in Chapter 5.1.3.

5.2.2.3 Choice of emission factors

For estimating the CH_4 emissions from cattle and all other livestock categories (goats, horses, mules and asses), the 2006 IPCC Guidelines Tier 2 approach[167] has been applied.

For estimating the CH_4 emissions from the livestock categories cattle, the TIER 2 approach of the 2019 Refinement to 2006 IPCC Guidelines has been applied. The country specific emission factors for methane (CH_4) is estimated using the following equation.

Equation 10.21 (updated): CH_4 emission factors for enteric fermentation from a livestock category (2019 Refinement to 2006 IPCC GL, Vol. 4, Chap. 10)[178]

$$\boldsymbol{Emission\ factor_T} = \frac{\boldsymbol{GE} \times \frac{\boldsymbol{Y_m}}{\boldsymbol{100}} \times \boldsymbol{365}}{\boldsymbol{55.65}}$$

Where:

EF = emission factor, kg CH_4 head-1 yr-1

GE = gross energy intake, MJ head-1 day-1

Ym = methane conversion factor, per cent of gross energy in feed converted to methane

energy content of methane = 55.65 (MJ/kg CH_4)

[166] Available (3. Januar 2021) on https://www.INSTAT.org/eng/index.php

[167] Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chapter 10 Emissions from Livestock and Manure Management - sub-chapter 10.3.2 Choice of EF

The GE is estimated based on the following equation:

Equation 10.16 (updated): gross energy for cattle/buffalo (2019 Refinement to 2006 IPCC GL, Vol. 4, Chap. 10) [178]

$$GE = \frac{\left(\frac{NE_m + NE_a + NE_l + NE_{work} + NE_p}{REM}\right) + \left(\frac{NE_g}{REM}\right)}{DE}$$

Where:

Parameter	Description	Equations
GE	= gross energy, MJ day-1	
NE_m	= net energy required by the animal for maintenance (MJ day-1)	
NE_a	= net energy for animal activity (MJ day-1)	10.4 and 10.5
NE_l	= net energy for lactation (MJ day-1)	10.8, 10.9, 10.10
NE_{work}	= net energy for work (MJ day-1)	10.11
NE_p	= net energy required for pregnancy (MJ day-1)	10.13
REM	= ratio of net energy available in a diet for maintenance to digestible energy	10.14
NE_g	= net energy needed for growth (MJ day-1)	10.6, 10.7
REG	= ratio of net energy available for growth in a diet to digestible energy consumed	10.15
DE	= digestibility of feed expressed as a fraction of gross energy (digestible energy/gross energy)	

In the following tables the calculation of CH4 emissions from CRT category 3.A.1 Cattle and CRT category 3.A.2 Sheep are provided exemplary including relevant parameters.

Table 5-11 Exemplary calculation of CH4 remissions from 3.A.1 Cattle

			3A1a	3A1b1	3A1b2	3A1b3	3A1b4
			Dairy Cattle	Bulls	Calves	Replacement/growing (1- 2 years old)	Cattle of 2 years and over (excluding cows & Oxen/bulls)
L	**Livestock (# of animals)**	INSTAT, EUROSTAT,FAO	406 148	**17 823**	91 414	**60 092**	**58 209**
W (=MW)	**Live Weight**	FAO 'Domestic Animal Diversity Information System (DAD-IS)	450	500	155	350	350
BW	Live Body Weight	Eq. 7 - IPCC Ref Man_1996	33.18	36.06	14.30	27.21	27.21
WG	Average Daily Weight Gain		NA	NA	0.66	NA	NA
AMiY	Annual Milk Yield		1.482	NA	NA	NA	NA
DMiY	**Daily Milk Yield**		**4.06**	NA	NA	NA	NA
Fat	Fat Content of Milk	Expert Judgement	3.8%	NA	NA	NA	NA
DE	**Digestible Energy**	TABLE 10.2, Chap. 10, Vol. 4, 2006 IPCC Guidelines	**75%**	**75%**	**75%**	**75%**	**75%**
NEm	Net Energy for Maintenance	Equation 10.3 & Table 10.4, Chap. 10, Vol. 4, 2006 IPCC Guidelines-Cattle/Buffalo (lactating cows)	37.71	1.28	16.25	26.06	26.06
NEa	Net Energy for Activity	Equation 10.4 & Table 10.5, Chap. 10, Vol. 4, 2006 IPCC Guidelines-Grazing large areas	6.41	0.11	1.38	2.21	2.21

NEg	Net Energy for Growth	Equation 10.6, Chap. 10, Vol. 4, 2006 IPCC Guidelines	0.00	0.00	2.76	0.00	0.00
NEmobilised	Net Energy due to Weight Loss		NO	NO	NO	NO	NO
NEl	Net Energy for Lactation	Equation 10.8, Chap. 10, Vol. 4, 2006 IPCC Guidelines	12.14	NA	NA	NA	NA
NEw	Net Energy for Draft Power (Work)	Equation 10.11, Chap. 10, Vol. 4, 2006 IPCC Guidelines	NO	0.00	0.00	0.00	0.00
NEp	Net Energy for Pregnancy	Equation 10.13, Chap. 10, Vol. 4, 2006 IPCC Guidelines	3.77	0.00	0.00	0.00	0.00
REM (NEma/DE)	Ratio of Net Energy in a Diet for Maintenance to Digestible Energy Consumed	Equation 10.14, Chap. 10, Vol. 4, 2006 IPCC Guidelines	0.54	0.54	0.54	0.54	0.54
REG (NEga/DE)	Ratio of Net Energy Available for Growth in a Diet to Digestible Energy Consumed	Equation 10.15, Chap. 10, Vol. 4, 2006 IPCC Guidelines	0.35	0.35	0.35	0.35	0.35
GE	**Gross Energy Intake (average)**	Equation 10.16, Chap. 10, Vol. 4, 2006 IPCC Guidelines	**148.01**	**3.43**	**53.95**	**77.24**	**69.70**
Ym	**CH4 conversion rate (average)**	TABLE 10.12, Chap. 10, Vol. 4, 2006 IPCC Guidelines	**6.50%**	**6.50%**	**6.50%**	**6.50%**	**6.50%**
EF - CH4	**Emission Factor - CH4**	Equation 10.21, Chap. 10, Vol. 4, 2006 IPCC Guidelines	**63.15**	**1.46**	**23.01**	**32.95**	**29.74**
CH4 Emi	**CH4 Emissions**		**25.65**	**0.026**	**2.10**	**1.98**	**1.73**
M	**Method**		**T2**	**T2**	**T2**	**T2**	**T2**
EF used	**EF used**		**CS**	**CS**	**CS**	**CS**	**CS**

Table 5-12 Exemplary calculation of CH4 remissions from 3.A.2 Sheep

			3A2a1	**3A2a2**
			Dairy Sheep	**Non-Dairy Sheep**
L	**Livestock (# of animals)**	INSTAT, EUROSTAT, FAO	1 237 019	250 598
W (=MW)	**Live Weight**	2019 Refinements IPCC 'TABLE 10A.5 Default values for live weights for animal categories	40	31
BW	Live Body Weight	Eq. 7 - IPCC Ref Man_1996	4.90	4.01
WG	Average Daily Weight Gain		NA	NA
AMiY	Annual Milk Yield	expert judgment; TK 2019-05-02	41	-
DMiY	**Daily Milk Yield**		0.11	-
Fat	Fat Content of Milk	Qualitative characteristics of sheep's and goat's milk in Albania (https://www.pagepressjournals.org/ijfs/article/view/12122/12004#:~:text=The%20fat%20content%20of%20sheep,of%205.3%25%20to%209.9%25)	7.7%	NA
Wool	**Wool production**		1.76	1.65
DE	**Digestible Energy**	TABLE 10.2, Chap. 10, Vol. 4, 2006 IPCC Guidelines	**75%**	**50%**
NEm	Net Energy for Maintenance	Equation 10.3 & Table 10.4, Chap. 10, Vol. 4, 2006 IPCC Guidelines	3.45	2.85
NEa	Net Energy for Activity	Equation 10.4 & Table 10.5, Chap. 10, Vol. 4, 2006 IPCC Guidelines	0.04	0.33
NEg	Net Energy for Growth	Equation 10.6, Chap. 10, Vol. 4, 2006 IPCC Guidelines	0.00	0.00
NEmobilised	Net Energy due to Weight Loss		NO	NO
NEl	Net Energy for Lactation	Equation 10.8, Chap. 10, Vol. 4, 2006 IPCC Guidelines	0.53	NA
NEw	Net Energy for Wool	Equation 10.12, Chap. 10, Vol. 4, 2006 IPCC Guidelines	0.11	0.11
NEp	Net Energy for Pregnancy	Equation 10.13, Chap. 10, Vol. 4, 2006 IPCC Guidelines	0.35	0.00
REM (NEma/DE)	Ratio of Net Energy in a Diet for Maintenance to Digestible Energy Consumed	Equation 10.14, Chap. 10, Vol. 4, 2006 IPCC Guidelines	0.54	0.44
REG (NEga/DE)	Ratio of Net Energy Available for Growth in a Diet to Digestible Energy Consumed	Equation 10.15, Chap. 10, Vol. 4, 2006 IPCC Guidelines	0.35	0.19
GE	**Gross Energy Intake (average)**	Equation 10.16, Chap. 10, Vol. 4, 2006 IPCC Guidelines	**11.03**	**15.01**
Ym	**CH4 conversion rate (average)**	TABLE 10.12, Chap. 10, Vol. 4, 2006 IPCC Guidelines	**6.50%**	**6.50%**
IEF - CH4	**Implied Emission Factor - CH4**	Equation 10.21, Chap. 10, Vol. 4, 2006 IPCC Guidelines	**4.70**	**6.40**
CH4 Emi	CH4 Emissions (Tier 2)		**6.00**	**1.608**
M	**Method**	-	**T2**	**T2**
EF used	**EF used**	-	**CS**	**CS**

5.2.3 Uncertainties and time-series consistency for CRT category 3.A.1 Enteric Fermentation

The uncertainties for activity data and emission factors used for CRT category *3.A.1 Enteric Fermentation* are presented in the following table.

Table 5-13 Uncertainty for CRT category 3.A.1 Enteric Fermentation.

Uncertainty	Cattle	sheep, goats, horses, mules and asses	Reference
	CH_4	CH_4	2006 IPCC GL, Vol. 4, Chap. 10
Activity data: Livestock	20%	20%	Chapter 10.2.3
Activity data: Feed digestibility (DE%)	20%	-	Chapter 10.2.3
Emission factor	20%	40%	Chapter 10.3.4
Combined Uncertainty	**35%**	**45%**	$U_{Total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

The time-series are considered to be consistent with the data reported by INSTAT and FAO. The break in the time series is due to change in statistical methodology.

5.2.4 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed out:

⇒ Checked of calculations by spreadsheets
  - consistent use of livestock data (INSTAT statistical yearbook and FAOstat- Live Animals, EUROSTAT),
  - documented sources,
  - use of units,
  - strictly defined interfaces between spreadsheets/calculation modules,
  - unique structure of sheets which do the same,
  - record keeping, use of write protection,
  - unique use of formulas, special cases are documented/highlighted,
  - quick-control checks for data consistency through all steps of calculation.

⇒ cross-checked from different sources: national statistic (INSTAT) and international statistics (FAO, EUROSTAT)

⇒ consistency and completeness checks are performed;

⇒ time series consistency - plausibility checks of dips and jumps.

5.2.5 Category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends

The following table presents the main revisions and recalculations done since the last submission to the UNFCCC and relevant to CRT category *3.A.1 Enteric Fermentation*.

Table 5-14 Recalculations done in CRT category 3.A.1 Enteric Fermentation

GHG source & sink category	Revisions	Type of revision	Type of improvement
3.A	Correction of technical mistakes (re-calculations)	AD, EF	Accuracy

5.2.6 Category-specific planned improvements including tracking of those identified in the review process

Considering the potential contribution of identified improvements in the total GHG emissions and the corresponding resources needed to make these improvements effective, developments presented in following table will be explored.

Table 5-15 Planned improvements for CRT category 3.A.1 Enteric Fermentation

GHG source & sink category	Planned improvement	Type of improvement		Priority
3.A. 3.B. 3.D.	Husbandry and management practice with consideration • characteristics of manure management practice: o stall / housed and Housing period o pasture/range/paddock (flat/hilly) o grazing large areas (flat/hilly) o daily spread o solid storage o dry lot o liquid/slurry with/without natural crust cover o uncovered anaerobic lagoon o pit storage below animal confinements o anaerobic digester o burned for fuel o cattle and swine deep bedding o composting o aerobic treatment	AD	Accuracy Consistency Comparability Transparency Completeness	high
3.A. 3.B.	Manure management by temperature for sheep, goats, horses, mules, and asses, and poultry	AD	Accuracy Comparability Transparency	medium
3.A.1.j 3.B. 3.D	Survey and/or research on Livestock which is not included in current statistics: e.g. buffalo, fur bearing animals	AD	Completeness	High
3.A.1	Correction of technical mistakes in calculation	AD EF	Completeness	high

5.3 Manure management (CRT category 3.B)

This section describes the estimation of methane and nitrous oxide emissions resulting during the storage and treatment of manure, and from manure deposited on pasture. The term 'manure' is used here collectively to include both dung and urine (i.e., the solids and the liquids) produced by livestock. The following figure shows a schematic overview of manure management practices.

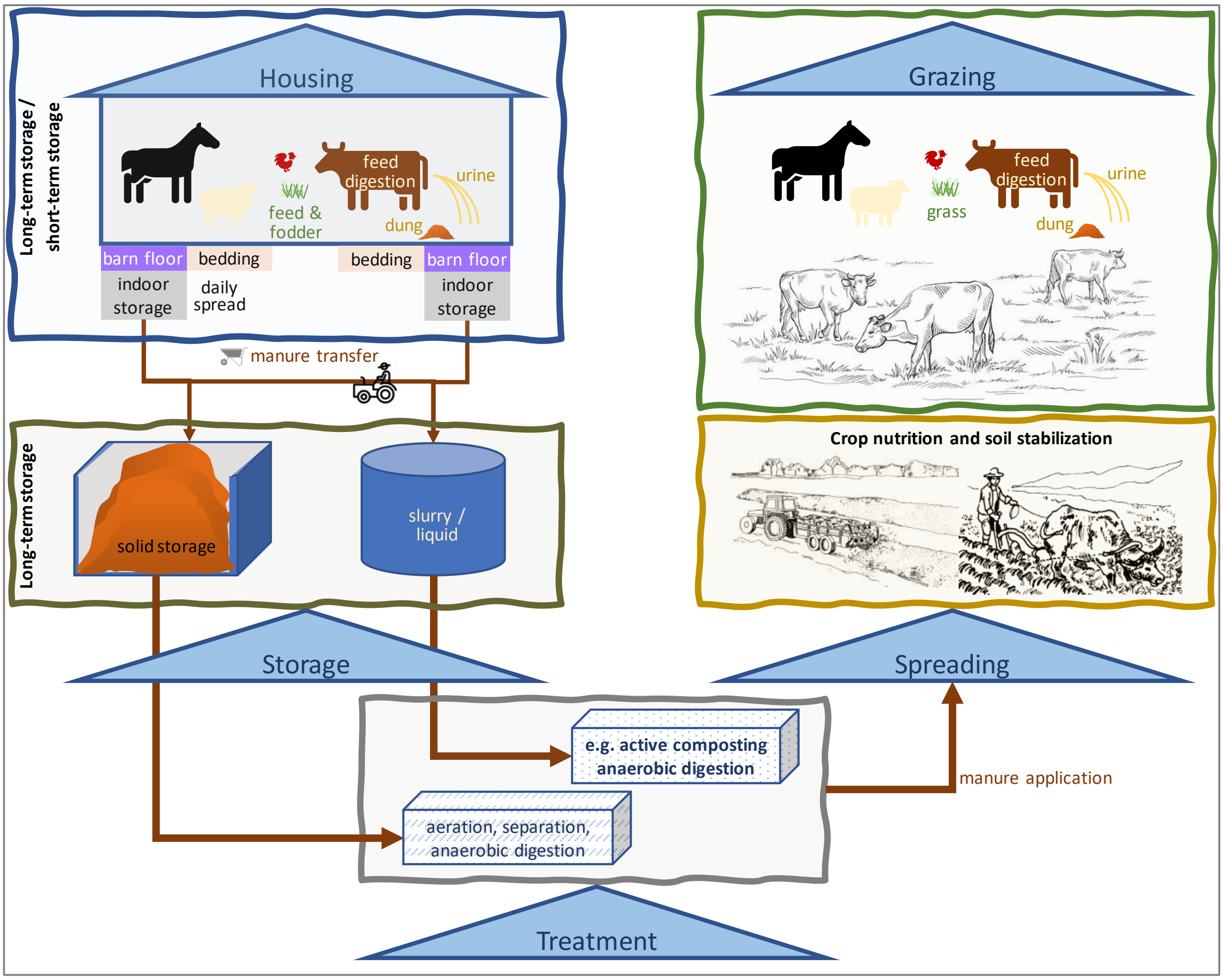


Figure 5-9 Schematic overview of manure management practices

As described in the 2006 IPCC Guidelines (Volume 4, Chapter 10.4) methane (CH_4) is produced during decomposition of manure under anaerobic conditions (i.e., in the absence of oxygen), during storage and treatment. These conditions occur most readily when large numbers of animals are managed in a confined area (e.g., dairy farms, beef feedlots, and swine and poultry farms), and where manure is disposed of in liquid-based systems.

The main factors affecting CH_4 emissions are

- the amount of manure produced:
  - ⇒ depending on the rate of waste production per animal and the number of animals
- the portion of the manure that decomposes anaerobically
  - ⇒ depending on how the manure is managed.
    - when manure is stored or treated as a liquid (e.g., in lagoons, ponds, tanks, or pits), it decomposes anaerobically and can produce a significant quantity of CH_4. The temperature and

the retention time of the storage unit greatly affect the amount of methane produced.

- when manure is handled as a solid (e.g., in stacks or piles) or when it is deposited on pastures and rangelands, it tends to decompose under more aerobic conditions and less CH_4 is produced.

In the following table are the different manure management systems and their definitions presented. The table below provides information regarding the manure management system (MMS) in Albania as used in the inventory .

Table 5-16 Definitions of manure management systems

System	Definition	Storage time of manure
Pasture/ Range/ Paddock (PRP)	The manure from pasture and range grazing animals is allowed to lie as deposited, and is not managed.	-
Daily spread	Manure is routinely removed from a confinement facility and is applied to cropland or pasture within 24 hours of excretion.	-
Solid storage	The storage of manure, typically for a period of several months, in unconfined piles or stacks. Manure is able to be stacked due to the presence of a sufficient amount of bedding material or loss of moisture by evaporation.	long period of time (months)
Dry lot	A paved or unpaved open confinement area without any significant vegetative cover where accumulating manure may be removed periodically.	-
Liquid/Slurry	Manure is stored as excreted or with some minimal addition of water in either tanks or earthen ponds outside the animal housing, usually for periods less than one year.	≥ 6 months
Uncovered anaerobic lagoon	A type of liquid storage system designed and operated to combine waste stabilization and storage. Lagoon supernatant is usually used to remove manure from the associated confinement facilities to the lagoon. Anaerobic lagoons are designed with varying lengths of storage (up to a year or greater), depending on the climate region, the volatile solids loading rate, and other operational factors. The water from the lagoon may be recycled as flush water or used to irrigate and fertilize fields.	30 days to >200 days
Pit storage below animal confinements	Collection and storage of manure usually with little or no added water typically below a slatted floor in an enclosed animal confinement facility, usually for periods less than one year.	two categories: <1 month > 1 month
Anaerobic digester	Animal excreta with or without straw are collected and anaerobically digested in a large containment vessel or covered lagoon. Digesters are designed and operated for waste stabilization by the microbial reduction of complex organic compounds to CO_2 and CH_4, which is captured and flared or used as a fuel.	-
Burned for fuel	The dung and urine are excreted on fields. The sun dried dung cakes are burned for fuel.	-
Cattle and Swine deep bedding	As manure accumulates, bedding is continually added to absorb moisture over a production cycle and possibly for as long as 6 to 12 months. This manure management system also is known as a bedded pack manure management system and may be combined with a dry lot or pasture.	6 to 12 months
Composting – in- vessel	Composting, typically in an enclosed channel, with forced aeration and continuous mixing.	-
Composting – Static pile	Composting in piles with forced aeration but no mixing.	-
Composting – Intensive windrow	Composting in windrows with regular (at least daily) turning for mixing and aeration.	-
Composting – Passive windrow	Composting in windrows with infrequent turning for mixing and aeration.	-
Poultry manure with litter	Similar to cattle and swine deep bedding except usually not combined with a dry lot or pasture. Typically used for all poultry breeder flocks and for the production of meat type chickens (broilers) and other fowl.	-

System	Definition	Storage time of manure
Poultry manure without litter	May be similar to open pits in enclosed animal confinement facilities or may be designed and operated to dry the manure as it accumulates. The latter is known as a high-rise manure management system and is a form of passive windrow composting when designed and operated properly.	-
Aerobic treatment	The biological oxidation of manure collected as a liquid with either forced or natural aeration. Natural aeration is limited to aerobic and facultative ponds and wetland systems and is due primarily to photosynthesis. Hence, these systems typically become anoxic during periods without sunlight.	-

Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chapter 10 Emissions from Livestock and Manure Management - sub-chapter 10.4.4 Uncertainty assessment. Table 10.18 Definitions of manure management systems. Page 10.48.

Table 5-17 Manure management system (MMS) in Albania

		Manure System								
		Pasture Range & Paddock	Daily Spread	Solid Storage	Dry Lot	Liquid/ Slurry System	Burned for fuel	An-aerobic Lagoon	Other	Total
3.B.2.a.i	**Dairy Cattle**	30%	2.5%	35%	15%	17.5%	0%	0%	0%	100%
3.B.2.a.ii	**Other Cattle**	80%	0%	10%	10%	0%	0%	0%	0%	100%
3.B.2.c	**Sheep**	80%	10%	10%	0%	0%	0%	0%	0%	100%
3.B.2.d	**Goats**	90%	5%	5%	0%	0%	0%	0%	0%	100%
3.B.2.f	**Horses**	70%	15%	15%	0%	0%	0%	0%	0%	100%
3.B.2.g	**Mules and Asses**	50%	15%	15%	IE	IE	20%	IE	IE	IE
3.B.2.h	**Swine**	5%	1%	50%	0%	41%	0%	3%	0%	100%
3.B.2.i	**Poultry**	5%	5%	75%	0%	15%	0%	0%	0%	100%

Source: Expert judgment and FAO (2018): Nitrogen inputs to agricultural soils from livestock manure New statistics. In : Integrated Crop Management. Vol. 24 – 2018. Rome. Page 56. Available (18.02.2019) at http://www.fao.org/3/I8153EN/i8153en.pdf

As described in the 2006 IPCC Guidelines (Volume 4, Chapter 10.5) nitrous oxide (N_2O) is produced, directly and indirectly, during the storage and treatment of manure before it is applied to land or otherwise used for feed, fuel, or construction purposes.

Direct N_2O emissions occur via combined nitrification and denitrification of nitrogen contained in the manure. The emission of N_2O from manure during storage and treatment depends on the nitrogen and carbon content of manure, and on the duration of the storage and type of treatment. Nitrification (the oxidation of ammonia nitrogen to nitrate nitrogen) is a necessary prerequisite for the emission of N_2O from stored animal manures. Nitrification is likely to occur in stored animal manures provided there is a sufficient supply of oxygen. Nitrification does not occur under anaerobic conditions. Nitrites and nitrates are transformed to N_2O and dinitrogen (N2) during the naturally occurring process of denitrification, an anaerobic process.

Indirect emissions result from volatile nitrogen losses that occur primarily in the forms of ammonia and NOx. The fraction of excreted organic nitrogen that is mineralized to ammonia nitrogen during manure collection and storage depends primarily on time, and to a lesser degree temperature. Simple forms of organic nitrogen such as urea (mammals) and uric acid (poultry) are rapidly mineralized to ammonia nitrogen, which is highly volatile and easily diffused into the surrounding air. Nitrogen losses begin at the point of excretion in houses and other animal production areas (e.g., milk parlors) and continue through on-site management in storage and treatment systems (i.e., manure management systems). Nitrogen is also lost through runoff and leaching into soils from the solid storage of manure at outdoor areas, in feedlots and where animals are grazing in pastures.

The CH_4 emissions generated by manure in the

- system 'buildings housing livestock, manure stores or yards' are reported under
  ⇒ 3.B *Manure Management*
- system 'manure handling and storage' are reported under
  ⇒ 3.B *Manure Management*

The N_2O emissions generated by manure in the

- system 'pasture, range, and paddock' occur directly and indirectly from the soil, and are therefore reported under the category
  ⇒ 3.D.a *Direct N_2O emissions from managed soils*
  ⇒ 3.D.a.2 *Organic N fertilizers*
  ⇒ *3.D.a.2.a Animal manure applied to soils*
  ⇒ 3.D.b *IndirectN$_2$O Emissions from managed soils*

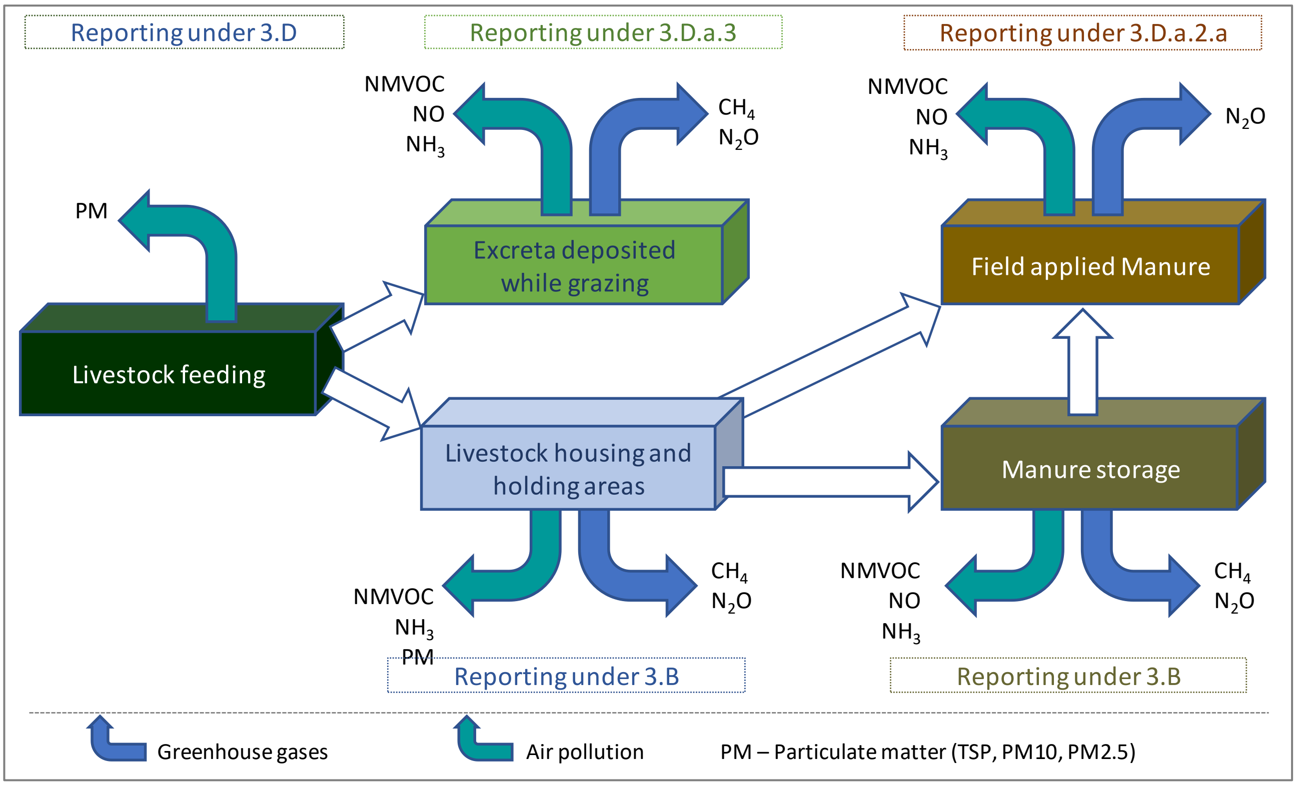


Figure 5-10 Scheme for emissions resulting from livestock feeding, livestock excreta and manure management

5.3.1 Source category description

IPCC code	description	CO_2		CH_4		N_2O	
		Estimated	Key Category	estimated	Key category	estimated	Key category
3.B.2	Manure Management						
3.B.2.a	Cattle						
3.B.2.a.i	Dairy cows	NA	-	✓		✓	-
3.B.2.a.ii	Other cattle	NA	-	✓		✓	-
3.B.2.b	Buffalo	NA	-	NO		NO	-

IPCC code	description	CO_2		CH_4		N_2O	
		Estimated	Key Category	estimated	Key category	estimated	Key category
3.B.2.c	Sheep	NA	-	✓		✓	-
3.B.2.d	Goats	NA	-	✓		✓	-
3.B.2.e	Camels	NA	-	NO	-	✓	-
3.B.2.f	Horses	NA	-	✓	-	✓	-
3.B.2.g	Mules and Asses	NA	-	✓	-	✓	-
3.B.2.h	Swine	NA	-	NO	-	NO	-
3.B.2.i	Poultry	NA	-	✓	-	✓	-
3.B.2.j	Other (e.g rabbit)	NA	-	NE	-	NE	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential							
LA – Level Assessment (in year); TA – Trend Assessment							

In the period 1990 – 2022 the CH_4 emissions decreased by -45.4% and in the period 2005 – 2022 the CH_4 emissions decreased by -47.8% mainly due to decreased number of livestock. In 2022, CH4 emissions from CRT category 3.A Enteric fermentation amounted to 5.55 kt.

Cattle are the most significant source of methane because of their high numbers, large size and ruminant digestive system, followed by sheep and goats. The significant drop is mainly due to statistical revisions.

An overview of the methane emissions resulting from CRT category 3.B *Manure Management* is provided in the following figure and tables.

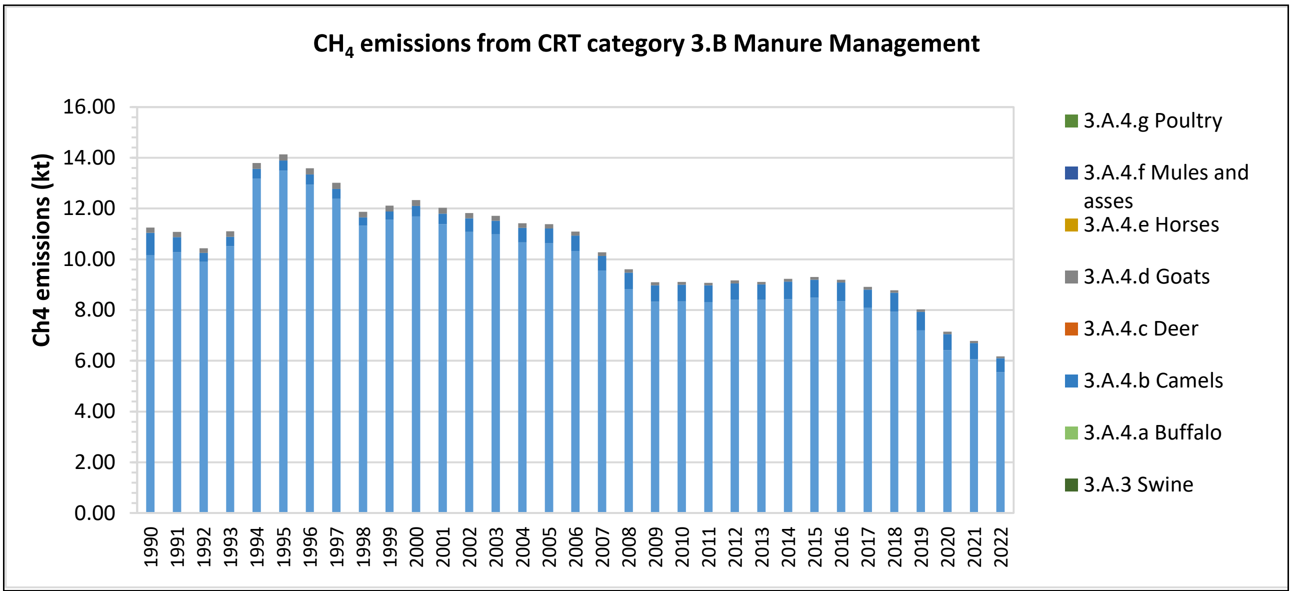


Figure 5-11 CH4 emissions from CRT category 3.B Manure management for the period of 1990–2022

In the period 1990 – 2022 the N2O emissions decreased by -51.34% and in the period 2005 – 2022 the N2O emissions decreased by -50.26% mainly due to decreased number of livestock. In 2022, N2O emissions from CRT category 3.B Manure management amounted to 0.126 kt.

Cattle are the most significant source of methane because of their high numbers, large size and ruminant digestive system, followed by sheep and goats. The significant drop is mainly due to statistical revisions.

An overview of the N2O emissions resulting from CRT category 3.B *Manure Management* is provided in the following figure and tables.

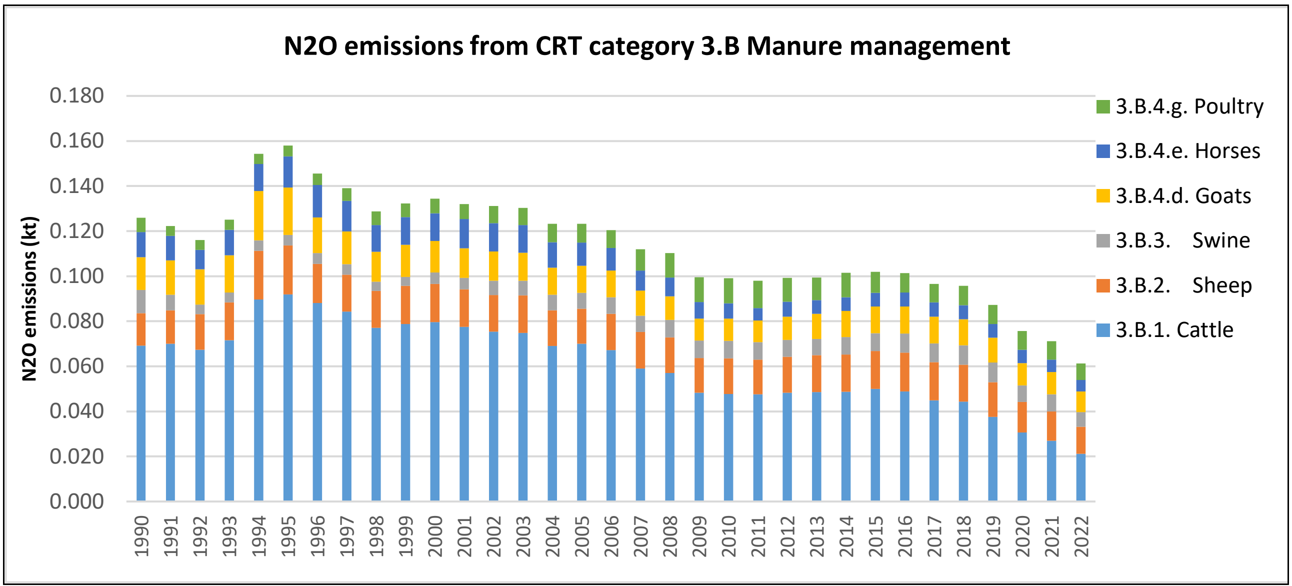


Figure 5-12 N2O emissions from CRT category 3.B Manure management for the period of 1990–2022

Table 5-18 CH4 emissions from CRT category 3.B Manure management – Main livestock

CH_4 emissions	3.B.	3.B.1.a	3.B.1.a.	3.B.1.b.	3.B.2	3.B.3	3.B.4
	Manaure Management	Cattle	Dairy cattle	Non-dairy cattle	Sheep	Swine	Other livestock
	kt	kt	kt	kt	kt	kt	kt
1990	**11.25**	10.16	8.12	2.04	0.002	0.88	0.21
1991	**11.08**	10.28	8.22	2.06	0.002	0.59	0.20
1992	**10.44**	9.89	7.91	1.98	0.002	0.36	0.18
1993	**11.11**	10.52	8.41	2.11	0.003	0.37	0.22
1994	**13.79**	13.17	10.53	2.64	0.003	0.39	0.23
1995	**14.14**	13.49	10.79	2.71	0.003	0.40	0.24
1996	**13.59**	12.95	10.35	2.60	0.003	0.39	0.25
1997	**13.01**	12.38	9.90	2.48	0.003	0.39	0.24
1998	**11.88**	11.32	9.05	2.27	0.003	0.33	0.22
1999	**12.12**	11.56	9.25	2.32	0.003	0.32	0.23
2000	**12.34**	11.69	9.35	2.35	0.003	0.41	0.23
2001	**12.03**	11.38	9.10	2.28	0.003	0.42	0.22
2002	**11.82**	11.08	8.86	2.22	0.002	0.53	0.21
2003	**11.72**	10.99	8.78	2.21	0.003	0.53	0.20
2004	**11.43**	10.67	8.70	1.97	0.002	0.57	0.18
2005	**11.39**	10.63	8.60	2.03	0.002	0.59	0.17
2006	**11.09**	10.33	8.40	1.93	0.003	0.61	0.16
2007	**10.28**	9.55	7.92	1.63	0.002	0.59	0.14
2008	**9.61**	8.83	7.20	1.63	0.002	0.64	0.13
2009	**9.09**	8.33	7.06	1.27	0.002	0.64	0.12
2010	**9.12**	8.34	7.10	1.24	0.002	0.66	0.11
2011	**9.08**	8.32	7.08	1.24	0.002	0.65	0.10
2012	**9.17**	8.42	7.15	1.26	0.002	0.64	0.11
2013	**9.12**	8.40	7.13	1.28	0.003	0.61	0.10
2014	**9.23**	8.43	7.16	1.28	0.003	0.69	0.11
2015	**9.30**	8.48	7.15	1.33	0.003	0.71	0.11
2016	**9.19**	8.36	7.06	1.30	0.003	0.72	0.11
2017	**8.91**	8.09	6.93	1.16	0.003	0.72	0.10
2018	**8.79**	7.95	6.80	1.15	0.003	0.74	0.10
2019	**8.03**	7.19	6.28	0.92	0.003	0.74	0.10
2020	**7.15**	6.42	5.74	0.68	0.002	0.63	0.09
2021	**6.79**	6.06	5.51	0.55	0.002	0.64	0.09
2022	**6.18**	5.55	5.22	0.33	0.002	0.55	0.08
Trend							
1990 - 2022	*-45.1%*	*-45.4%*	*-35.7%*	*-83.8%*	-8.8%	-37.5%	-62.1%
2005 - 2022	*-45.7%*	*-47.8%*	*-39.3%*	*-83.7%*	-14.2%	-6.6%	-55.1%
2021 - 2022	*-9.0%*	*-8.5%*	*-5.3%*	*-40.0%*	-7.3%	-13.8%	-13.5%

Table 5-19 CH4 emissions from CRT category 3.B Manure management – Other livestock

CH_4 emissions	3.B.	3.B.4	3.B.4.a	3.B.4.b.	3.B.4.c.	3.B.4.d.	3.B.4.e.	3.B.4.f.	3.B.4.g	3.B.4.h
	Manure management	Other livestock	Buffalo	Camels	Deer	Goats	Horses	Mules and asses	Poultry	Other
	kt	kt	kt	kt		kt	kt	kt	kt	kt
1990	**11.25**	0.21	NO	NO	NO	0.0002	0.094	0.11	0.0001	NO
1991	**11.08**	0.20	NO	NO	NO	0.0002	0.092	0.11	0.0001	NO
1992	**10.44**	0.18	NO	NO	NO	0.0002	0.072	0.11	0.0001	NO
1993	**11.11**	0.22	NO	NO	NO	0.0002	0.095	0.13	0.0001	NO
1994	**13.79**	0.23	NO	NO	NO	0.0003	0.102	0.12	0.0001	NO
1995	**14.14**	0.24	NO	NO	NO	0.0003	0.116	0.12	0.0001	NO
1996	**13.59**	0.25	NO	NO	NO	0.0002	0.121	0.12	0.0001	NO
1997	**13.01**	0.24	NO	NO	NO	0.0002	0.115	0.12	0.0001	NO
1998	**11.88**	0.22	NO	NO	NO	0.0002	0.100	0.12	0.0001	NO
1999	**12.12**	0.23	NO	NO	NO	0.0002	0.103	0.13	0.0001	NO
2000	**12.34**	0.23	NO	NO	NO	0.0002	0.103	0.13	0.0001	NO
2001	**12.03**	0.22	NO	NO	NO	0.0002	0.110	0.11	0.0001	NO
2002	**11.82**	0.21	NO	NO	NO	0.0002	0.107	0.10	0.0001	NO
2003	**11.72**	0.20	NO	NO	NO	0.0002	0.103	0.10	0.0001	NO
2004	**11.43**	0.18	NO	NO	NO	0.0002	0.095	0.09	0.0001	NO
2005	**11.39**	0.17	NO	NO	NO	0.0002	0.087	0.09	0.0001	NO
2006	**11.09**	0.16	NO	NO	NO	0.0002	0.084	0.07	0.0001	NO
2007	**10.28**	0.14	NO	NO	NO	0.0001	0.075	0.07	0.0001	NO
2008	**9.61**	0.13	NO	NO	NO	0.0001	0.071	0.06	0.0002	NO
2009	**9.09**	0.12	NO	NO	NO	0.0001	0.062	0.06	0.0002	NO
2010	**9.12**	0.11	NO	NO	NO	0.0001	0.057	0.06	0.0002	NO
2011	**9.08**	0.10	NO	NO	NO	0.0001	0.047	0.06	0.0002	NO
2012	**9.17**	0.11	NO	NO	NO	0.0001	0.056	0.06	0.0002	NO
2013	**9.12**	0.10	NO	NO	NO	0.0001	0.052	0.05	0.0002	NO
2014	**9.23**	0.11	NO	NO	NO	0.0002	0.052	0.05	0.0002	NO
2015	**9.30**	0.11	NO	NO	NO	0.0002	0.051	0.05	0.0002	NO
2016	**9.19**	0.11	NO	NO	NO	0.0002	0.052	0.06	0.0002	NO
2017	**8.91**	0.10	NO	NO	NO	0.0002	0.053	0.05	0.0002	NO
2018	**8.79**	0.10	NO	NO	NO	0.0002	0.052	0.05	0.0002	NO
2019	**8.03**	0.10	NO	NO	NO	0.0001	0.052	0.05	0.0002	NO
2020	**7.15**	0.09	NO	NO	NO	0.0001	0.049	0.04	0.0002	NO
2021	**6.79**	0.09	NO	NO	NO	0.0001	0.048	0.04	0.0002	NO
2022	**6.18**	0.08	NO	NO	NO	0.0001	0.043	0.04	0.0001	
Trend										
1990 - 2022	*-45.1%*	-62.1%	*NA*	*NA*	*NA*	*-33.1%*	*-54.5%*	*-68.5%*	*2.9%*	*NA*
2005 - 2022	*-45.7%*	-55.1%	*NA*	*NA*	*NA*	*-23.3%*	*-50.9%*	*-59.4%*	*6.5%*	*NA*
2021 - 2022	*-9.0%*	-13.5%	*NA*	*NA*	*NA*	*-6.9%*	*-10.3%*	*-17.0%*	*-10.5%*	*NA*

Table 5-20 N2O emissions from CRT category 3.B Manure management – Main livestock

N2O emissions	3.B.1	3.B.1.a	3.B.1.a.i	3.B.1.a.ii	3.B.1.a.iii	3.B.2	3.B.3	3.B.4
	Manaure Management	Cattle	Mature dairy cattle	Other mature cattle	Growing cattle	Sheep	Swine	Other livestock
	kt	kt	kt	kt		kt	kt	kt
1990	**0.126**	0.069	0.021	0.027	0.021	0.0144	0.0103	0.032
1991	**0.122**	0.070	0.021	0.027	0.022	0.0149	0.0070	0.030
1992	**0.116**	0.067	0.020	0.026	0.021	0.0157	0.0043	0.029
1993	**0.125**	0.072	0.022	0.028	0.022	0.0168	0.0044	0.032
1994	**0.154**	0.090	0.027	0.035	0.028	0.0216	0.0047	0.038
1995	**0.158**	0.092	0.028	0.036	0.028	0.0217	0.0048	0.040
1996	**0.146**	0.088	0.027	0.034	0.027	0.0174	0.0047	0.035
1997	**0.139**	0.084	0.025	0.033	0.026	0.0163	0.0047	0.034
1998	**0.129**	0.077	0.023	0.030	0.024	0.0164	0.0040	0.031
1999	**0.132**	0.079	0.024	0.031	0.024	0.0170	0.0039	0.033
2000	**0.134**	0.080	0.024	0.031	0.025	0.0170	0.0050	0.033
2001	**0.132**	0.077	0.023	0.030	0.024	0.0167	0.0052	0.033
2002	**0.131**	0.075	0.023	0.029	0.023	0.0162	0.0064	0.033
2003	**0.130**	0.075	0.023	0.029	0.023	0.0167	0.0064	0.032
2004	**0.123**	0.069	0.022	0.026	0.021	0.0157	0.0069	0.032
2005	**0.123**	0.070	0.022	0.027	0.021	0.0154	0.0071	0.031
2006	**0.120**	0.067	0.022	0.025	0.020	0.0160	0.0073	0.030
2007	**0.112**	0.059	0.020	0.022	0.017	0.0162	0.0073	0.030
2008	**0.110**	0.057	0.019	0.022	0.017	0.0158	0.0077	0.030
2009	**0.100**	0.048	0.018	0.017	0.013	0.0155	0.0077	0.028
2010	**0.099**	0.048	0.018	0.016	0.013	0.0158	0.0078	0.028
2011	**0.098**	0.048	0.018	0.016	0.013	0.0154	0.0077	0.027
2012	**0.099**	0.048	0.018	0.017	0.013	0.0158	0.0075	0.027
2013	**0.099**	0.049	0.018	0.017	0.013	0.0164	0.0073	0.027
2014	**0.101**	0.049	0.018	0.017	0.013	0.0166	0.0077	0.028
2015	**0.102**	0.050	0.018	0.018	0.014	0.0168	0.0079	0.027
2016	**0.101**	0.049	0.018	0.017	0.013	0.0173	0.0085	0.027
2017	**0.097**	0.045	0.018	0.017	0.010	0.0169	0.0084	0.026
2018	**0.096**	0.044	0.017	0.017	0.010	0.0163	0.0086	0.027
2019	**0.087**	0.038	0.016	0.014	0.008	0.0154	0.0087	0.026
2020	**0.076**	0.031	0.015	0.010	0.005	0.0136	0.0073	0.024
2021	**0.071**	0.027	0.014	0.008	0.004	0.0130	0.0075	0.024
2022	**0.061**	0.021	0.013	0.005	0.003	0.012	0.007	0.022
Trend								
1990 - 2022	*-51.34%*	*-69.47%*	*-35.75%*	*-81.07%*	*-87.80%*	*-16.68%*	*-36.28%*	*-32.62%*
2005 - 2022	*-50.26%*	*-69.87%*	*-39.31%*	*-80.95%*	*-87.72%*	*-22.06%*	*-7.12%*	*-29.54%*
2021 - 2022	*-13.94%*	*-21.86%*	*-5.31%*	*-39.55%*	*-41.13%*	*-7.35%*	*-12.70%*	*-8.92%*

Table 5-21 N2O emissions from CRT category 3.B Manure management – Other livestock

N2O emissions	3.B.1	3.B.4	3.B.4.a	3.B.4.b.	3.B.4.c.	3.B.4.d.	3.B.4.e.	3.B.4.f.	3.B.4.g	3.B.4.h
	Manure manageme nt	Other livestock	Buffalo	Camels	Deer	Goats	Horses	Mules and asses	Poultry	Other
	kt	kt	kt	kt		kt	kt	kt	kt	kt
1990	**0.126**	0.032	NO	NO	NO	0.0146	0.011	IE	0.006	NO
1991	**0.122**	0.030	NO	NO	NO	0.0152	0.011	IE	0.004	NO
1992	**0.116**	0.029	NO	NO	NO	0.0157	0.009	IE	0.004	NO
1993	**0.125**	0.032	NO	NO	NO	0.0165	0.011	IE	0.005	NO
1994	**0.154**	0.038	NO	NO	NO	0.0219	0.012	IE	0.005	NO
1995	**0.158**	0.040	NO	NO	NO	0.0210	0.014	IE	0.005	NO
1996	**0.146**	0.035	NO	NO	NO	0.0159	0.014	IE	0.005	NO
1997	**0.139**	0.034	NO	NO	NO	0.0146	0.014	IE	0.006	NO
1998	**0.129**	0.031	NO	NO	NO	0.0134	0.012	IE	0.006	NO
1999	**0.132**	0.033	NO	NO	NO	0.0143	0.012	IE	0.006	NO
2000	**0.134**	0.033	NO	NO	NO	0.0141	0.012	IE	0.006	NO
2001	**0.132**	0.033	NO	NO	NO	0.0131	0.013	IE	0.007	NO
2002	**0.131**	0.033	NO	NO	NO	0.0129	0.013	IE	0.008	NO
2003	**0.130**	0.032	NO	NO	NO	0.0125	0.012	IE	0.008	NO
2004	**0.123**	0.032	NO	NO	NO	0.0120	0.011	IE	0.008	NO
2005	**0.123**	0.031	NO	NO	NO	0.0120	0.010	IE	0.008	NO
2006	**0.120**	0.030	NO	NO	NO	0.0120	0.010	IE	0.008	NO
2007	**0.112**	0.030	NO	NO	NO	0.0112	0.009	IE	0.009	NO
2008	**0.110**	0.030	NO	NO	NO	0.0104	0.008	IE	0.011	NO
2009	**0.100**	0.028	NO	NO	NO	0.0098	0.007	IE	0.011	NO
2010	**0.099**	0.028	NO	NO	NO	0.0099	0.007	IE	0.011	NO
2011	**0.098**	0.027	NO	NO	NO	0.0097	0.006	IE	0.012	NO
2012	**0.099**	0.027	NO	NO	NO	0.0103	0.007	IE	0.011	NO
2013	**0.099**	0.027	NO	NO	NO	0.0111	0.006	IE	0.010	NO
2014	**0.101**	0.028	NO	NO	NO	0.0115	0.006	IE	0.011	NO
2015	**0.102**	0.027	NO	NO	NO	0.0119	0.006	IE	0.009	NO
2016	**0.101**	0.027	NO	NO	NO	0.0120	0.006	IE	0.009	NO
2017	**0.097**	0.026	NO	NO	NO	0.0119	0.006	IE	0.008	NO
2018	**0.096**	0.027	NO	NO	NO	0.0117	0.006	IE	0.009	NO
2019	**0.087**	0.026	NO	NO	NO	0.0110	0.006	IE	0.009	NO
2020	**0.076**	0.024	NO	NO	NO	0.0099	0.006	IE	0.008	NO
2021	**0.071**	0.024	NO	NO	NO	0.0099	0.006	IE	0.008	NO
2022	**0.061**	0.022	NO	NO	NO	0.0092	0.005	IE	0.007	NO
Trend										
1990 - 2022	*-51.34%*	*-32.62%*	*NA*	*NA*	*NA*	*-36.93%*	*-54.55%*	*NA*	*15.73%*	*NA*
2005 - 2022	*-50.26%*	*-29.54%*	*NA*	*NA*	*NA*	*-23.32%*	*-50.94%*	*NA*	*-12.08%*	*NA*
2021 - 2022	*-13.94%*	*-8.92%*	*NA*	*NA*	*NA*	*-6.94%*	*-10.34%*	*NA*	*-10.35%*	*NA*

5.3.2 Methodological issues

5.3.2.1 Choice of methods

For estimating the

- The CH_4 emissions from all livestock the 2006 IPCC Guidelines Tier 1 approach[168] has been applied.
- The N_2O emissions from all livestock Tier 2 nitrogen flow approach (N-flow model) based on 2018 update to the EMEP/EEA Guidebook [169]has been applied.

TIER 1 approach – methane emissions

Tier 1 is simplified method that only requires livestock population data by animal species/category and climate region or temperature, in combination with IPCC default emission factors, to estimate emissions. Because some emissions from manure management systems are highly temperature dependent, it is good practice to estimate the average annual temperature associated with the locations where manure is managed.

Equation 10.22: CH_4 emissions from manure management from a livestock category

$$\boldsymbol{Emissions_{CH4} = Livestock_{\ category} \times \left(\frac{Emission\ Factor_T}{10^6}\right)}$$

Where:

Emissions $_{CH4}$	= CH_4 emissions (Gg CH_4)
Livestock $_{category}$	= number of head of livestock species / category T
Emission factor $_T$	= default emission factor for a defined livestock population (kg CH_4 head^{-1}).
T	= species/category of livestock

Finally, the total emissions from the species/category of livestock was estimated applying the following equation:

Total emissions from livestock manure management

$$\boldsymbol{Emissions_{CH4\ manure} = \sum_i emissions_i}$$

Where:

Emissions $_{CH4\ manure}$	= total CH_4 emissions from Manure Management (Gg CH_4)
Emission $_i$	= emissions for the ith livestock categories and subcategories.

TIER 2 approach – N_2O emissions from Manure Management

Tier 2 uses a mass-flow approach based on the concept of a flow of TAN through the manure management system (use N-flow model)

It should be noted that the calculations of a mass-flow approach must be carried out on the basis of kg of N. The resultant estimates of NH3-N emissions are then converted to NH3. If calculating emissions of NH3 using a mass-flow approach, a system based on TAN is preferred to one based on total N, as is used by IPCC to estimate emissions of N2O. This is because emissions of NH3 and other forms of gaseous N arise from TAN. Accounting for the TAN in manure as it passes through the manure management system therefore allows for more accurate estimates of gaseous N emissions. It also allows for the methodology to reflect the consequences of changes in livestock diets on gaseous N emissions, since the excretion of total N and TAN

[168] Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chapter 10 Emissions from Livestock and Manure Management, sub-chap 10.4.1 Choice of method
[169] Source: 2018 update to the EMEP/EEA Guidebook 2023, 3.B Manure management

respond differently to such changes. Such estimates of the percentage of TAN (Total Ammonium Nitrogen)in manures may be used to verify the accuracy of the mass-flow calculations (e.g. Webb and Misselbrook, 2004).

Tier 2 methodologies estimate the mineralization of N and the immobilization of TAN during manure management, and also estimate other losses of N, e.g. as NO, in order to more accurately estimate the TAN available at each stage of manure management.

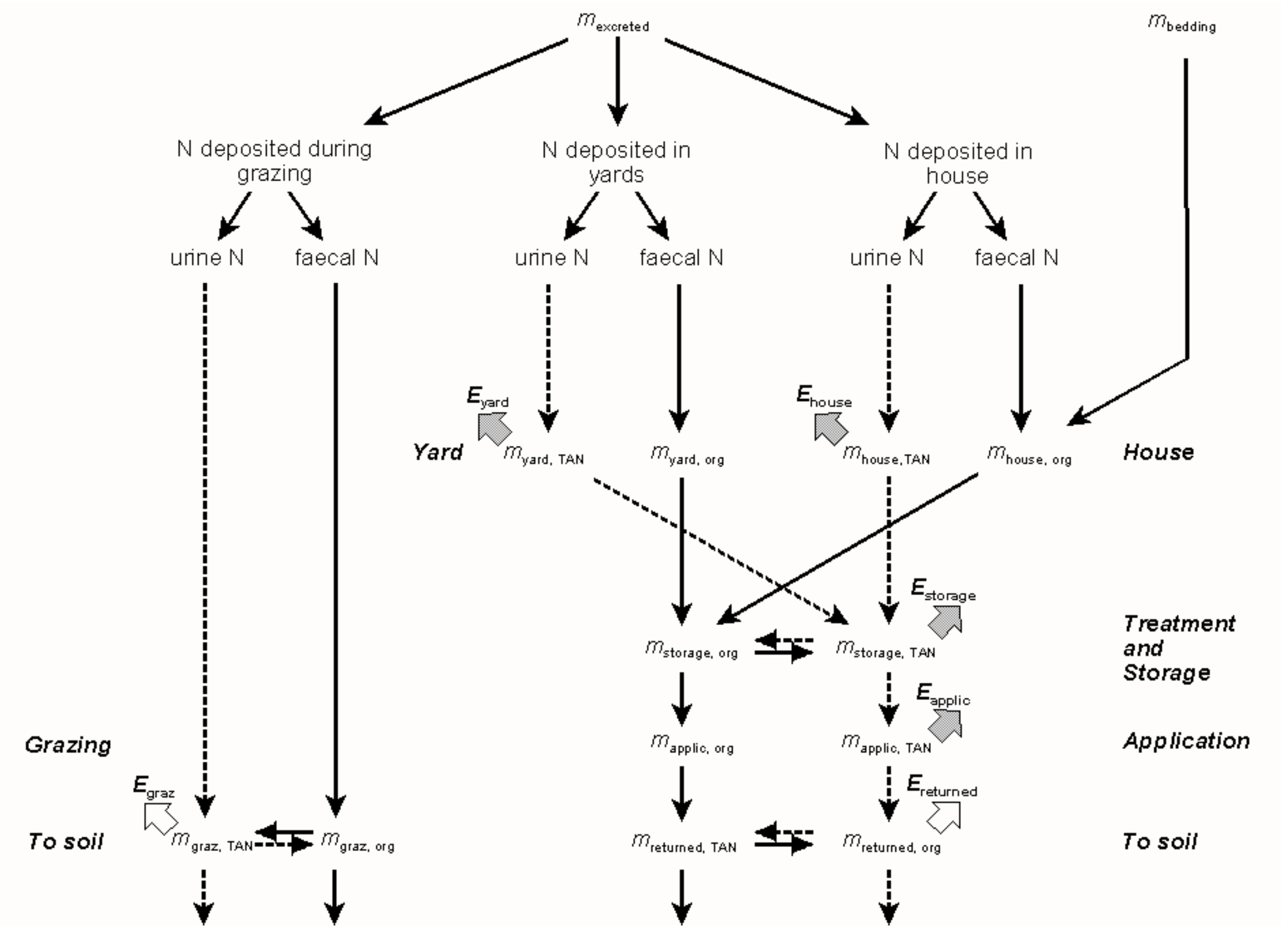


Figure 5-13 N flows in the manure management system (Source: Dämmgen and Hutchings, 2008)[170]

Following the guidance provided in EMEP/EEA Guidebook 2023, 3.B Manure management 2023 (3.4 Tier 2 technology-specific approach) the following fifteen steps were used to estimate direct N_2O emissions from Manure Management:

Step 1: Collect population data from the Livestock Population Characterization (livestock subcategories that are homogeneous with respect to feeding, excretion and age/weight range);

Step 2: Calculate the total annual excretion of N by the animals (Nex; kg AAP–1 a–1);

Step 3: Calculation of Total N excretion deposited in housing, on outdoor yards and on grazed land;

Step 4: Allocation of organic-N and TAN excretion between housing, outdoor yards and grazing;

Step 5: Estimate amounts of TAN deposited in housing as slurry or solid;

Step 6: Calculate NH3 emissions from housing and yards;

Step 7: Calculate total-N and TAN leaving housing (only solid);

[170] Source: EMEP/EEA air pollutant emission inventory Guidebook 2023, 3.B Manure management, pg.9

Step 8: Calculate Total-N and TAN entering storage (slurry and solid);

Step 9: Calculate TAN from which slurry storage emissions will occur (only slurry);

Step 10: Calculate storage emissions;

Step 11: Calculate organic-N and TAN applied to field;

Step 12: Calculate emissions during and immediately following application to field;

Step 13: Calculate total-N and TAN returned to soil after NH3 emissions (doesn't account for NO and N2O emissions);

Step 14: Calculate NH3 - N emissions from grazing;

Step 15: All emissions from the manure management system that are to be reported under Chapter 3B, 3Da2a and 3Da3 are summed and converted to the mass of the relevant compound.

5.3.2.2 Choice of activity data

As described in Chapters 5.1.2 and 5.1.3 above, the original data provider for the national and international agricultural data is the Ministry of Agriculture and Rural Development and Statistical Office of Albania (INSTAT)[171]. The data are presented in the figures and tables in Chapter 5.1.3.

5.3.2.3 Choice of emission factors

Default emission factors for methane (CH_4)

The default emission factors for methane (CH_4) were taken from IPCC 2006 Guidelines and are presented in the following table.

Table 5-22 Emission factors for Tier 1 for CRT category 3.B Manure Management

Livestock	CH_4 emission factor by average annual temperature (°C) (kg/head per year)		Region / average annual temperature	Source
	EF	type	EF	
Dairy Cows	15	D	Eastern Europe: 14/15°	**2006 IPCC Guidelines Vol. 4, Chap. 10 (10.4.2)** Table 10.14 Manure management methane emission factors by temperature (page 10.38ff)
Other Cattle	8	D		
Swine	3.0	D		
Sheep	0.15	D	Developing countries / Temperate (15 to 25°C)	**2006 IPCC Guidelines Vol. 4, Chap. 10 (10.4.2)** Table 10.15 Manure management methane emission factors by temperature (page 10.40)
Goats	0.17	D		
Horses	1.64	D		
Mules and Asses	0.9	D		
Poultry	0.02	D		
Note: D Default CS Country specific PS Plant specific IEF Implied emission factor				

[171] Available (5. September 2024) on https://www.instat.gov.al/

Nitrous oxide (N_2O) - Annual average nitrogen excretion rates ($Nex_{(T)}$)

The Annual average nitrogen excretion rates ($Nex_{(T)}$) was calculated according to Equation 10.30 of 2006 IPCC GL[172] and are presented in the following table.

Equation 10.30: Annual N excretion rates (2006 IPCC GL, Vol. 4, Chap. 10)

$$\boldsymbol{Nex_{(T)} = N_{rate(T)} \times \frac{TAM}{1000} \times 365}$$

Where:

$Nex_{(T)}$ = annual N excretion for livestock category T (kg N animal^{-1} $^{yr-1}$)

$N_{rate(T)}$ = default N excretion rate (kg N (1000 kg animal mass)$^{-1}$ day^{-1})

$TAM_{(T)}$ = tanimal mass for livestock category T (kg animal^{-1})

Annual average nitrogen excretion rate $N_{rate(T)}$

Annual nitrogen excretion rates should be determined for each livestock category defined by the livestock population characterization. As no country specific nitrogen excretion rate $N_{rate(T)}$ were available, the default N excretion rates were used. They are presented in the following table.

Table 5-23 Typical animal mass, default nitrogen excretion rate and annual N excretion for livestock category

	Category of animal	Typical animal mass for livestock $TAM_{(T)}$ (kg)	Default values for nitrogen excretion rate ($N_{rate(T)}$) (kg N (1000 kg animal mass)$^{-1}$ day^{-1})	Annual N excretion for livestock category (kg N animal-1 $^{yr-1}$)
			Region – Eastern Europe	
3.B.2.a.i	Dairy Cattle	450	0.35	57.49
3.B.2.a.ii	Other Cattle	350	0.35	44.71
3.B.2.c	Other - Sheep	40.00	0.9	13.14
3.B.2.d	Other - Goats	36.00	1.28	16.82
3.B.2.f	Other - Horses	377	0.3	41.28
3.B.2.g	Other - Mules and Asses	130	0.3	14.24
3.B.2.h	Swine	204	0.46	34.25
3.B.2.i	Other - Poultry	1.1	1.1	0.44
Source:		*INSTAT*	*Table 10.19 Default values for nitrogen excretion rate*[173]	*calculated*

The direct N_2O emissions are exemplarily calculated in (direct N_2O emissions) applying the default emission factors for direct N_2O emissions from manure management (see Table 5-24).

Table 5-24 Default Tier 2 emission factors for direct N_2O emissions from manure management

Storage system	EF_3 [kg N_2O-N (kg Nitrogen excreted)$^{-1}$]
Cattle slurry without natural crust	0
Cattle slurry with natural crust	0.01
Pig slurry without natural crust	0.00
Cattle manure heaps, solid	0.02

[172] 2006 IPCC Guidelines, Volume 4: AFOLU, Chapter 10 Emissions from Livestock and Manure Management, sub-chap 10.5.2 Choice of emission factors. Equation 10.30. page 10.57.

[173] 2006 IPCC Guidelines, Vol. 4, Chap. 10, sub-chap. 10.5.2 Choice of emission factors, page 10.59.

Storage system	EF_3 [kg N_2O-N (kg Nitrogen excreted)$^{-1}$]
Pig manure heaps, solid	0.01
Sheep and goats manure heaps, solid	0.02
Horse (mules and asses) manure heaps, solid	0.02
Layer manure heaps, solid	0.002
Broiler manure heaps, solid	0.002
Turkey and duck manure heaps, solid	0.002
Goose manure heaps, solid	0.002
Source: EMEP/EEA air pollutant emission inventory Guidebook 2023, 3.B Manure management, Table 3-8	

Table 5-25 Exemplary calculation including parameter of CH4 and N2O from 3.B Manure management

CH4 and N2O emissions from 3.B Manure management			3.B.1-Dairy Cattle
L	Livestock (# of animals)	-	406 148
TAM (W)	Typical Animal Mass (average) (also TAM)	-CS	450.00
MS1	Manure System - Pasture Range & Paddock		30%
MS2	Manure System - Daily Spread	2.6	2.5%
MS3	Manure System - Solid Storage	kg/hd/day	35%
MS4	Manure System - Dry Lot		15%
MS5	Manure System - Liquid/Slurry		17.5%
MS6	Manure System - Burned for fuel		0%
MS7	Manure System - Anaerobic Lagoon		0%
MS8	Manure System - other AWMS		0%
MS9	Manure System - other AWMS		0%
	Check Total MS		100%
GE	Gross Energy Intake (average)	{[(NEm+NEa+NEl+NEw+NEp)/REM]+[NEg/REG]}/(DE/100)	143.78
DE	Digestible Energy	-	55%
ASH	Ash Content of the Manure	-	0.08
VS	Volatile Solid Daily Excretion	GEx(1-(DE/100)+(1-(UE*GE))x(1-(ASH/18.45))	148.10
Bo	CH4 Producing Potential	-	0.13
EF_{CH4}	EF	-	20
CH4 Emi	CH4 Emissions	L x EF_{CH4} x 10^-6	8.12
M	Method	-	T1
EF used	EF used	-	D
Nrate(T)	N excretion rate	-	0.35
Nex(T)	Annual N excretion per head	Nrate(T)*TAM*10^-3*365	57.49
	Housed period	days	180
	Proportion of N excreted as TAN	Fraction	0.60
	Prop excreta on yards	Fraction	0.25
m_{graz_N}	Amount of the annual N excreted - grazing	kg	8,875,592.88
m_{yard_N}	Amount of the annual N excreted - yard	kg	5,837,101.62
m_{house_N}	Amount of the annual N excreted - house	kg	8,635,711.99

CH4 and N2O emissions from 3.B Manure management			3.B.1-Dairy Cattle
Total Nex	*Total* Nex	kg	23,348,406.49
m_{graz_TAN}	The proportion of the N excreted as TAN (xTAN) - grazing	kg	5,325,355.73
m_{yard_TAN}	The proportion of the N excreted as TAN (xTAN) - yard	kg	3,502,260.97
m_{house_TAN}	The proportion of the N excreted as TAN (xTAN) - house	kg	5,181,427.19
Total TAN	The proportion of the N excreted as TAN (xTAN)	kg	14,009,043.89
Xhouse_slurry	The proportion of livestock manure handled as slurry	Fraction	0.5
$m_{house\_slurry\_TAN}$	Amounts of TAN handled as liquid slurry	kg	2,590,713.60
$m_{house\_solid\_TAN}$	Amounts of TAN handled as solid	kg	2,590,713.60
Total housing TAN	Total TAN deposited during housing	kg	5,181,427.19
$m_{house\_slurry\_N}$	Amounts of N handled as liquid slurry	kg	4,317,855.99
$m_{house\_solid\_N}$	Amounts of N handled as solid	kg	4,317,855.99
Total housing N	Total N deposited during housing	kg	8,635,711.99
EF	EF_NH3_house_slurry	Fraction TAN	0.24
EF	EF_NH3_house_slurry	Fraction TAN	0.09
	Proportion_tied_housing	Fraction TAN	0.40
EF	EF_NH3_house_solid	Fraction TAN	0.08
EF	EF_NH3_house_solid	Fraction TAN	0.09
EF	EF_NH3_yard	Fraction TAN	0.3
EMI	Ehouse_slurry	kg	466,328.45
EMI	Ehouse_solid	kg	217,619.94
EMI	Eyard	kg	1,050,678.29
Straw	Straw	kg/yr	304,610,652.17
	$N_{\_added\_in\_straw}$	kg/animal/yr	6.00
	m_{bedding} *kg N*	kg N	1,218,442.61
	f_{imm}	kg N/kg straw	0.0067
	$m_{ex\text{-}house\_solid\_TAN}$	kg	332,202.29
	$m_{ex\text{-}house\_solid\_N}$	kg	5,318,678.66
	$x_{\text{store\_slurry}}$	Fraction	
	$x_{\text{store\_solid}}$	Fraction	0.20
	$m_{\text{storage\_slurry\_TAN}}$	kg	0.80
	$m_{\text{storage\_slurry\_N}}$	kg	915,193.57
	$m_{\text{storage\_solid\_TAN}}$	kg	1,727,590.18
	$m_{\text{storage\_solid\_N}}$	kg	265,761.83
	x_{biogas_slurry}	Fraction	0.00
	$m_{\text{ biogas\_slurry\_TAN}}$	kg	0.00
	$m_{\text{ biogas\_slurry\_N}}$	kg	0.00
	x_{biogas_solid}	Fraction	0.00
	$m_{\text{ biogas\_solid\_TAN}}$	kg	0.00
	$m_{\text{ biogas\_solid\_N}}$	kg	0.00

CH4 and N2O emissions from 3.B Manure management			3.B.1-Dairy Cattle
	$m_{applied\_direct\_slurry\_TAN}$	kg	3,660,774.26
	$m_{applied\_direct\_slurry\_N}$	kg	6,910,360.70
	$m_{applied\_direct\_solid\_TAN}$	kg	66,440.46
	$m_{applied\_direct\_solid\_N}$	kg	1,063,735.73
fmin	Fraction of the organic N is mineralised	kg N/kg	0.1
$mm_{storage\_slurry\_TAN}$	The modified mass from which emissions are calculated	kg	996,433.2271
EF	EF_NH3_storage_slurry	Fraction TAN	0.2500
EF	EF_N2O_storage_slurry_with_natural_crust	Fraction TAN	0.01
EF	EF_N2O_storage_slurry_without_natural_crust	Fraction TAN	0.00
	Proportion_with_natural_crust	Fraction	0.8
	Proportion_without_natural_crust	Fraction	0.2
EF	EF_NO_storage_slurry	Fraction TAN	0.0001
EF	EF_N2_storage_slurry	Fraction TAN	0.0030
EF	EF_NH3_storage_solid	Fraction TAN	0.3200
EF	EF_N2O_storage_solid	Fraction TAN	0.0200
EF	EF_NO_storage_solid	Fraction TAN	0.0100
EF	EF_N2_storage_solid	Fraction TAN	0.3000
EMI	$E_{storage\_slurry\_NH3}$	kg N	249,108.3068
EMI	$E_{storage\_slurry\_N2O}$	kg N	7,971.4658
EMI	$E_{storage\_slurry\_NO}$	kg N	99.6433
EMI	$E_{storage\_slurry\_N2}$	kg N	2,989.2997
EMI	$E_{storage\_solid\_NH3}$	kg N	85,043.7850
EMI	$E_{storage\_solid\_N2O}$	kg N	5,315.2366
EMI	$E_{storage\_solid\_NO}$	kg N	2,657.6183
EMI	$E_{storage\_solid\_N2}$	kg N	79,728.5484
	$m_{applic\_slurry\_TAN}$	kg	4,397,038.78
	$m_{applic\_slurry\_N}$	kg	8,377,782.16
	$m_{applic\_solid\_TAN}$	kg	159,457.10
	$m_{applic\_solid\_N}$	kg	5,145,933.47
EF	EF_NH3_applic_slurry	Fraction TAN	0.55
EF	EF_NH3_applic_solid	Fraction TAN	0.68
EMI	Eapplic_slurry	kg	2,418,371.33
EMI	Eapplic_solid	kg	108,430.83
	$m_{returned\_slurry\_TAN}$	kg	1,978,667.45
	$m_{returned\_slurry\_N}$	kg	5,959,410.84
	$m_{returned\_solid\_TAN}$	kg	51,026.27
	$m_{returned\_solid\_N}$	kg	5,037,502.65
EF	EF_NO_Managed_Soils_Manure	kg NO2/kg N input	0.04
EMI	Soils NO Emissions from Livestock	kg NOx (as NO2)	540,948.63

CH4 and N2O emissions from 3.B Manure management			3.B.1-Dairy Cattle
EF	EF_N2O_Manure_application	kg N2O-N/kg N input	0.01
EMI	N2O Emissions (kg N) - manure	kg N	135,237.16
EMI	Soils N2O Emissions from Livestock	kg N2O	212,515.53
EF	EF_NH3_grazing	Fraction TAN	0.14
EMI	E graz	kg	745,549.80
	TAN returned	kg	4,579,805.92
	N returned	kg	8,130,043.08
EF	EF_N2O_Grazing	kg N2O-N/kg N input	0.02
EMI	N2O Emissions (kg N)	kg N	177,511.86
EMI	Grazing N2O Emissions	kg N2O	278,947.20
EF	EF_NO_Managed_Soils_Excreta	kg NO2/kg N input	0.04
EMI	Grazing NO Emissions	kg NOx (as NO2)	355,023.72
EMI	Housing, manure as slurry	kg NH3	566,255.97
EMI	Housing, manure as solid	kg NH3	264,252.79
EMI	Yards	kg NH3	1,275,823.64
EMI	Slurry storage	kg NH3	302,488.66
EMI	Solid storage	kg NH3	103,267.45
EMI	**3B Total**	**kt**	**2.5121**
EMI	Slurry application	kg NH3	2,936,593.75
EMI	Solid application	kg NH3	131,666.00
EMI	**3Da2a total**	**kt**	**3.0683**
EMI	Grazing	kg NH3	905,310.47
EMI	**3Da3 total**	**kt**	**0.9053**
EMI	Slurry storage	kg N2O	12,526.59
EMI	Solid storage	kg N2O	8,352.51
EMI	**3B Total**	**kt**	**0.0209**
EMI	**3Da2a total**	**kt**	**0.2125**
EM	**3Da3 total**	**kt**	**0.2789**
EM	Slurry storage	kg NOx (as NO2)	327.40
EM	Solid storage	kg NOx (as NO2)	8,732.17
EM	**3B Total**	**kt**	**0.0091**
EM	**3Da2a total**	**kt**	**0.5409**
EM	**3Da3 total**	**kt**	**0.3550**
EM	Slurry storage	kg N2	2,989.30
EM	Solid storage	kg N2	79,728.55
EMI	**3B Total**	**kt**	**0.0827**
	Total Nex	kt	23.34841

CH4 and N2O emissions from 3.B Manure management			3.B.1-Dairy Cattle
	Total bedding (mbedding kg N)	kt	1.21844
	Total Nex grazing (mgraz_N)	kt	8.87559
	Total N loss in Manure management systems and emissions from biodigesters (not grazing)	kt	2.1675
	mapplic_N (Total N available to apply to soils)	kt	13.5237156
	N input	**kg**	**24,566,849.10**
	N output	**kg**	**24,566,849.10**

In Albania it is not common to use dung as fuel. When estimating the $Nex_{(T)}$ for animals whose manure is classified in the manure management system burned for fuel, it should be kept in mind that the dung is burned and the urine stays in the field. As a rule of thumb, 50% of the nitrogen excreted is in the dung and 50% is in the urine.

5.3.3 Uncertainties and time-series consistency for CRT category 3.B Manure management

The uncertainties for activity data and emission factors used for CRT category 3.B *Manure management* are presented in the following table.

Table 5-26 Uncertainty for CRT category 3.B Manure management.

Uncertainty	CH_4	N_2O	N_2O	Reference
				2006 IPCC GL, Vol. 4, Chap. 10
Activity data: Livestock	20%	20%	20%	Chapter 10.2.3
Activity data: Manure Management System Usage	38%	38%	38%	Chapter 10.4.4
Emission factor	30%			Chapter 10.4.4
Emission factor (direct emission)		250%		Chapter 10.4.4
Emission factor (indirect emission)			50%	Chapter 10.4.4
Combined Uncertainty	52%	254%	502%	$U_{Total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

5.3.4 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed out:

⇒ Checked of calculations by spreadsheets
- consistent use of livestock data (statistical yearbook and FAOstat- Live Animals),
- documented sources,
- use of units,
- strictly defined interfaces between spreadsheets/calculation modules,
- unique structure of sheets which do the same,
- record keeping, use of write protection,
- unique use of formulas, special cases are documented/highlighted,
- quick-control checks for data consistency through all steps of calculation.

⇒ cross-checked from different sources: national statistic (INSTAT, Agricultural Census 2003) and international statistics (FAO)

⇒ cross checks with other relevant sectors are performed to avoid double counting or omissions;

⇒ consistency and completeness checks are performed;

⇒ time series consistency - plausibility checks of dips and jumps.

5.3.5 Category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends

The following table presents the main revisions and recalculations done since the last submission (NC & BUR) to the UNFCCC and relevant to CRT category 3.B *Manure management*.

Table 5-27 Recalculations done in CRT category 3.B *Manure management*

GHG source & sink category	Revisions of data ⇒ submission 2024	Type of revision	Type of improvement
3.B (N_2O)	Application of • 2019 refinements to the 2006 IPCC Guidelines, and EMEP/EEA air pollutant emission inventory guidebook 2019 (Tier 2)	AD EF EMI	Accuracy

5.3.6 Category-specific planned improvements including tracking of those identified in the review process

Considering the potential contribution of identified improvements in the total GHG emissions and the corresponding resources needed to make these improvements effective, developments presented in following table will be explored.

Table 5-28 Planned improvements for CRT category 3.B *Manure management*

GHG source & sink category	Planned improvement	Type of improvement		Priority
3.A.2	Correction of technical mistakes in calculation	AD, EF	Completeness	high
3.A. 3.B. 3.D.	Husbandry and Management Practice with consideration • characteristics of Livestock Husbandry for the whole time series: ○ breed, ○ age distribution, ○ weight ○ milk wool yield, ○ wool yield, ○ working hours • characteristics of manure management practice: ○ stall / housed and Housing period ○ pasture/range/paddock (flat/hilly) ○ grazing large areas (flat/hilly) ○ daily spread ○ solid storage ○ dry lot ○ liquid/slurry with/without natural crust cover ○ uncovered anaerobic lagoon ○ pit storage below animal confinements ○ anaerobic digester ○ burned for fuel ○ cattle and swine deep bedding ○ composting ○ aerobic treatment	AD	Accuracy Consistency Comparability Transparency Completeness	high
3.A. 3.B.	Manure management by temperature for sheep, goats, horses, mules, and asses, and poultry	AD	Accuracy Comparability Transparency	medium
3.A.2	Estimation of methane emissions applying TIER 2 approach as these sub-categories are key categories	method	Transparency Comparability	high
3.A.1.j 3.B. 3.D	Survey and/or research on Livestock which is not included in current statistics: e.g. buffalo, fur bearing animals	AD	Completeness	Medium
3.B	Survey and/or research on VS excretion rates		Accuracy	medium

5.4 Rice cultivation (CRT category 3.C)

The CRT category 3.C *Rice cultivation* does not exist in Albania.

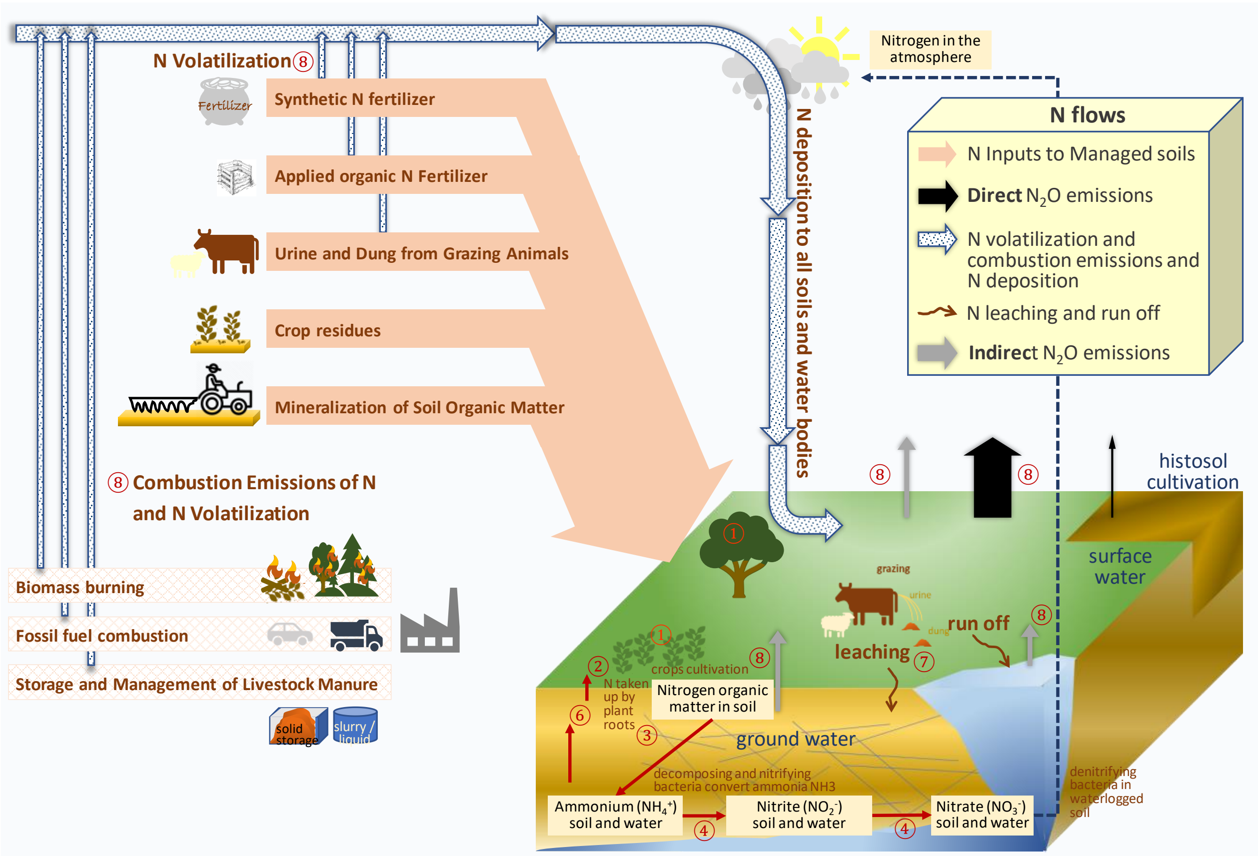
5.5 Agricultural soils (CRT category 3.D)

This section describes the estimation of nitrous oxide emissions from managed soils due to nitrogen input, including indirect N_2O emissions from additions of N to land due to deposition and leaching. As defined in 2006 IPCC GL, Vol. 4, Chap. 1.1 managed land is land where human interventions and practices have been applied to perform production, ecological or social functions. The emissions of N_2O that result from anthropogenic N inputs or N mineralization occur through both:

- direct pathway: directly from the soils to which the N is added/released
- indirect pathways: (i) following volatilization of NH_3 and NO_x from managed soils and from fossil fuel combustion and biomass burning, and the subsequent redeposition of these gases and their products NH_4^+ and NO_3^- to soils and waters; and

  (ii) after leaching and runoff of N, mainly as NO_3^-, from managed soils.

The principal pathways are illustrated in the following figure. Direct emissions of N_2O from managed soils are estimated separately from indirect emissions, though using a common set of activity data.



The nitrogen cycle: (1) uptake of nitrogen by plants from the atmosphere: (2) uptake of ammonium and nitrate by plants from soil and water: nitrogen-fixing bacteria in humus and in root nodules of leguminous plants (3) ammonification, (4) nitrification, (5) denitrification, (6) nitrate immobilization by soil sorption, (7) nitrate leaching from the soil, (8) release of ammonia (NH3), gaseous nitrogen and nitrous oxide to the atmosphere.

Figure 5-14 Schematic diagram illustrating the sources and pathways of N that result in direct and indirect N_2O emissions from soils and waters

Source: After (1) 2006 IPCC Guidelines, Volume 4, Chapter 11, Figure 11.1, page 11.8. and
(2) Bednarek, A.; Szklarek, S. & Zalewski, M. (2014): Nitrogen pollution removal from areas of intensive farming—comparison of various denitrification biotechnologies. In: Ecohydrology & Hydrobiology 14 (2014) 132–141.

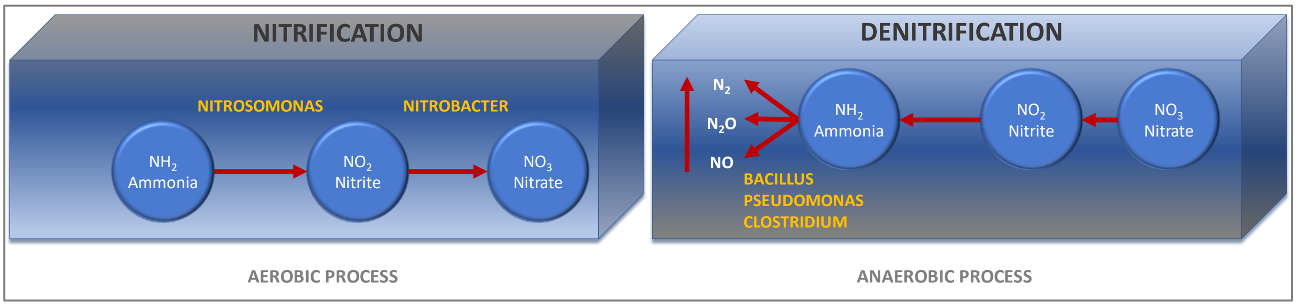


Figure 5-15 Nitrification and Denitrification

As described in Chapter 5.3 and in Figure 5-10 the N_2O emissions generated by manure in the

- system "livestock housing and holding areas" and "manure storage" are reported under the category
  - ⇒ 3.B Manure management
- system 'pasture, range, and paddock' occur directly and indirectly from the soil, and are therefore reported under the category
  - ⇒ 3.D.a *Direct N_2O emissions from managed soils*
    - ⇒ 3.D.a.2 *Organic N fertilizers*
      - ⇒ *3.D.a.2.a Animal manure applied to soils*
  - ⇒ 3.D.b *IndirectN_2O Emissions from managed soils*

Beyond that further 'man-made' nitrogen applied to the soil are synthetic fertilizer application, crop residues, and mineralization of soil organic matter. Through nitrogen vitalization and combustion emissions of N from fossil fuels from all nitrogen sources a 'nitrogen stock in the atmosphere' is formed also depending of the amount and characteristics of the N-inputs.

The deposition of nitrogen (N) to soils and water bodies result from

- Nitrogen vitalization from
  - synthetic fertilizer application
  - application of organic N fertilizer
  - urine and dung from grazing animals
  - crop residues
  - mineralization of soil organic matter
- Nitrogen vitalization and combustion emission of N from
  - biomass burning
  - fossil fuel combustion
  - storage and management of livestock manure

5.5.1 Source category description

IPCC code	Description	Description	CO_2		CH_4		N_2O	
			Estimated	Key Category	estimated	Key category	estimated	Key category
3.D	**Manure Management**							
3.D.1	**Direct N_2O emissions from managed soils**			-		-		-
3.D.1.a	Inorganic N fertilizers	N input from application of inorganic fertilizers to cropland and grassland	NA	-	NA	-	✓	-
3.D.1.b	Organic N fertilizers	N input from organic N fertilizers to cropland and grassland	NA	-	NA	-	✓	-
3.D.1.b.i	Animal manure applied to soils	N input from manure applied to soils	NA	-	NA	-	✓	-
3.D.1.b.ii	Sewage sludge applied to soils	N input from sewage sludge applied to soils	NA	-	NA	-	NE	-
3.D.1.b.iii	Other organic fertilizers applied to soils	N input from application of other organic fertilizers	NA	-	NA	-	✓	-
3.D.1.b	Urine and dung deposited by grazing animals	N excretion on pasture, range and paddock	NA	-	NA	-	✓	-
3.D.1.a	Crop residues	N in crop residues returned to soils	NA	-	NA	-	✓	-
3.D.1.e	Mineralization/ immobiliza-tion associated with loss/gain of soil organic matter	N in mineral soils that is mineralized in association with loss of soil C	NA	-	NA	-	NO	-
3.D.1.f	Cultivation of organic soils	Area of cultivated organic soils (i.e, histosols)	NA	-	NA	-	NO	-
3.D.1.g	Other		NA	-	NA	-	NO	
3.D.b	**Indirect N_2O Emissions from managed soils**							
3.D.b.1	Atmospheric deposition	Volatilized N from agricultural inputs of N	NA	-	NA	-	NE	-
3.D.b.2	Nitrogen leaching and run-off	N from fertilizers and other agricultural inputs that is lost through leaching and run-off	NA	-	NA	-	NE	-

A '✓' indicates: emissions from this sub-category have been estimated.
Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential

LA – Level Assessment (in year); TA – Trend Assessment

N_2O emissions from CRT category 3.D.1. Direct N2O emissions from managed soils amounted to 2.567 kt N2O in 1990 and 1.289 kt N_2O in 2022, which is a decrease of -49.8% for that period, and decreased -34.7 % in the period of 2005-2022.

- decreased amount of manure from increased number of livestock,
- increased amount of inorganic fertilizer applied,
- area for crop production which implicates increased.

Table 5-29 N_2O emissions from CRT category 3.D.1 *Direct N_2O emissions from managed soils*

N_2O	3.D.1	3.D.1.a	3.D.1.b	3.D.1.b.i	3.D.1.b.ii	3.D.1.b.iii	3.D.1.c	3.D.1.d
	Direct N_2O emissions from managed soils	**Inorganic N fertilizers**	**Organic N fertilizers**	**Animal manure applied to soils**	**Sewage sludge applied to soils**	**Other organic fertilizers applied to soils**	**Urine and dung deposited by grazing animals**	**Crop residues**
	N input from application of inorganic fertilizers to cropland and grassland	N input from organic N fertilizers to cropland and grassland	N input from manure applied to soils	N input from sewage sludge applied to soils	N input from application of other organic fertilizers	N excretion on pasture, range and paddock	N in crop residues returned to soils	N input from application of inorganic fertilizers to cropland and grassland
	kt	kt	kt	kt	kt	kt	kt	kt
1990	**2.567**	1.167	0.393	0.393	NE	NO	1.008	NE
1991	**2.329**	0.920	0.375	0.375	NE	NO	1.033	NE
1992	**1.978**	0.579	0.355	0.355	NE	NO	1.043	NE
1993	**1.762**	0.274	0.378	0.378	NE	NO	1.109	NE
1994	**2.106**	0.224	0.465	0.465	NE	NO	1.417	NE
1995	**2.095**	0.199	0.476	0.476	NE	NO	1.420	NE
1996	**1.808**	0.148	0.450	0.450	NE	NO	1.210	NE
1997	**1.676**	0.103	0.433	0.433	NE	NO	1.139	NE
1998	**1.622**	0.145	0.402	0.402	NE	NO	1.074	NE
1999	**1.674**	0.147	0.412	0.412	NE	NO	1.115	NE
2000	**1.724**	0.188	0.420	0.420	NE	NO	1.115	NE
2001	**1.641**	0.150	0.413	0.413	NE	NO	1.078	NE
2002	**1.783**	0.320	0.413	0.413	NE	NO	1.050	NE
2003	**1.910**	0.452	0.410	0.410	NE	NO	1.047	NE
2004	**1.990**	0.585	0.404	0.404	NE	NO	1.000	NE
2005	**1.973**	0.580	0.402	0.402	NE	NO	0.991	NE
2006	**1.926**	0.543	0.393	0.393	NE	NO	0.989	NE
2007	**1.840**	0.519	0.379	0.379	NE	NO	0.942	NE
2008	**1.734**	0.474	0.366	0.366	NE	NO	0.892	NE
2009	**1.694**	0.493	0.352	0.352	NE	NO	0.848	NE
2010	**1.701**	0.492	0.354	0.354	NE	NO	0.854	NE
2011	**1.730**	0.535	0.356	0.356	NE	NO	0.839	NE
2012	**1.758**	0.540	0.352	0.352	NE	NO	0.866	NE
2013	**1.777**	0.537	0.349	0.349	NE	NO	0.890	NE
2014	**1.767**	0.505	0.357	0.357	NE	NO	0.905	NE
2015	**1.785**	0.515	0.351	0.351	NE	NO	0.919	NE
2016	**1.852**	0.578	0.347	0.347	NE	NO	0.926	NE
2017	**1.867**	0.623	0.338	0.338	NE	NO	0.906	NE
2018	**1.782**	0.560	0.336	0.336	NE	NO	0.886	NE
2019	**1.671**	0.536	0.313	0.313	NE	NO	0.821	NE
2020	**1.515**	0.501	0.283	0.283	NE	NO	0.730	NE
2021	**1.486**	0.514	0.272	0.272	NE	NO	0.700	NE
2022	**1.289**	0.399	0.248	0.248	NE	NO	0.642	NE
Trend								

N_2O	3.D.1	3.D.1.a	3.D.1.b	3.D.1.b.i	3.D.1.b.ii	3.D.1.b.iii	3.D.1.c	3.D.1.d
	Direct N_2O emissions from managed soils	**Inorganic N fertilizers**	**Organic N fertilizers**	**Animal manure applied to soils**	**Sewage sludge applied to soils**	**Other organic fertilizers applied to soils**	**Urine and dung deposited by grazing animals**	**Crop residues**
	N input from application of inorganic fertilizers to cropland and grassland	N input from organic N fertilizers to cropland and grassland	N input from manure applied to soils	N input from sewage sludge applied to soils	N input from application of other organic fertilizers	N excretion on pasture, range and paddock	N in crop residues returned to soils	N input from application of inorganic fertilizers to cropland and grassland
	kt	**kt**	**kt**	**kt**	**kt**	**kt**	**kt**	**kt**
1990 - 2022	*-49.8%*	*-65.8%*	*-36.9%*	*-36.9%*	*NA*	*NA*	*-36.3%*	*NA*
2005 - 2022	*-34.7%*	*-31.2%*	*-38.3%*	*-38.3%*	*NA*	*NA*	*-35.2%*	*NA*
2021 - 2022	*-13.3%*	*-22.3%*	*-9.0%*	*-9.0%*	*NA*	*NA*	*-8.3%*	*NA*

5.5.2 Direct N_2O emissions (CRT category 3.D.a)

The following sources are included in CRT category 3.D.a *Direct N_2O emissions from managed soils.*

3.D.a	**Direct N_2O emissions from managed soils**	
3.D.a.1	Inorganic N fertilizers	N input from application of inorganic fertilizers to cropland and grassland
3.D.a.2	Organic N fertilizers	N input from organic N fertilizers to cropland and grassland
3.D.a.2.a	Animal manure applied to soils	N input from manure applied to soils
3.D.a.2.b	Sewage sludge applied to soils	N input from sewage sludge applied to soils
3.D.a.2.c	Other organic fertilizers applied to soils	N input from application of other organic fertilizers
3.D.a.3	Urine and dung deposited by grazing animals	N excretion on pasture, range and paddock
3.D.a.4	Crop residues	N in crop residues returned to soils
3.D.a.5	Mineralization/ immobilization associated with loss/gain of soil organic matter	N in mineral soils that is mineralized in association with loss of soil C
3.D.a.6	Cultivation of organic soils (i.e. histosols)	Area of cultivated organic soils
3.D.a.7	Other	

5.5.2.1 Methodological issues

5.5.2.1.1 Choice of methods

For estimating the direct N_2O emissions from managed soils the 2006 IPCC Guidelines Tier 1 approach[174] has been applied.

TIER 1 approach – direct N_2O emissions from managed soils

The Tier 1 method (Equation 11.1) entails adding up the

- annual direct N_2O–N emissions produced from managed soils (kg N_2O–N)
- annual direct N_2O–N emissions from N inputs to managed soils (kg N_2O–N)
- annual direct N_2O–N emissions from managed organic soils (kg N_2O–N)
- annual direct N_2O–N emissions from urine and dung inputs to grazed soils (kg N_2O–N)

and converting the N_2O–N emissions to N_2O emissions for reporting purposes.

[174] Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chapter 11: N_2O Emissions from Managed Soils, and CO_2 Emissions from Lime and Urea Application, sub-chap 11.2.1.1 Choice of method. Page 11.6.

Equation: Conversion N_2O emissions from of N_2O–N emissions (2006 IPCC GL, Vol. 4, Chap. 11)

$$N_2O\ emissions_{direct} = N_2O - N \times \frac{44}{28}$$

Equation 11.1: Direct N_2O emissions from managed soils

$$N_2O\ emissions_{direct} - N = N_2O - N_{N\ inputs} + N_2O - N_{OS} + N_2O - N_{PRP}$$

Where:

N_2O emissions $_{direct}$ = direct N_2O emissions from managed soils (kg N_2O)

N_2O_{Direct} –N = annual direct N_2O–N emissions produced from managed soils (kg N_2O–N)

N_2O–$N_{N\ inputs}$ = annual direct N_2O–N emissions from N inputs to managed soils (kg N_2O–N)

N_2O–N_{OS} = annual direct N_2O–N emissions from managed organic soils (kg N_2O–N)

N_2O–N_{PRP} = annual direct N_2O–N emissions from urine and dung inputs to grazed soils (kg N_2O–N) with PRP = pasture, range and paddock

Equation 11.1: Direct N_2O emissions from managed soils (2006 IPCC GL, Vol. 4, Chap. 11)[175]

$$N_2O\ emissions_{direct} - N = N_2O - N_{N\ inputs} + N_2O - N_{OS} + N_2O - N_{PRP}$$

Where

Annual direct N_2O–N emissions from N inputs to managed soils

(11.1.a)

$$N_2O - N_{N\ inputs} = \begin{bmatrix} [(F_{SN} + F_{ON} + F_{CR} + F_{SOM}) \times EF_1] + \\ [(F_{SN} + F_{ON} + F_{CR} + F_{SOM})_{FR} \times EF_{1FR}] \end{bmatrix}$$

Annual direct N_2O–N emissions from managed organic soils

(11.1.b)

$$N_2O - N_{OS} = \begin{bmatrix} (F_{OS,CG,Temp} \times EF_{2CG,Temp}) + (F_{OS,CG,Trop} \times EF_{2CG,Trop}) + \\ (F_{OS,F,Temp,NR} \times EF_{2F,Temp,NR}) + (F_{OS,F,Temp,NP} \times EF_{2F,Temp,NP}) \\ +(F_{OS,F,Trop} \times EF_{2F,Trop}) \end{bmatrix}$$

Annual direct N_2O–N emissions from urine and dung inputs to grazed soils

(11.1.c)

$$N_2O - N_{PRP} = [(F_{PRP,CPP} \times EF_{3PRP,CPP}) + (F_{PRP,SO} \times EF_{3PRP,SO})]$$

Where:

N_2O emissions $_{direct}$ = direct N_2O emissions from managed soils (kg N_2O)

N_2O_{Direct} –N = annual direct N_2O–N emissions produced from managed soils (kg N_2O–N)

N_2O–$N_{N\ inputs}$ = annual direct N_2O–N emissions from N inputs to managed soils (kg N_2O–N)

N_2O–N_{OS} = annual direct N_2O–N emissions from managed organic soils (kg N_2O–N)

N_2O–N_{PRP} = annual direct N_2O–N emissions from urine and dung inputs to grazed soils (kg N_2O–N) with PRP = pasture, range and paddock

F_{SN} = annual amount of synthetic fertiliser N applied to soils (kg N)

F_{ON} = annual amount of animal manure, compost, sewage sludge and other organic N additions applied to soils

F_{CR} = annual amount of N in crop residues (above-ground and below-ground), including N-fixing

[175] Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chapter 11: N_2O Emissions from Managed Soils, and CO_2 Emissions from Lime and Urea Application, sub-chap 11.2.1.1 Choice of method. Equation 11.1 direct N_2O emissions from managed soils (TIER 1). Page 11.7.

crops, and from forage/pasture renewal, returned to soils, kg N yr^{-1}

F_{SOM} = annual amount of N in mineral soils that is mineralised, in association with loss of soil C from soil organic matter as a result of changes to land use or management, kg N yr^{-1}

F_{OS} = annual area of managed/drained organic soils, ha

(Note: the subscripts CG, F, Temp, Trop, NR and NP refer to Cropland and Grassland, Forest Land, Temperate, Tropical, Nutrient Rich, and Nutrient Poor, respectively)

F_{PRP} = annual amount of urine and dung N deposited by grazing animals on pasture, range and paddock, kg N yr^{-1} (Note: the subscripts CPP and SO refer to Cattle, Poultry and Pigs, and Sheep and Other animals, respectively)

EF_1 = emission factor for N_2O emissions from N inputs, kg N_2O–N (kg N input)$^{-1}$

EF_{1FR} = emission factor for N_2O emissions from N inputs to flooded rice, kg N_2O–N (kg N input)$^{-1}$

EF_2 = emission factor for N_2O emissions from drained/managed organic soils, kg N_2O–N ha-1 yr^{-1}

(Note: the subscripts CG, F, Temp, Trop, NR and NP refer to Cropland and Grassland, Forest Land, Temperate, Tropical, Nutrient Rich, and Nutrient Poor, respectively)

$EF_{3\ PRP}$ = 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)$^{-1}$;

(Note: the subscripts CPP and SO refer to Cattle, Poultry and Pigs, and Sheep and Other animals, respectively)

For better understanding the processes in soil and crust the following figures provide simplified illustration of nitrogen (N) transactions

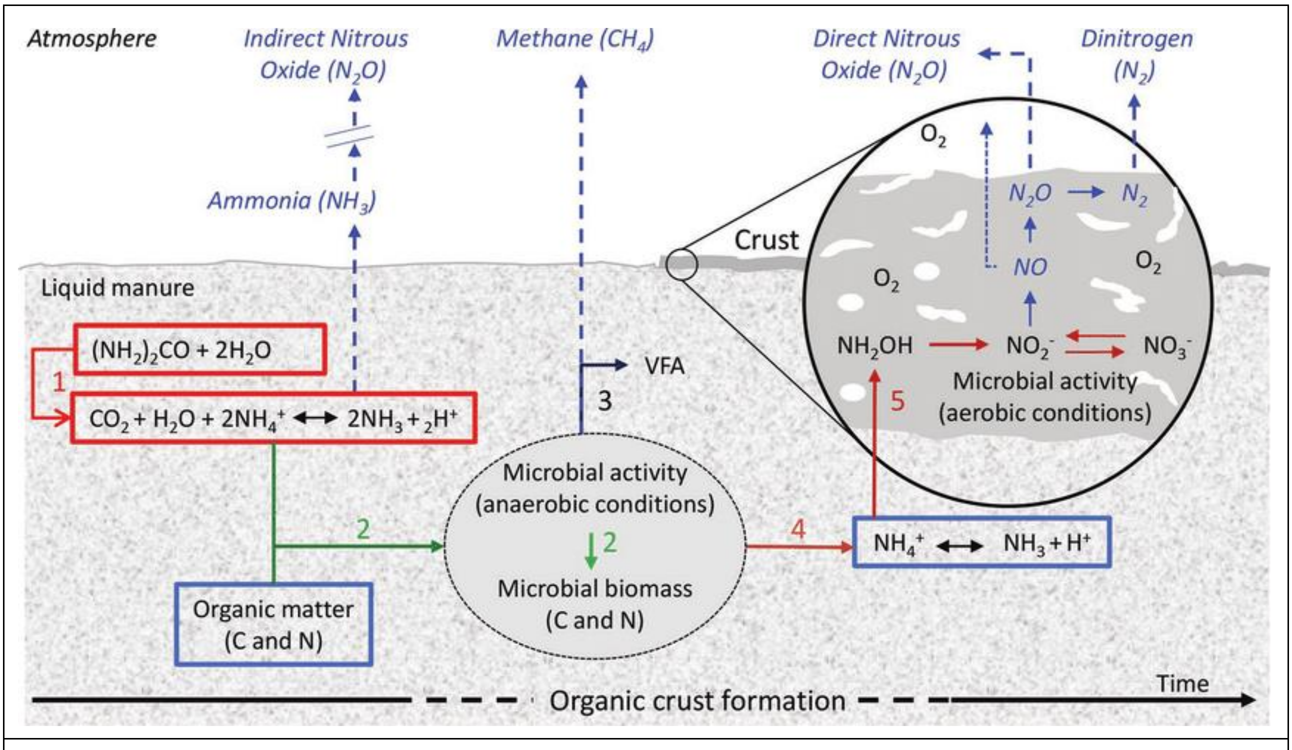


Figure 5-16 Simplified illustration of N transactions between the atmosphere and liquid manure with emphasis on critical processes involved in the emission of gases

Simplified illustration of N transactions between the atmosphere and liquid manure (data from Aguerre et al., 2012), with emphasis on critical processes involved in the emission of gases: (1) hydrolysis of urinary urea-N (giving rise to ammonia, which after emission and deposition on soils contributes to indirect nitrous oxide emission), microbial fermentation of OM under anaerobic conditions (giving rise to methane) associated with (2) microbial growth, (3) acidification of the medium through the formation of VFA, and (4) ammonia formation from the degradation of N-containing organic compounds. In addition, when an organic crust formed (5), the nitrification of ammonium under aerobic conditions was responsible for nitrous oxide and presumably dinitrogen emissions.

Nitrogen-containing structures are as follows:

$(NH_2)_2CO$ = urea; NH_4^+ = ammonium; NH_3 = ammonia; NH_2OH = hydroxylamine; NO_2^- = nitrite; NO_3^- = nitrate; NO = nitric oxide (emitted gas); N_2O = nitrous oxide; N_2 = dinitrogen.

Source: WATTIAUX, M. A.; PAS, UDDIN, M. E. ; LETELIER, P., JACKSON, R. D. & LARSON, R. A. (2019): Emission and mitigation of greenhouse gases from dairy farms: The cow, the manure, and the field. In: Applied Animal Science 35:238–254. Sustainability and Integrated Systems. https://doi.org/10.15232/aas.2018-01803

Available on 29.04.2019 at: https://www.researchgate.net/publication/331916870_Invited_Review_Emission_and_mitigation_of_greenhouse_gases_from_dairy_farms_The_cow_the_manure_and_the_field

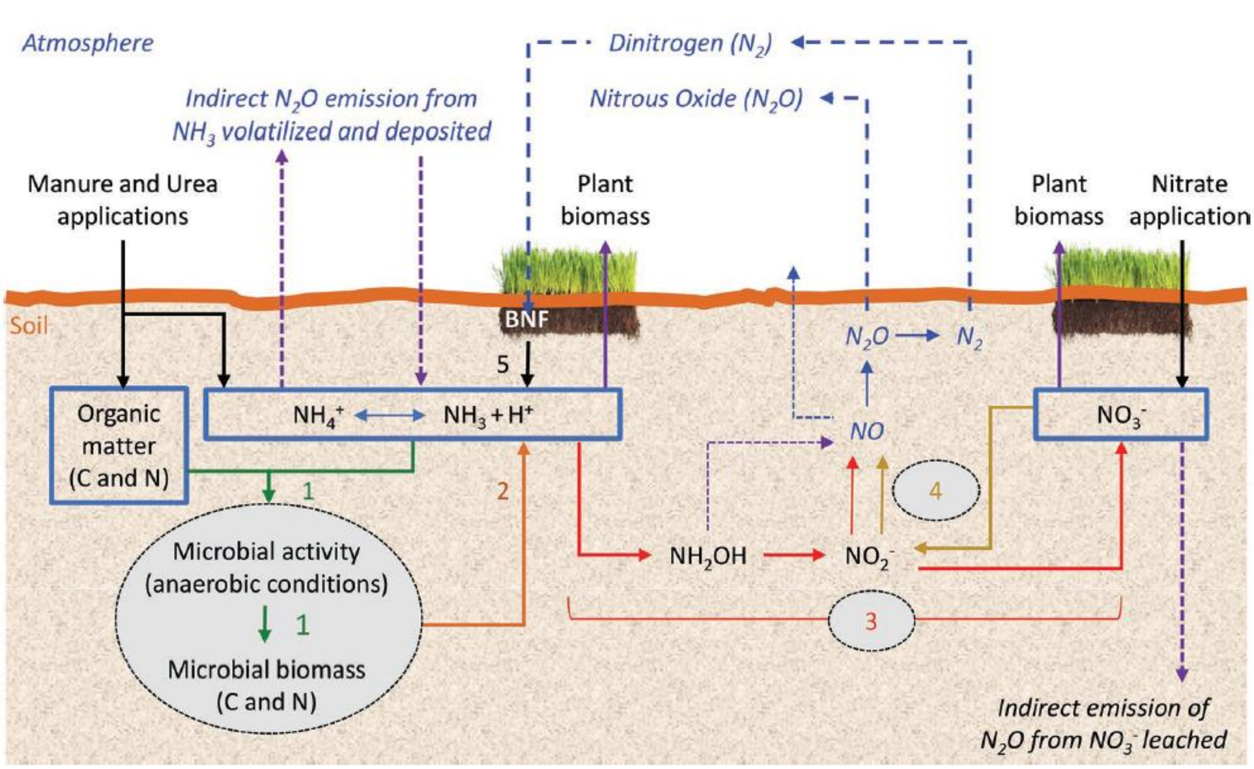


Figure 5-17 Simplified illustration of N transactions between the atmosphere and the soil with emphasis on agronomic aspects related to plant fertilization and the reactions involved in the formation and emission of nitrous oxide (direct and indirect)

Simplified illustration of N transactions between the atmosphere and the soil with emphasis on agronomic aspects related to plant fertilization and the reactions involved in the formation and emission of nitrous oxide (direct and indirect). Different types of arrows are used to identify the main transformations associated with (1) immobilization, (2) mineralization, (3) nitrification, (4) denitrification, and (5) biological nitrogen fixation (BNF) by legumes. Nitrogen-containing structures are as follows: N_2 = dinitrogen; NH_3 = ammonia; $NH4^+$ = ammonium; NH_2OH = hydroxylamine; NO = nitric oxide (emitted gas); NO_2^- = nitrite; NO_3^- = nitrate; N_2O = nitrous oxide
Source: WATTIAUX, M. A.; PAS, UDDIN, M. E. ; LETELIER, P., JACKSON, R. D. & LARSON, R. A. (2019): Emission and mitigation of greenhouse gases from dairy farms: The cow, the manure, and the field. In: Applied Animal Science 35:238–254. Sustainability and Integrated Systems. https://doi.org/10.15232/aas.2018-01803 Available on 29.04.2019 at: https://www.researchgate.net/publication/331916870_Invited_Review_Emission_and_mitigation_of_greenhouse_gases_from_dairy_farms_The_cow_the_manure_and_the_field

5.5.2.1.2 Choice of activity data (AD) and emission factor (EF)

In the following subchapters/sections the activity data (AD) and emission factors (EF) as well as the emission calculations and results are presented separately for each N input from

1) Applied synthetic fertilizer (F_{SN})	$$N_2O - N_{N\ inputs} = \begin{bmatrix} [(F_{SN}) \times EF_1] + \\ [(F_{SN})_{FR} \times EF_{1FR}] \end{bmatrix}$$ *See above equation 11.1.a*[175]
2) Applied organic N fertilizer (F_{ON})	$$N_2O - N_{N\ inputs} = \begin{bmatrix} [(F_{ON}) \times EF_1] + \\ [(F_{ON})_{FR} \times EF_{1FR}] \end{bmatrix}$$ *See above equation 11.1.a*[175]
3) annual amount of N in crop residues, including N-fixing crops, and from forage/pasture renewal, returned to soils (F_{CR})	$$N_2O - N_{N\ inputs} = \begin{bmatrix} [(F_{CR}) \times EF_1] + \\ [(F_{CR})_{FR} \times EF_{1FR}] \end{bmatrix}$$ *See above equation 11.1.a*[175]
4) Mineralised N resulting from loss of soil organic C stocks in mineral soils through land-use change or management practices (F_{SOM})	$$N_2O - N_{N\ inputs} = \begin{bmatrix} [(F_{SOM}) \times EF_1] + \\ [(F_{SOM})_{FR} \times EF_{1FR}] \end{bmatrix}$$ *See above equation 11.1.a*[175]

5) Area of drained/managed organic soils (F_{OS})	*See above equation 11.1.b*[175]
6) Urine and dung from grazing animals (F_{PRP})	*See above equation 11.1.c*[175]

5.5.2.1.2.1 AD and calculation for N Input from Applied synthetic fertilizer (F_{SN})

Activity data, parameter and emission calculation for *N Input from Applied synthetic fertilizer (F_{SN})*

The data of annual amount of applied synthetic fertilizer (F_{SN}) consumption is taken from international source: FAO agricultural data base on synthetic fertilizer consumption[176].

The information on fertilizer consumption / distribution of the Albania Statistical yearbook was used only for crosscheck.

Default emission factors (EF_1) and (EF_{1FR}) were taken from Table 11.1 of 2006 IPCC Guidelines, Vol. 4, Chap. 11[177] and are presented in the following table.

[176] http://www.fao.org/faostat/en/#data

[177] Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chapter 11: N_2O Emissions from Managed Soils, and CO_2 Emissions from Lime and Urea Application, sub-chap 11.2.1.2 Choice of emission factor. Table 11.1. Page 11.11.

Table 5-30 Default emission factors to estimate direct N_2O emissions from managed soils

Emission factor		N_2O (kg N_2O–N (kg N)$^{-1}$) EF	type	Source 2006 IPCC Guidelines Vol. 4, Chap. 11 (11.2.1.2)
EF_1 for N additions from mineral fertilizers, organic amendments and crop residues, and N mineralized from mineral soil as a result of loss of soil carbon	EF_1	0.01	D	**Table 11.1** Default emission factors to estimate direct N_2O emissions from managed soils (page 11.11)

Note:

D	Default	CS	Country specific	PS	Plant specific	IEF	Implied emission factor

With the Equation 11.1.a (see also in section 5.5.2.1.1 Choice of methods) and the equation for conversion N_2O-N tot N_2O the N_2O emissions from N inputs to managed soils

Annual direct N_2O–N emissions from N inputs to managed soils (2006 IPCC GL, Vol. 4, Chap. 11)[175]

$$\boldsymbol{N_2O - N_{N\,inputs}} = [[(\boldsymbol{F_{SN}}) \times \boldsymbol{EF_1}] + [(\boldsymbol{F_{SN}})_{\boldsymbol{FR}} \times \boldsymbol{EF_{1FR}}]]$$

(11.1.a)

$$\boldsymbol{N_2O\ emissions_{direct}} = \boldsymbol{N_2O - N} \times \frac{\mathbf{44}}{\mathbf{28}}$$

Table 5-31 Annual amount of applied synthetic fertilizer (CRT category 3.D.1.a. Inorganic N fertilizers)

	Nutrient nitrogen N (total)				
	Agricultural Use	Production	Import Quantity	Export Quantity	Source
	t	t	t	t	
1990	74233.33	NO	74233.33	NO	FAO database
1991	58566.67	NO	58566.67	NO	
1992	36866.67	NO	36866.67	NO	
1993	17440.00	NO	17440.00	NO	
1994	14233.33	NO	14233.33	NO	
1995	12633.33	NO	12633.33	NO	
1996	9393.33	NO	9393.33	NO	
1997	6566.67	NO	6566.67	NO	
1998	9233.33	NO	9233.33	NO	
1999	9333.33	NO	9333.33	NO	
2000	11966.67	NO	11966.67	NO	
2001	9533.33	NO	9533.33	NO	
2002	20338.99	NO	20338.99	NO	
2003	28765.10	NO	28765.10	NO	
2004	37238.34	NO	37238.34	NO	
2005	36902.89	NO	36902.89	NO	
2006	34554.75	NO	34554.75	NO	
2007	33009.45	NO	33009.45	NO	
2008	30187.50	NO	30187.50	NO	
2009	31389.60	NO	31389.60	NO	
2010	31325.81	NO	31325.81	NO	
2011	34041.77	NO	34041.77	NO	
2012	34376.42	NO	34376.42	NO	
2013	34182.91	NO	34182.91	NO	
2014	32122.60	NO	32122.60	NO	
2015	32742.53	NO	32742.53	NO	
2016	36803.92	NO	36803.92	NO	
2017	39628.31	NO	39628.31	NO	
2018	35616.69	NO	35616.69	NO	
2019	34094.52	NO	34094.52	NO	
2020	31892.44	NO	31892.44	NO	
2021	32691.81	NO	32691.81	NO	
2022	25404.08	NO	25404.08	NO	

5.5.2.1.2.2 AD and calculation for N Input from *Applied organic N fertilizer (F_{ON})*

Activity data, parameter and emission calculation for N Input from *Applied organic N fertilizer (F_{ON})*

The data of annual amount of applied organic fertilizer (F_{ON}) is calculated according the following equation taken from 2006 IPCC Guidelines, Vol. 4, Chap. 11[178] .

Equation 11.3: N from organic N additions applied to soils (TIER 1) (2006 IPCC GL, Vol. 4, Chap. 11) [178]

$$\boldsymbol{F_{ON} = F_{AM} + F_{SEW} + F_{COMP} + F_{OOA}}$$

Where:

F_{ON} = total annual amount of organic N fertiliser applied to soils other than by grazing animals (kg N yr^{-1})

F_{AM} = annual amount of animal manure N applied to soils (kg N yr^{-1})

F_{SEW} = annual amount of total sewage N (coordinate with Waste Sector to ensure that sewage N is not double-counted) that is applied to soils (kg N yr^{-1})

F_{COMP} = annual amount of total compost N applied to soils (ensure that manure N in compost is not double-counted), kg N yr^{-1}

F_{OOA} = annual amount of other organic amendments used as fertiliser (e.g., rendering waste, guano, brewery waste, etc.) (kg N yr^{-1})

F_{AM} - annual amount of animal manure N applied to soils

The term F_{AM} is determined by adjusting the amount of manure N available (N_{MMS_Avb}) for the amount of

- managed manure used for feed ($Frac_{FEED}$),
- burned for fuel ($Frac_{FUEL}$), or
- used for construction ($F_{racCNST}$)

Equation 11.4: N from animal manure applied to soils (TIER 1)
(2006 IPCC GL, Vol. 4, Chap. 11)[179]

$$\boldsymbol{F_{AM} = N_{MMS\ Avb} \times [1 - (Frac_{Feed} + Frac_{Fuel} + Frac_{CNST})]}$$

Where:

F_{AM} = annual amount of animal manure N applied to soils (kg N yr^{-1})

N_{MMS_Avb} = amount of managed manure N available for soil application, feed, fuel or construction, (kg N yr^{-1}) *(Equation 10.34 in Chapter 10 of Vol. 4 of 2006 IPCC GL*[180]*)*

$Frac_{FEED}$ = fraction of managed manure used for feed

$Frac_{FUEL}$ = fraction of managed manure used for fuel

$Frac_{CNST}$ = fraction of managed manure used for construction

[178] Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chapter 11: N_2O Emissions from Managed Soils, and CO_2 Emissions from Lime and Urea Application, sub-chap 11.2.1.3 Choice of activity data. Page 11.13.

[179] Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chapter 10: N_2O Emissions from Managed Soils, and CO_2 Emissions from Lime and Urea Application. Sub-chap. 11.2.1.3. Equation 11.4. Page 11.13.

[180] Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chapter 10: Emissions from Livestock and Manure Management, sub-chap. 10.5.4 Coordination with reporting for N_2O emissions from managed soils. Page 10.64.

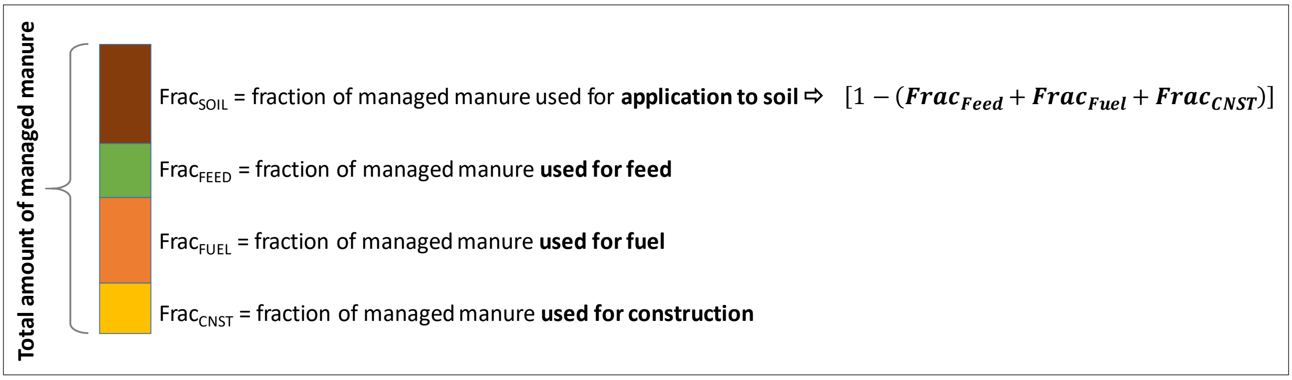


Figure 5-18 Fraction of of managed animal manure used for different purposes.

Data for $Frac_{FUEL}$, $Frac_{FEED}$, $Frac_{CNST}$ was not available therefore N_{MMS_Avb} was used as F_{AM} without adjusting for $Frac_{FUEL}$, $Frac_{FEED}$, $Frac_{CNST}$, which is also proposed by 2006 IPCC GL**Error! Bookmark not defined.**.

Finally, the managed manure nitrogen available for

- (a) application to managed soils,
- (b) for use in feed, fuel, or construction purposes (assumed be 0)

is estimated according to Equation 10.34 of Vol. 4 of 2006 IPCC GL[180].

Equation 10.34: Managed manure N available for application to managed soils, feed, fuel or construction uses (2006 IPCC GL, Vol. 4, Chap. 10.5.4)

$$N_{NMS\_Avb} = \sum_{S}\left\{\sum_{(T)}\left[\left[\left(N_{(T)} \times Nex_{(T)} \times MS_{(T,S)}\right) \times \left(1 - \frac{Frac_{LossMS}}{100}\right)\right] + \left[N_{(T)} \times MS_{(T,S)} \times N_{beddingMS}\right]\right]\right\}$$

Where:

$NMMS_{\_Avb}$	= amount of managed manure nitrogen available for application to managed soils or for feed, fuel, or construction purposes (kg N yr^{-1})
$N_{(T)}$	= number of head of livestock species/category T
$Nex_{(T)}$	= annual average N excretion per animal of species/category T (kg N $animal^{-1}$ $^{yr-1}$)
$MS_{(T,S)}$	= fraction of total annual nitrogen excretion for each livestock species/category T that is managed in manure management system S, dimensionless
$Frac_{LossMS}$	= amount of managed manure nitrogen for livestock category T that is lost in the manure management system S (%)
$N_{beddingMS}$	= amount of nitrogen from bedding (to be applied for solid storage and deep bedding MMS if known organic bedding usage) (kg N animal-1 $^{yr-1}$)
S	= manure management system
T	= species/category of livestock

Data used for estimation the amount of managed manure nitrogen available for application to managed soils or for feed, fuel, or construction purposes were already used in other categories of CRT sector *Agriculture* and presented front sections.

$N_{(T)}$ - Number of head of livestock species/category T

The activity data are the same as used in category 3.A Enteric Fermentation and 3.B Manure Management.

$Nex_{(T)}$ - Annual average N excretion per animal of species/category T

The annual average N excretion per animal of species/category T ($Nex_{(T)}$) is calculated with Equation 10.30 of 2006 IPCC GL[181], presented in Table 5-24.

$MS_{(T,S)}$ - fraction of total annual nitrogen excretion for each livestock species/category T that is managed in manure management system S

The fraction of total annual nitrogen excretion for each livestock species/category T that is managed in manure management system S is defined in Table 5-16 and is presented in Table 5-17.

$Frac_{LossMS}$ - amount of managed manure nitrogen for livestock category T that is lost in the manure management systems

Default values for total nitrogen loss from manure management was taken from Table 10.23 of 2006 IPCC GL[182] and are presented in the following table. These default values include losses that occur from the point of excretion, including animal housing losses, manure storage losses, and losses from leaching and runoff at the manure storage system where applicable.

Table 5-32 Default values for nitrogen loss due to volatilization of NH_3 and NO_x from manure management

Animal type	Manure management system (MMS)	Total N loss from MMS ($Frac_{LossMS}$)
Dairy Cow	Liquid/Slurry	40%
	Solid storage	40%
	Daily spread	22%
Poultry	Poultry without litter	55%
	Poultry with litter	50%
Other Cattle	Solid storage	50%
	Deep bedding	40%
Other (includes sheep, horses, and fur-bearing animals)	Deep bedding	35%
	Solid storage	15%

Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chapter 10: Emissions from Livestock and Manure Management, sub-chapter 10.5.5 Uncertainty assessment, Table 10.22: Default values for nitrogen loss due to volatilization of NH_3 and NO_x from manure management, p. 10.67.

$N_{beddingMS}$ - amount of nitrogen from bedding

Bedding materials vary greatly and are depending on the characteristics of bedding material used in their livestock industries. Due to lack of data in this inventory cycle, it was assumed that this manure management did not exist in the country. See also planned improvements.

[181] Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chapter 10: Emissions from Livestock and Manure Management, sub-chapter 10.5.2 Choice of emission factors, p. 10.57.

[182] Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chapter 10: Emissions from Livestock and Manure Management, sub-chapter 10.5.5 Uncertainty assessment, Table 10.23 Default values for total nitrogen loss from manure management. P. 10.67.

F_{SEW} - Annual amount of total sewage N that is applied to soils

The annual amount of total sewage sludge applied to soil depends on the sewage practices which is quite different between rural and urban regions. Information about the amount of sewage sludge and related N content was not available. Therefore, this source of nitrogen was not estimated. (See also planned improvements in chapter **Error! Reference source not found.**.)

N_2O emissions from wastewater treatment is entirely estimated in Chapter 7.5.

Double counting is therefore excluded.

F_{COMP} - Annual amount of total compost N applied to soil

The annual amount of compost applied to soils depends on the composting activities within the country. However, information about amount of compost applied to soil and related N content was not available. Therefore, this source of nitrogen was not estimated. (See also planned improvement)

N_2O Emissions from biological treatment is entirely estimated in Chapter 7.3.

Double counting is therefore excluded.

F_{OOA} - annual amount of other organic amendments used as fertiliser

No information about the amount of other organic amendments (e.g., rendering waste, guano, brewery waste, etc.) used as fertilizer was not available. Therefore, this source of nitrogen was not estimated. (See also planned improvement).

5.5.2.1.2.3 AD and calculation for N Input from annual amount of N in crop residues (F_{CR})

Activity data, parameter and emission calculation for N Input from annual amount of *N in crop residues, including N-fixing crops, and from forage/pasture renewal, returned to soils (F_{CR})*

The term F_{CR} refers to the amount of N in crop residues (above-ground and below-ground), including N-fixing crops, returned to soils annually. It also includes the N from N-fixing and non-N-fixing forages mineralised during forage or pasture renewal. It is estimated from crop yield statistics and default factors for above-/ belowground residue: yield ratios and residue N contents.

Equation 11.6: N from crop residues and forage/pasture renewal (TIER 1)
2006 IPCC GL, Vol. 4, Chap. 11.2.1.3)

$$F_{CR} = \sum_{T}\{Crop_{(T)} \times Frac_{Renew(T)} \times \left[\left(Area_{(T)} - Area_{\,burnt\,(T)} \times C_F\right) \times R_{AG(T)} \times N_{AG(T)} \times \left(1 - Frac_{Remove(T)}\right) + Area_{(T)} - R_{BG(T)} \times N_{BG(T)}\right]\}$$

As no country specific data were available the recommended alternative approach was applied for estimating the amount of N in crop residues (above-ground and below-ground), including N-fixing crops, returned to soils annually.

Equation 11.7A: N from crop residues and forage/pasture renewal (TIER 1)
Alternative approach to estimate F_{CR} (using Table 11.2)
2006 IPCC GL, Vol. 4, Chap. 11.2.1.3

$$F_{CR} = \sum_{T}\{Frac_{Renew(T)} \times \left[\left(Area_{(T)} - Area_{\,burnt\,(T)} \times C_F\right) \times AG_{DM(T)} \times 1000 \times N_{AG(T)} \times \left(1 - Frac_{Remove(T)}\right) + Area_{(T)} \times \left(AG_{DM(T)} \times 1000 + Crop_{(T)}\right) \times R_{BG-BIO(T)} \times N_{BG(T)}\right]\}$$

Where:

F_{CR} = annual amount of N in crop residues (above and below ground), including N-fixing crops, and from forage/pasture renewal, returned to soils annually (kg N yr^{-1})

$Crop_{(T)}$ = harvested annual dry matter yield for crop T (kg d.m. ha-1)

$Area_{(T)}$ = total annual area harvested of crop T (ha $^{yr-1}$)

Area burnt $_{(T)}$ = annual area of crop T burnt (ha $^{yr-1}$)

C_f = combustion factor (dimensionless)

referred to 2006 IPCC GL, Vol. 4, Chapter 2, Table 2.6

$AG_{DM(T)}$ = above-ground residue dry matter (Mg/ha)

see equation below

$N_{AG(T)}$ = N content of above-ground residues for crop T (kg N (kg d.m.) $^{-1}$;

*see **Error! Reference source not found.** which is based on Table 11.2 of 2006 IPCC GL, Vol. 4, Chapter 11*

$Frac_{Remove(T)}$ = fraction of above-ground residues of crop T removed annually for purposes such as feed, bedding and construction, kg N (kg crop-N)$^{-1}$.

No data for $Frac_{Remove}$ were available, thus no removal is assumed.

$R_{BG\text{-}BIO(T)}$ = Ratio of belowground residues to above-ground biomass (kg d.m. (kg d.m.)$^{-1}$) by the ratio of total above-ground biomass to crop yield.

See *Table 11.2 of 2006 IPCC GL, Vol. 4, Chapter 11*

$N_{BG(T)}$ = N content of below-ground residues for crop T (kg N (kg d.m.)$^{-1}$)

See Table 11.2 of 2006 IPCC GL, Vol. 4, Chapter 11

T = crop or forage type: wheat, potatoes, beans, etc.

The term $AG_{DM(T)}$ refers to the above-ground residue dry matter and is calculated according to the following equation.

Equation for calculation of the above-ground residue dry matter ($AG_{DM(T)}$)
2006 IPCC GL, Vol. 4, Chap. 11.2.1.3, Table 11.2)

$$AG_{DM(T)} = \frac{Crop_{(T)}}{1000} \times\ slope_{(T)} \times +intercept_{(T)}$$

The yield statistics for all crops are reported as fresh weight, a correction factor needs to be applied to estimate dry matter yields ($Crop_{(T)}$) following the Equation 11.7 of 2006 IPCC GL, Vol. 4, Chap. 11. The default values for dry matter content given in the following tables and were taken from Table 11.2 of 2006 IPCC GL, Vol. 4, Chap. 11. may be used.

Equation 11.7: Dry-weight correction of reported crop yields
(2006 IPCC GL, Vol. 4, Chap. 11.2.1.3)

$$Crop_{(T)} =\ Yield\ Fresh_{(T)} \times DRY$$

Where:

$Crop_{(T)}$ = harvested dry matter yield for crop T (kg d.m. ha^{-1})

$Yield\_Fresh_{(T)}$ = harvested fresh yield for crop T (kg fresh weight ha^{-1})

DRY = dry matter fraction of harvested crop T (kg d.m. (kg fresh weight)-^{1})

Default factors for estimation of N added to soils from crop residues:

- Dry matter fraction of harvested product (DRY)
- Above-ground residue dry matter AG_{DM}(T)
- AGDM(T) = (Crop(T)/1000)*
- slope(T) +
- intercept(T)
- N content of above-ground residues (NAG)
- Ratio of below- ground residues to above-ground biomass (RBG-BIO)
- N content of below-ground residues (NBG)

With the Equation 11.1.a (see also above in 5.5.2.1.1 Choice of methods) and the Equation for conversion N_2O-N tot N_2O the N_2O emissions from N inputs to managed soils

Annual direct N_2O–N emissions from N inputs to managed soils (2006 IPCC GL, Vol. 4, Chap. 11)[175]

$$\boldsymbol{N_2O - N_{N\ inputs}} = [[(\boldsymbol{F_{CR}}) \times \boldsymbol{EF_1}] + [(\boldsymbol{F_{CR}})_{\boldsymbol{FR}} \times \boldsymbol{EF_{1FR}}]] \quad \textbf{(11.1.a)}$$

$$\boldsymbol{N_2O\ emissions_{direct}} = \boldsymbol{N_2O - N} \times \frac{\mathbf{44}}{\mathbf{28}}$$

5.5.2.1.2.4 AD and calculation for N Input from *Mineralised N (F_{SOM})*

Activity data, parameter and emission calculation for N Input from *Mineralised N resulting from loss of soil organic C stocks in mineral soils through land-use change or management practices (F_{SOM})*

The term F_{SOM} refers to the amount of N mineralised from loss in soil organic C in mineral soils through land use change or management practices.

According to 2006 IPCC GL, Vol. 4, Chap. 2[183], land-use change and a variety of management practices can have a significant impact on soil organic C storage. Organic C and N are intimately linked in soil organic matter. Where soil C is lost through oxidation as a result of land-use or management change, this loss will be accompanied by a simultaneous mineralisation of N. Where a loss of soil C occurs, this mineralised N is regarded as an additional source of N available for conversion to N_2O; just as mineral N released from decomposition of crop residues, for example, becomes a source.

For estimating changes and release in N supply from mineralisation due to land use change, where soil C losses occur (as calculated in 2006 IPCC GL, Vol. 4, Chap 2, Equation 2.25[184]), the Tier 1 method can be applied in 3 steps:

[183] 2006 IPCC GL, Vol. 4 AFOLU, Chap 2 Generic Methodologies Applicable to Multiple Land-Use Categories, Section 2.3.3 Change in carbon stocks in soils. Page 2.28

[184] 2006 IPCC GL, Vol. 4 AFOLU, Chap 2 Generic Methodologies Applicable to Multiple Land-Use Categories, Section 2.3.3.1 Soil C estimation methods. Equation 2.25 Annual change in organic carbon stocks in mineral soils. Page 2.30.

Step 1: Calculate the average annual loss of soil C ($\Delta C_{Mineral, LU}$) for the area, over the inventory period, using Equation 2.25. Using the Tier 1 approach, the value for $\Delta C_{Mineral, LU}$ will have a single value for all land-uses and management systems.

Equation 2.24 Annual change in organic carbon stocks in mineral soils[184]

(2006 IPCC GL, Vol. 4, Chap. 2)

$$\Delta C_{\text{Mineral}} = \frac{SOC_0 - SOC_{(0-T)}}{D}$$

with

$$SOC = \sum_{c,s,i} \left(SOC_{REFc,s,i} \times F_{LUc,s,i} \times F_{MGc,s,i} \times F_{Ic,s,i} \times A_{c,s,i} \right)$$

Where:

$\Delta C_{Mineral}$ = annual change in carbon stocks in mineral soils (tonnes C $^{yr-1}$)

SOC_0 = soil organic carbon stock in the last year of an inventory time period (tonnes C)

$SOC_{(0-T)}$ = soil organic carbon stock at the beginning of the inventory time period (tonnes C)

SOC_0 and $SOC_{(0-T)}$ are calculated using the SOC equation in the box where the reference carbon stocks and stock change factors are assigned according to the land-use and management activities and corresponding areas at each of the points in time (time = 0 and time = 0-T)

T = number of years over a single inventory time period, yr

D = Time dependence of stock change factors which is the default time period for transition between equilibrium SOC values, yr. Commonly 20 years, but depends on assumptions made in computing the factors FLU, FMG and FI. If T exceeds D, use the value for T to obtain an annual rate of change over the inventory time period (0-T years).

c = represents the climate zones, s the soil types, and i the set of management systems that are present.

SOC_{REF} = the reference carbon stock (tonnes C ha-1)

F_{LU} = stock change factor for land-use systems or sub-system for a particular land-use, dimensionless

F_{MG} = stock change factor for management regime, dimensionless

F_I = stock change factor for input of organic matter, dimensionless

A = land area of the stratum being estimated (ha)

Step 2: Estimate the N mineralised as a consequence of this loss of soil C (F_{SOM}), using Equation 11.8[185]:

Equation 11.8 N mineralized in mineral soils as a result of loss of soil c through change in land use or management (TIER1)

(2006 IPCC GL, Vol. 4, Chap. 11)

$$F_{\text{SOM}} = \sum_{LU} \left[\left(\Delta C_{\text{Mineral,LU}} \times \frac{1}{R} \right) \times 1000 \right]$$

Where:

F_{SOM} = the net annual amount of N mineralised in mineral soils as a result of loss of soil carbon through change in land use or management, kg N

$\Delta C_{Mineral, LU}$ = average annual loss of soil carbon for each land-use type (LU), tonnes C

Note: for Tier 1, $\Delta C_{mineral, LU}$ will have a single value for all land-uses and management systems.

R = C:N ratio of the soil organic matter.

[185] Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chapter 11: N_2O Emissions from Managed Soils, and CO_2 Emissions from Lime and Urea Application, sub-chap 11.2.1.3 Choice of activity data. Equation 11.8, Page 11.16.

A default value of 15 for the C:N ratio (R) may be used for situations involving land-use change from Forest Land or Grassland to Cropland, in the absence of more specific data for the area.

A default value of 10 may be used for situations involving management changes on Cropland Remaining Cropland. C:N ratio can change over time, land use, or management practice.

LU = land-use and/or management system type

Step 3: For Tier 1, the value for F_{SOM} is calculated in a single step.

In the following table is presented the exemplary calculation of direct N_2O emissions from managed soils (TIER 1) due to mineralised N resulting from loss of soil organic C stocks in mineral soils through land-use change or management practices (F_{SOM}).

Table 5-33 Exemplary calculation of direct N_2O emissions from managed soils (TIER 1) due to mineralised N resulting from loss of soil organic C stocks in mineral soils through land-use change or management practices (F_{SOM})

Parameter	Parameter description	Unit	Formula	Parameter Source	2022
A_1	Perennials converted to annual crops	kha	-	From calculation in sector LULUCF	NE
SOC_0	Soil C after 20 years of LUC	t C/ha	-		NE
$SOC_{(0-T)}$	Soil C stock before LUC	t C/ha	-		NE
A_2	Annual croplands converted to perennials	kha	-		NE
SOC_0	Soil C after 20 years of LUC	t C/ha	-		NE
$SOC_{(0-T)}$	Soil C stock before LUC	t C/ha	-		NE
$\Delta C_{Mineral\ LUC-1}$	Net carbon stock change in soils	t C	$\Delta C_{mineral,\ LU}$ = (SOC_0 - $SOC_{(0-T)}$) / D	Equation 2.25, Chap. 2.3.3.1, Vol. 4, 2006 IPCC GL, p. 2.29	NE
$\Delta C_{Mineral\ LUC-2}$	Net carbon stock change in soils	t C	$\Delta C_{mineral,\ LU}$ = (SOC_0 - $SOC_{(0-T)}$) / D		NE
sum					NE
R	C:N ratio of soil organic matter			Explanation to Equation 11.8, Chap. 11.2.1.3, Vol. 4, 2006 IPCC GL, p. 11.16	10
F_{SOM}	Annual amount of N mineralised in mineral soils	kg N	($\Delta C_{mineral,\ LU}$ * 1/R) * 1000	Equation 11.8, Chap. 11.2.1.3, Vol. 4, 2006 IPCC GL, p. 11.16	NE
EF_1 - N_2O-N	Emission Factor - N_2O-N	kg N_2O-N/kg N	-	Table. 11.1, Chap. 11, Vol. 4, 2006 IPCC GL, p. 11.11 See also Table 5-30	0.01
N_2O-N	N_2O-N emissions	Gg	F_{SOM}*EF1	Equation 11.1, Chap. 11, Vol. 4, 2006 IPCC GL, p. 11.7	NE
N_2O	N_2O emissions	Gg	N_2O - N*44/28	Equation for conversion, Chap. 11, Vol. 4, 2006 IPCC GL, page 11.10	NE
N_2O	Method	-	-	-	T1
N_2O	EF used	-	-	-	D

5.5.2.1.2.5 AD and calculation for N Input from area of drained/managed organic soils (F_{OS})

Activity data, parameter and emission calculation for *N Input from area of drained/managed organic soils (FOS)*

The term F_{OS} refers to the total annual area (ha) of drained/managed organic soils (see footnote 4 for definition). This definition is applicable for both the Tier 1 and Tier 2 methods. For all land uses, the areas should be stratified by climate zone (temperate and tropical). In addition, for temperate Forest Land the areas should be further stratified by soil fertility (nutrient rich and nutrient poor). The area of drained/managed organic soils (FOS) may be collected from official national statistics. Alternatively, total areas of organic soils from each country are available from FAO (http://faostat.fao.org/), and expert advice may be used to estimate areas that are drained/managed. For Forest Land, national data will be available at soil survey organisations and from wetland surveys, e.g., for international conventions. In case no stratification by soil fertility is possible, countries may rely on expert judgment.

For this inventory cycle no information and data regarding cultivation of organic soils were available.

5.5.2.1.2.6 AD and calculation for N Input from Urine and dung from grazing animals (F_{PRP})

Activity data, parameter and emission calculation for *N Input from Urine and dung from grazing animals (FPRP)*

The term F_{PRP} refers to the annual amount of N deposited on pasture, range and paddock soils by grazing animals. It is important to note that the N from managed animal manure applied to soils is included in the F_{AM} term of F_{ON}. The annual amount of N deposited on pasture, range and paddock F_{PRP} is estimated using Equation 11.5 from 2006 IPCC GL, Volume 4, Chapter 11.

Equation 11.5: N in urine and dung deposited by grazing animals on pasture, range and paddock (PRP) (TIER 1) (2006 IPCC GL, Vol. 4, Chap. 11.2.1.3)

$$\boldsymbol{F_{PRP}} = \sum_{\boldsymbol{T}} \left[\left(\boldsymbol{N_{(T)}} \times \boldsymbol{Nex_{(T)}} \right) \times \boldsymbol{MS_{(T,PRP)}} \right]$$

Where:

F_{PRP} = annual amount of urine and dung N deposited on pasture, range, paddock (PRP) and by grazing animals (kg N yr^{-1})

$N_{(T)}$ = number of head of livestock species/category T

$Nex_{(T)}$ = annual average N excretion per head of species/category T (kg N animal-1 $^{yr-1}$)

$MS_{(T,PRP)}$ = fraction of total annual N excretion for each livestock species/category T that is deposited on pasture, range and paddock (PRP).

Data used for estimation the annual amount of urine and dung N deposited on pasture, range, paddock (PRP) and by grazing animals are already used in other categories of CRT sector *Agriculture* and presented above.

$N_{(T)}$ - Number of head of livestock species/category T

The activity data are the same as used in category 3.A Enteric Fermentation and 3.B Manure Management.

$Nex_{(T)}$ - Annual average N excretion per animal of species/category T

The annual average N excretion per animal of species/category T ($Nex_{(T)}$) is calculated with Equation 10.30 of 2006 IPCC GL[186], presented in Table 5-24.

[186] Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chapter 10: Emissions from Livestock and Manure Management, sub-chapter 10.5.2 Choice of

$MS_{(T,PRP)}$ - fraction of total annual N excretion for each livestock species/category T that is deposited on pasture, range and paddock (PRP)

The fraction of total annual N excretion for each livestock species/category T that is deposited on pasture, range and paddock (PRP) is defined in Table 5-16 and is presented in Table 5-17.

With the Equation 11.1.a (see also above in 5.5.2.1.1 Choice of methods) and the Equation for conversion N_2O-N tot N_2O the N_2O emissions from N inputs to managed soils

Annual direct N_2O–N emissions from N inputs to managed soils (2006 IPCC GL, Vol. 4, Chap. 11)

$$\boldsymbol{N_2O - N_{N\ inputs}} = [[(\boldsymbol{F_{PRP}}) \times \boldsymbol{EF_1}] + [(\boldsymbol{F_{PRP}})_{\boldsymbol{FR}} \times \boldsymbol{EF_{1FR}}]] \qquad \textbf{(11.1.a)}$$

$$\boldsymbol{N_2O\ emissions_{direct}} = \boldsymbol{N_2O - N} \times \frac{\boldsymbol{44}}{\boldsymbol{28}}$$

5.5.2.1.3 Uncertainties and time-series consistency for CRT category 3.D.a Direct N_2O emissions

The uncertainties for activity data and emission factors used for CRT category 3.D Agricultural soils are presented in the following table.

Table 5-34 Uncertainty for CRT category 3.D.a Direct N_2O emissions

Uncertainty	CH_4	N_2O	N_2O	Reference
				2006 IPCC GL, Vol. 4, Chap. 10
Activity data	NA	20%	NA	Chapter 11.2.1.4
Emission factor (direct emission)		250%		Chapter 10.4.4
Combined Uncertainty		254%		

5.5.3 Indirect N_2O emissions from managed soils (CRT category 3.D.b)

3.D.b	**Indirect N_2O Emissions from managed soils**	
3.D.b.1	Atmospheric deposition	Volatilized N from agricultural inputs of N
3.D.b.2	Nitrogen leaching and run-off	N from fertilizers and other agricultural inputs that is lost through leaching and run-off

In addition to the direct emissions of N_2O from managed soils, emissions of N_2O also take place through two indirect pathways.

emission factors, p. 10.57.

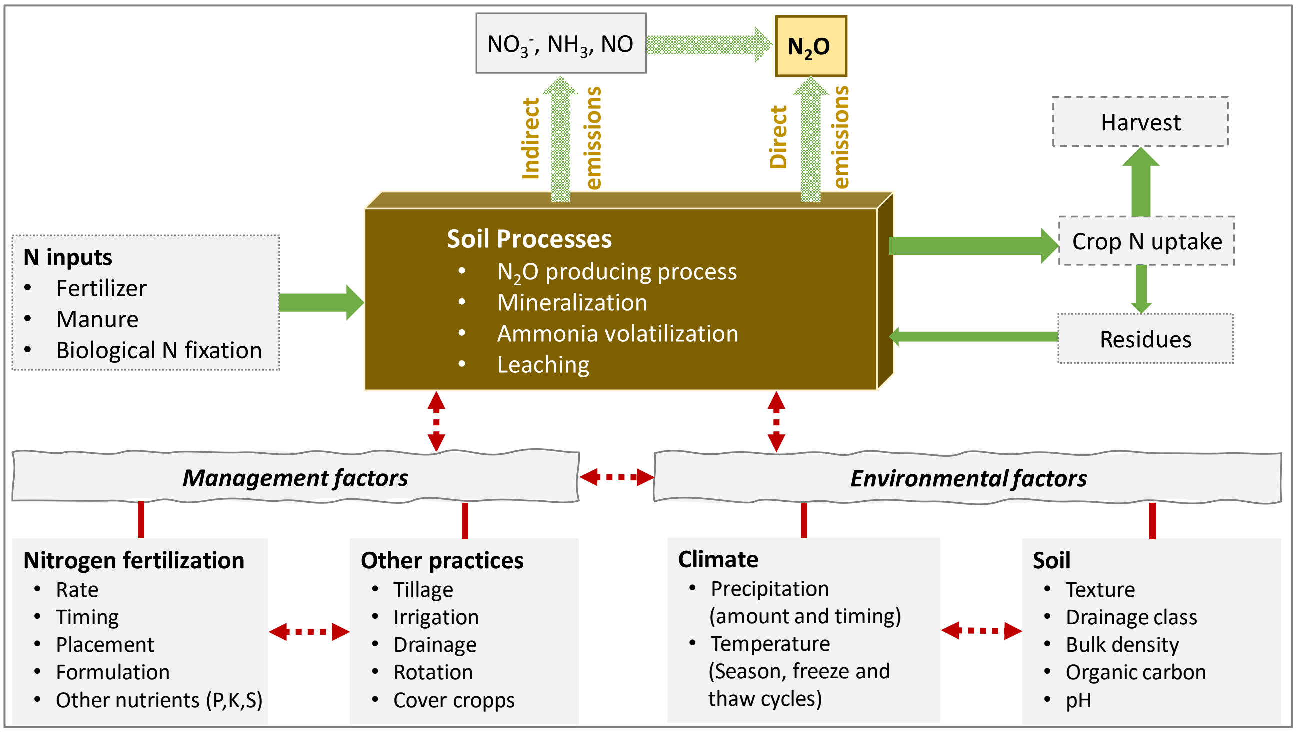


Figure 5-19 Factors influencing direct and indirect emissions of N_2O from agricultural soils

Source: WATTIAUX, M. A.; PAS, UDDIN, M. E. ; LETELIER, P., JACKSON, R. D. & LARSON, R. A. (2019): Emission and mitigation of greenhouse gases from dairy farms: The cow, the manure, and the field. In: Applied Animal Science 35:238–254. Sustainability and Integrated Systems. https://doi.org/10.15232/aas.2018-01803
Available on 29.04.2019 at: https://www.researchgate.net/publication/331916870_Invited_Review_Emission_and_mitigation_of_greenhouse_gases_from_dairy_farms_The_cow_the_manure_and_the_field

The first pathways is the volatilisation of N as NH_3 and oxides of N (NO_x), and the deposition of these gases and their products NH_4^+ and NO_3^- onto soils and the surface of lakes and other waters (see also Figure 5-19). As described in the 2006 IPCC GL, Vol. 4, Chapter 11.2.2 the sources of N as NH_3 and NO_x are not confined to agricultural fertilisers and manures, but also include fossil fuel combustion, biomass burning, and processes in the chemical industry. Thus, these processes cause N_2O emissions in an exactly analogous way to those resulting from deposition of agriculturally derived NH_3 and NO_x, following the application of synthetic and organic N fertilizers and /or urine and dung deposition from grazing animals (see also Figure 5-14).

The second pathway is the leaching and runoff from land of N from synthetic and organic fertilizer additions, crop residues, mineralization of N associated with loss of soil C in mineral and drained/managed organic soils through land-use change or management practices, and urine and dung deposition from grazing animals. As described in the 2006 IPCC GL, Vol. 4, Chapter 11.2.2 some of the inorganic N in or on the soil, mainly in the NO_3^- form, may bypass biological retention mechanisms in the soil/vegetation system by transport in overland water flow (runoff) and/or flow through soil macropores or pipe drains. Where NO_3^- is present in the soil in excess of biological demand, e.g., under cattle urine patches, the excess leaches through the soil profile. The nitrification and denitrification processes described at the beginning of this chapter transform some of the NH_4^+ and NO_3^- to N_2O. This may take place in the groundwater below the land to which the N was applied, or in riparian zones receiving drain or runoff water, or in the ditches, streams, rivers and estuaries (and their sediments) into which the land drainage water eventually flows.

Thus, agricultural nitrogen (N) sources of indirect N_2O emissions from managed soils arise from

- synthetic N fertilizers (F_{SN});

- organic N applied as fertilizer (e.g., applied animal manure, compost, sewage sludge, rendering waste and other organic amendments) (F_{ON});
- urine and dung N deposited on pasture, range and paddock by grazing animals (F_{PRP});
- N in crop residues (above- and below-ground), including N-fixing crops and forage/pasture renewal returned to soils (F_{CR}); and
- N mineralization associated with loss of soil organic matter resulting from change of land use or management on mineral soils (F_{SOM}).

5.5.3.1 Methodological issues

5.5.3.1.1 Choice of methods

TIER 1 approach - $N_2O_{(ATD)}$ Volatilization

For estimating the N_2O emissions from atmospheric deposition of N volatilized from managed the 2006 IPCC Guidelines Tier 1 approach[187] has been applied.

Equation 11.9: N_2O from atmospheric deposition of N volatilized from managed soils (TIER 1)

(2006 IPCC GL, Vol. 4, Chap. 11)

$$\boldsymbol{N_2O_{(ATD)} - N = \left[(F_{SN} \times Frac_{GASF}) + \left((F_{ON} \times Frac_{PRP}) \times Frac_{GASF}\right)\right] \times EF_4}$$

Where:

$N_2O_{(ATD)}$–N = annual amount of N_2O–N produced from atmospheric deposition of N volatilized from managed soils (kg N_2O–N yr^{-1})

F_{SN} = annual amount of synthetic fertiliser N applied to soils (kg N yr^{-1})

$Frac_{GASF}$ = fraction of synthetic fertiliser N that volatilises as NH3 and NOx (kg N volatilized (kg of N applied)$^{-1}$)

F_{ON} = annual amount of managed animal manure, compost, sewage sludge and other organic N additions applied to soils (kg N yr^{-1})

F_{PRP} = annual amount of urine and dung N deposited by grazing animals on pasture, range and paddock (kg N yr-1)

$Frac_{GASM}$ = fraction of applied organic N fertiliser materials (FON) and of urine and dung N deposited by grazing animals (FPRP) that volatilises as NH3 and NOx (kg N volatilized (kg of N applied or deposited)$^{-1}$) (Table 11.3)

EF_4 = emission factor for N_2O emissions from atmospheric deposition of N on soils and water surfaces ([kg N–N_2O (kg NH3–N + NOx–N volatilized)$^{-1}$])

Conversion of $N_2O_{(ATD)}$-N emissions to N_2O emissions for reporting purposes is performed by using the following equation:

Equation 11.10: Indirect N_2O emissions due to volatilization of N from manure management

$$\boldsymbol{N_2O_{(ATD)} = N_2O_{(ATD)} - N \times \frac{44}{28}}$$

Where:

$N_2O_{(ATD)}$ = indirect N_2O emissions due to volatilization of N from Manure Management (kg N_2O)

$N_2O_{(ATD)}$–N = annual amount of N_2O–N produced from atmospheric deposition of N volatilized from managed soils (kg N_2O–N yr^{-1})

44/28 = conversion of kg N_2O-N into kg N_2O.

[187] Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chap. 11, sub-chap. 11.2.2.1 Choice of method

TIER 1 approach - $N_2O_{(L)}$ Leaching/Runoff

For estimating the N_2O emissions from leaching and runoff in regions where leaching and runoff occurs the 2006 IPCC Guidelines Tier 1 approach[188] has been applied.

Equation 11.10: N_2O from N leaching/runoff from managed soils in regions where leaching/runoff occurs (TIER 1)

(2006 IPCC GL, Vol. 4, Chap. 11)

$$N_2O_{(L)} - N = (F_{SN} + F_{ON} + F_{PRP} + F_{CR} + F_{SOM}) \times Frac_{LEACH-(H)} \times EF_5$$

Where:

$N_2O_{(L)}$–N = annual amount of N_2O–N produced from leaching and runoff of N additions to managed soils in regions where leaching/runoff occurs (kg N_2O–N yr-1)

F_{SN} = annual amount of synthetic fertilizer N applied to soils in regions where leaching/runoff occurs (kg N yr-1)

F_{ON} = annual amount of managed animal manure, compost, sewage sludge and other organic N additions applied to soils in regions where leaching/runoff occurs (kg N yr-1)

F_{PRP} = annual amount of urine and dung N deposited by grazing animals in regions where leaching/runoff occurs (kg N yr-1)

from Equation 11.5, page 11.13, Chap. 11.2.1.3 Choice of activity data, Vol. 4 of 2006 IPCC GL

F_{CR} = amount of N in crop residues (above- and below-ground), including N-fixing crops, and from forage/pasture renewal, returned to soils annually in regions where leaching/runoff occurs (kg N yr-1)

F_{SOM} = annual amount of N mineralized in mineral soils associated with loss of soil C from soil organic matter as a result of changes to land use or management in regions where leaching/runoff occurs (kg N yr-1)

from Equation 11.8, page 11.16, Chap. 11.2.1.3 Choice of activity data, Vol. 4 of 2006 IPCC GL

$Frac_{LEACH-(H)}$ = fraction of all N added to/mineralized in managed soils in regions where leaching/runoff occurs that is lost through leaching and runoff (kg N (kg of N additions)-1)

from Table 11.3, page 11.23, Chap. 11.2.2.3 Choice of activity data, Vol. 4 of 2006 IPCC GL and presented in Table 5-35

EF_5 = emission factor for N_2O emissions from N leaching and runoff (kg N_2O–N (kg N leached & runoff)$^{-1}$)

from Table 11.3, page 11.23, Chap. 11.2.2.3 Choice of activity data, Vol. 4 of 2006 IPCC GL and presented in Table 5-35 in

Conversion of $N_2O_{(L)}$-N emissions to N_2O emissions for reporting purposes is performed by using the following equation:

Equation 11.10: Indirect N_2O emissions due to volatilization of N from manure management

$$N_2O_{(AL)} = N_2O_{(L)} - N \times \frac{44}{28}$$

Where:

$N_2O_{(L)}$ = indirect N_2O emissions due to leaching and runoff of N additions to managed soils in regions where leaching/runoff occurs (kg N_2O)

$N_2O_{(L)}$–N = annual amount of N_2O–N produced from leaching and runoff of N additions to managed soils in regions where leaching/runoff occurs (kg N_2O–N yr^{-1})

44/28 = conversion of kg N_2O-N into kg N_2O.

[188] Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chap. 11, sub-chap. 11.2.2.1 Choice of method

5.5.3.1.2 Choice of emission, volatilization and leaching factors

The method for estimating indirect N_2O emissions includes two emission factors:

- associated with volatilised and re-deposited N (EF_4),
- associated with N lost through leaching/runoff (EF_5).

The method also requires values for the fractions of N that are lost through volatilisation ($Frac_{GASF}$ and $Frac_{GASM}$) or leaching/runoff ($Frac_{LEACH-(H)}$).

As no country specific emission factors and values for the fractions of N that are lost were available, default emission factors and parameter were used.

Table 5-35 Default emission, volatilization and leaching factors for indirect soil N_2O emissions

Factor	Description	Unit	Default value
EF_4	N volatilisation and re-deposition	kg N_2O–N / (kg NH3–N + NOX–N volatilised)	0.010
EF_5	leaching/runoff	kg N_2O–N / (kg N leaching/runoff)	0.0075
$Frac_{GASF}$	Volatilization from synthetic fertilizer	(kg NH3–N + NOx–N) / (kg N applied)	0.10
$Frac_{GASM}$	Volatilization from all organic N fertilizers applied , and dung and urine deposited by grazing animals	(kg NH3–N + NOx–N) / (kg N applied or deposited)	0.20
$Frac_{LEACH-(H)}$	N losses by leaching/runoff for regions where ∑ (rain in rainy season) - ∑ (PE in same period) > soil water holding capacity, OR where irrigation (except drip irrigation) is employed	kg N / (kg N additions or deposition by grazing animals)	0.30
	N losses by leaching/runoff for dryland regions where precipitation is lower than evapotranspiration throughout most of the year and leaching is unlikely to occur		0

Source: 2006 IPCC GL, Vol. 4, Chap. 11, sub-chap. 11.2.2.3, Choice of activity data, Table 11.3, page 11.23

5.5.3.1.3 Choice of activity data

In order to estimate indirect N_2O emissions from the various N additions to managed soils, the parameters F_{SN}, F_{ON}, F_{PRP}, F_{CR}, F_{SOM} need to be estimated. These parameters are already described in Chapter 5.5.2.1.2 of this report described.

Applied synthetic fertiliser (F_{SN})

The term F_{SN} refers to the annual amount of synthetic fertiliser N applied to soils.

Relevant information is provided in Chapter 5.5.2.1.2.1 of this report.

Applied organic N fertilisers (F_{ON})

The term FON refers to the amount of organic N fertiliser materials intentionally applied to soils.

Relevant information is provided in Chapter 5.5.2.1.2.15.5.2.1.2.20 of this report.

Urine and dung from grazing animals (F_{PRP})

The term F_{PRP} refers to the amount of N deposited on soil by animals grazing on pasture, range and paddock.

Relevant information is provided in Chapter 5.5.2.1.2.6 of this report.

Crop residue N, including N from N-fixing crops and forage/pasture renewal, returned to soils (F_{CR})

The term FCR refers to the amount of N in crop residues (above- and below-ground), including N-fixing crops, returned to soils annually. It also includes the N from N-fixing and non-N-fixing forages mineralised during forage/pasture renewal.

Relevant information is provided in Chapter 5.5.2.1.2.1 of this report.

Mineralised N resulting from loss of soil organic C stocks in mineral soils (F_{SOM})

The term F_{SOM} refers to the amount of N mineralised from the loss of soil organic C in mineral soils through land-use change or management practices.

Relevant information is provided in Chapter 5.5.2.1.2.4 of this report.

5.5.4 Uncertainties and time-series consistency for CRT category 3.D Agricultural soils

The uncertainties for activity data and emission factors used for CRT category 3.D Agricultural soils are presented in the following table.

Table 5-36 Uncertainty for CRT category 3.D Agricultural soils.

Uncertainty		**N_2O**	**Reference**
			2006 IPCC GL, Vol. 4, Chap. 11
Activity data			
$Frac_{loss}$	amount of managed manure nitrogen for livestock category that is lost in the manure management system	20%	Table 10.32 p 10.67
F_{sn}	activity data on synthetic fertilizer	20%	Expert judgment
F_{cr}	activity data crop residues	20%	Expert judgment
EF_1	N_2O emission factor for soils	250%	Table 11.1, page 11.11
EF_{PRP}	emission factor N deposited by grazing animals on pasture, range and paddock	200%	Table 11.1 page 11.11
EF_4	N volatilization and re-deposition	50%	Table 11.1 page 11.11
Combined Uncertainty		326%	$U_{Total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

5.5.5 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed out:

⇒ Checked of calculations by spreadsheets
- consistent use of livestock data (statistical yearbook and FAOstat- Live Animals),
- consistent use of data on area and yield of crops (statistical yearbook and FAOstat- crops),
- documented sources,
- use of units,
- strictly defined interfaces between spreadsheets/calculation modules,
- unique structure of sheets which do the same,
- record keeping, use of write protection,
- unique use of formulas, special cases are documented/highlighted,
- quick-control checks for data consistency through all steps of calculation.

⇒ cross-checked of different sources: national statistic (INSTAT) and international statistics (FAO) and EUROSTAT

⇒ cross checks with other relevant sectors are performed to avoid double counting or omissions;

⇒ consistency and completeness checks are performed;

⇒ time series consistency - plausibility checks of dips and jumps.

5.5.6 Category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends

The following table presents the main revisions and recalculations done since the last submission (NC & BUR) to the UNFCCC and relevant to CRT category 3.D Agricultural soils.

Table 5-37 Recalculations done since NC & BUR in CRT category 3.D Agricultural soils

GHG source & sink category	Revisions of data NC / BUR ⇒ submission 2020	Type of revision	Type of improvement
3.D	Application of • 2019 refinements to the 2006 IPCC Guidelines, and • EMEP/EEA air pollutant emission inventory guidebook 2019	AD EF EMI	Accuracy

5.5.7 Category-specific planned improvements including tracking of those identified in the review process

Considering the potential contribution of identified improvements in the total GHG emissions and the corresponding resources needed to make these improvements effective, developments presented in following table will be explored.

Table 5-38 Planned improvements for CRT category 3.D Agricultural soils

GHG source & sink category	Planned improvement	Type of improvement		Priority
3.D	F_{SN} – National statistical data on annual amount of synthetic fertilizer consumption applied to soils. • amount and type (fertilizers by product and/or nutrient) of annual amount of applied/consumed synthetic fertilizer	AD	Accuracy Consistency Transparency	high
3.D	F_{ON} - annual amount of animal manure, compost, sewage sludge and other organic N additions applied to soils. • amount of animal manure and N content, • amount of compost and N content, • amount of sewage sludge and N content (cross-check with Waste Sector to ensure there is no double counting), • annual amount of other organic amendments used as fertiliser (e.g., rendering waste, guano, brewery waste, etc.) and N content	AD	Accuracy Consistency Transparency	high
3.D	(1) $Area_{(T)}$ - Total annual area harvested of crops (types) (2) $Yield_{\_Fresh(T)}$ - Harvested fresh yield for crop T (3) Area burnt $_{(T)}$ - annual area of crop T burned (4) Dry matter (d.m.) fraction (DRY) • grains: e.g. wheat (split in winter and summer harvest), barley, oats, rice, rye, millet, maize (corn), sorghum, spelt, teff, (wild) rice, etc. • beans & pulses: e.g. beans, lentils, peas, etc. • tubers: e.g. (sweet) potato, yam, cassava, sweet lupins, etc.	AD	Accuracy Consistency Transparency	high

GHG source & sink category	Planned improvement	Type of improvement		Priority
	• root crops: beets-roots, sugar beet, pigweed, sunflower, mustard, carrots, etc. • N-fixing forages • Non-N-fixing forages • Perennial grasses • Grass-clover mixtures			
3.D	SOC_0 - soil organic carbon stock in the last year of an inventory time period (tonnes C) $SOC_{(0-T)}$ - soil organic carbon stock at the beginning of the inventory time period (tonnes C) *See Planned Improvements for LULUCF*	AD	Accuracy Transparency Consistency Comparability Completeness	medium
3.D	(1) number of head of livestock species/category T fraction of total annual N excretion for each livestock (2) species/category T that is deposited on pasture, range and paddock (PRP) (3) annual average N excretion per head of species/category T	AD	Accuracy Consistency	High
3.D	To collect Crop production data for 3.D.1.d Crop residues emission estimatio	AD	Accuracy Completeness	High

5.6 Prescribed burning of savannas (CRT category 3.E)

GHG emission from CRT category 3.E *Prescribed burning of savannas* were not estimated due to lack of detailed information and resources. However, according to national experts prescribed fires and wildfires occurs occasionally in Albania.

GHG emissions from this sector comprise emissions from the following categories:

IPCC code	description	CO_2		CH_4		N_2O	
		Estimated	Key Category	estimated	Key category	estimated	Key category
3.E	Prescribed burning of savannas	NA	-	NO	-	NO	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential							
LA – Level Assessment (in year); TA – Trend Assessment							

The CRT category 3.E *Prescribed burning of savannas* does not exist in Albania.

5.7 Field burning of agricultural residues (CRT category 3.F)

Crop residue burning, which is a kind of biomass burning, are sometimes burned, for convenience and as a means of disease control through residue removals. As described in the *2006 IPCC Guidelines Volume 4, Chapter 5.2.4,* CH_4 and N_2O emissions from *Cropland* are usually associated with burning of agriculture residues, which vary by crop and management system. Field burning of agricultural residues emits CH_4 and N_2O. CO_2 emissions from biomass burning do not have to be reported, since the carbon released during the combustion process is assumed to be reabsorbed by the vegetation during the next growing season.

This chapter includes information on and description of methodologies used for estimating GHG emissions as well as references to activity data and emission factors reported under CRT category *Field burning of agricultural residues* for the period 1990 to 2022.

Emission calculations of this category are planed for the next reporting cycle.

5.8 Liming (CRT category 3.G)

This section the estimation of CO_2 emission from liming. In general liming is used to reduce soil acidity and improve plant growth in managed systems, particularly agricultural lands and managed forests. The adding of carbonates to soils in the form of lime (e.g., calcic limestone ($CaCO_3$), or dolomite ($CaMg(CO_3)_2$) leads to CO_2 emissions as the carbonate limes dissolve and release bicarbonate ($2HCO_3^-$), which evolves into CO_2 and water (H_2O) (IPCC 2006).

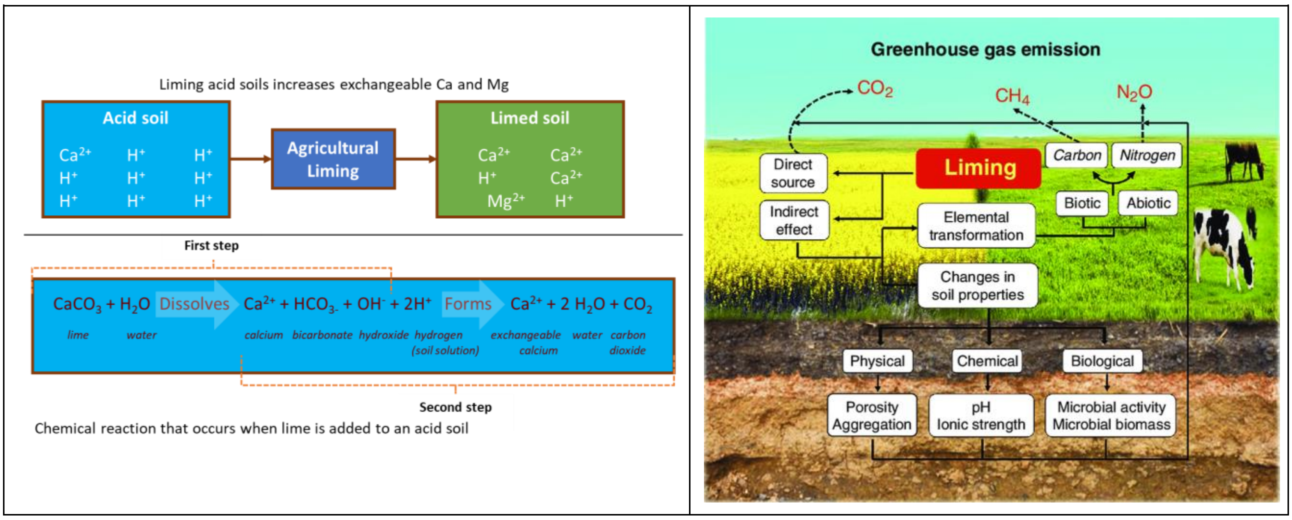


Figure 5-20 Conceptual flow diagram showing the effect of liming on greenhouse gases

Source (left Figure): Ritchey, E.L.; Murdock, L.W.; Ditsch, D. and McGrath, J.M. (2016): Agricultural Lime Recommendations Based on Lime Quality. In: Plant and Soil Sciences; F.J. Sikora, Division of Regulatory Services. In: Cooperative extension service university of Kentucky College of Agriculture, food and environment, Lexington, KY, 40546. ID-163.

Source (right Figure): Kunhikrishnan, A.; Thangarajan, R. ; Bolan, N.S.; Xu, Y.; Mandal, S.; Gleeson, D.B.; Seshadri, B.; Zaman; M.; Barton; L.; Tang; C.; Luo; J.; Dalal; R.; Ding; W.; Kirkham; M.B.; Naidu; R. (2016): Functional Relationships of Soil Acidification, Liming, and Greenhouse Gas Flux. In: Advances in Agronomy. Volume 139, 2016, Pages 1-71.

5.8.1 Source category description

IPCC code	description	CO_2		CH_4		N_2O	
		Estimated	Key Category	estimated	Key category	estimated	Key category
3.G	**Liming**	NE	-	NA	-	NA	-

A '✓' indicates: emissions from this sub-category have been estimated.
Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential

LA – Level Assessment (in year); TA – Trend Assessment

Due to lack of activity data emission calculations are not provided in this Inventory cycle.

5.9 Urea application (CRT category 3.H)

This chapter includes information on and description of methodologies used for estimating GHG emissions as well as references to activity data and emission factors reported under CRT category *Urea application*.

As described in the 2006 IPCC GL, Col. 4, Chap. 11, adding urea to soils during fertilisation leads to a loss of CO_2 that was fixed in the industrial production process. Urea ($CO(NH_2)_2$) is converted into ammonium (NH_4^+), hydroxyl ion (OH^-), and bicarbonate (HCO_3^-), in the presence of water and urease enzymes. Similar to the soil reaction following addition of lime, bicarbonate that is formed evolves into CO_2 and water.

(1) $CO(NH_2)_2 + 2H_2O \xrightarrow{\text{Urease enzyme}} (NH_4)_2CO_3$

Urea Water Ammonium carbonate

(2) $NH_4)_2CO_3 + 2H^+ \longrightarrow 2NH_4 + CO_2\uparrow + 2H_2O$

Ammonium carbonate Ammonium Carbon dioxide Water

(3) $NH_4 + OH^+ \longrightarrow Ca(NO_3)_2 + H_2O$

Ammonium Hydroxide Ammonia Water

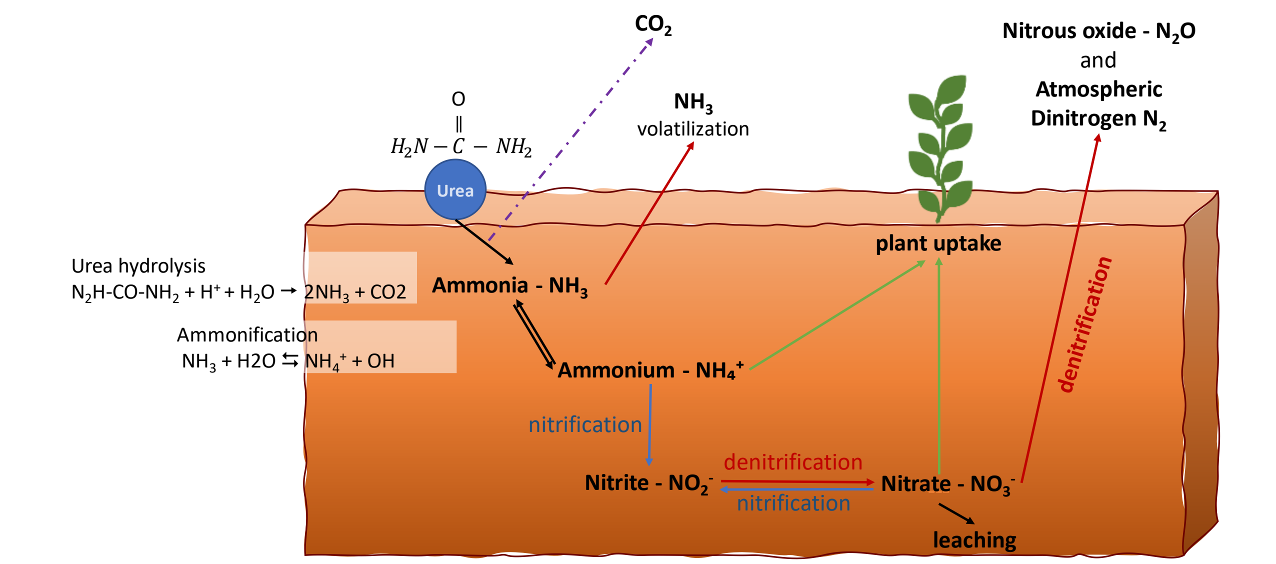


Figure 5-21 Urea hydrolysis reaction (equation)

This source category is included because the CO_2 removal from the atmosphere during urea manufacturing is estimated in the CRT sector *Industrial Processes and Product Use Sector (IPPU).*

5.9.1 Source category description

GHG emissions from this sector comprise emissions from the following categories:

IPCC code	description	CO_2		CH_4		N_2O	
		Estimated	Key Category	estimated	Key category	estimated	Key category
3.H	**Urea application**	✓	-	NA	-	NA	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential							
LA – Level Assessment (in year); TA – Trend Assessment							

5.9.2 Methodological issues

5.9.2.1 Choice of methods

TIER 1 approach

For estimating the CO_2 emissions from urea application, the 2006 IPCC Guidelines Tier 1 approach[189] has been applied.

Equation 11.13: CO_2 emissions from urea application
(2006 IPCC GL, Vol. 4, Chap. 11)

$$CO_2 - C\ emission = AD \times EF$$

$$CO_2\ emissions = \frac{CO_2O - C \times \frac{44}{12}}{1000}$$

Where:

CO_2 emission	= annual CO_2 emissions from urea application (Gg)
CO_2–C emission	= annual C emissions from urea application (tonnes C)
AD	= annual amount of urea fertilisation (tonnes urea)
EF	= emission factor (tonne of C / tonne of urea)
44/12	= conversion factor from C to CO_2

5.9.2.2 Choice of activity data

The agricultural data used and presented in this inventory are taken from national and international sources:

- INSTAT
- FAO agricultural data base[190]

The annual amount of urea in used CRT sector Agriculture is determined by national production, import and export, as well as ‘other uses of urea’.

Agricultural use of Urea **=** Pproduction **+** Iimport **–** Export **–** Other Uses of Urea

5.9.2.3 Choice of emission factors

The default emission factor was taken from IPCC 2006 Guidelines and presented in presented in the following table.

Table 5-39 CO_2 Emission factor TIER 1 for CRT category 3.H Urea application

	EF CO_2-C (t of carbon/t of urea)			Source
	Method	EF	type	
Urea application	T1	0.20	D	2006 IPCC Guidelines, Volume 4: AFOLU, Chapter 11 - N_2O Emissions from Managed Soils, and CO_2 Emissions from Lime and Urea Application, sub-chap. 11.4.2, page 11.34.

Note:
D Default CS Country specific PS Plant specific IEF Implied emission factor

[189] Source: 2006 IPCC Guidelines, Volume 4: AFOLU, Chapter 11 - N_2O Emissions from Managed Soils, and CO_2 Emissions from Lime and Urea Application, sub-chap. 11.4.1, page 11.32.

[190] https://www.fao.org/faostat/en/#data/RFB

5.9.3 Uncertainties and time-series consistency for CRT category 3.D Urea application

The uncertainties for activity data and emission factors used for CRT category 3.D Urea application are presented in the following table.

Table 5-40 Uncertainty for CRT category 3.D Urea application.

Uncertainty	CO_2	CH_4	N_2O	Reference
Activity data (AD)	10%	NA	NA	Table 2.15 and Table 3.1, 2006 IPCC GL, Vol. 2, Chap. 2 (2.4.2)
Emission factor (EF)	50%	NA	NA	Chapter 11.4.4, 2006 IPCC GL, Vol. 4, Chap. 11
Combined Uncertainty	51%	NA	NA	$U_{Total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

5.9.4 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed out:

⇒ Checked of calculations by spreadsheets
  - documented sources,
  - use of units,
  - strictly defined interfaces between spreadsheets/calculation modules,
  - unique structure of sheets which do the same,
  - record keeping, use of write protection,
  - unique use of formulas, special cases are documented/highlighted,
  - quick-control checks for data consistency through all steps of calculation.

⇒ cross-checked from different sources: national statistic (INSTAT) and international statistics (FAO)

⇒ time series consistency - plausibility checks of dips and jumps.

5.9.5 Category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends

The following table presents the main revisions and recalculations done since the last submission to the UNFCCC and relevant to CRT category 3.H *Urea application*.

Table 5-41 Recalculations done since last submission CRT category 3.H *Urea application*

GHG source & sink category	Revisions	Type of revision	Type of improvement
3.H	recalculation were performed due to update of Activity data	-	-

5.9.6 Category-specific planned improvements including tracking of those identified in the review process

Considering the potential contribution of identified improvements in the total GHG emissions and the corresponding resources needed to make these improvements effective, developments presented in following table will be explored.

Table 5-42 Planned improvements for CRT category 3.H *Urea application*

GHG source & sink category	Planned improvement	Type of improvement		Priority
3.H	Detailed cross-check of national data and international data (FAO, Eurostat)	AD	Transparency Consistency Comparability	High
3.H	Improvement of description of activity data	AD	Transparency	medium

5.10 Other carbon-containing fertilizers (CRT category 3.I)

GHG emissions from this sector comprise emissions from the following categories:

IPCC code	description	CO_2		CH_4		N_2O	
		Estimated	Key Category	estimated	Key category	estimated	Key category
3.I	Other carbon-containing fertilizers	NO	-	NA	-	NA	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential							
LA – Level Assessment (in year); TA – Trend Assessment							

The CRT category 3.I *Other carbon-containing fertilizers* does not exist in Albania.

5.11 Other (CRT category 3.J)

GHG emissions from this sector comprise emissions from the following categories:

IPCC code	description	CO_2		CH_4		N_2O	
		Estimated	Key Category	estimated	Key category	estimated	Key category
3.J	Other	NO	-	NA	-	NA	-
A '✓' indicates: emissions from this sub-category have been estimated. Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential							
LA – Level Assessment (in year); TA – Trend Assessment							

The CRT category 3.J *Other* does not exist in Albania.

6 Land Use, Land Use Change and Forestry (LULUCF) (CRT sector 4)

6.1 Sector Overview

7 Waste (CRT sector 5)

7.1 Overview of sector

This chapter includes information on and description of methodologies used for estimating GHG emissions, as well as references to activity data and emission factors reported under CRT sector *5 – Waste* for the period 1990 to 2021. In the Waste sector emissions of CO_2, CH_4 and N_2O originate from the IPCC categories:

- 5.A *Solid waste disposal*,
- 5.B *Biological treatment of solid waste*,
- 5.C *Incineration and open burning of waste*,
- 5.D Wastewater treatment *and* discharge.

7.1.1 Emission trends

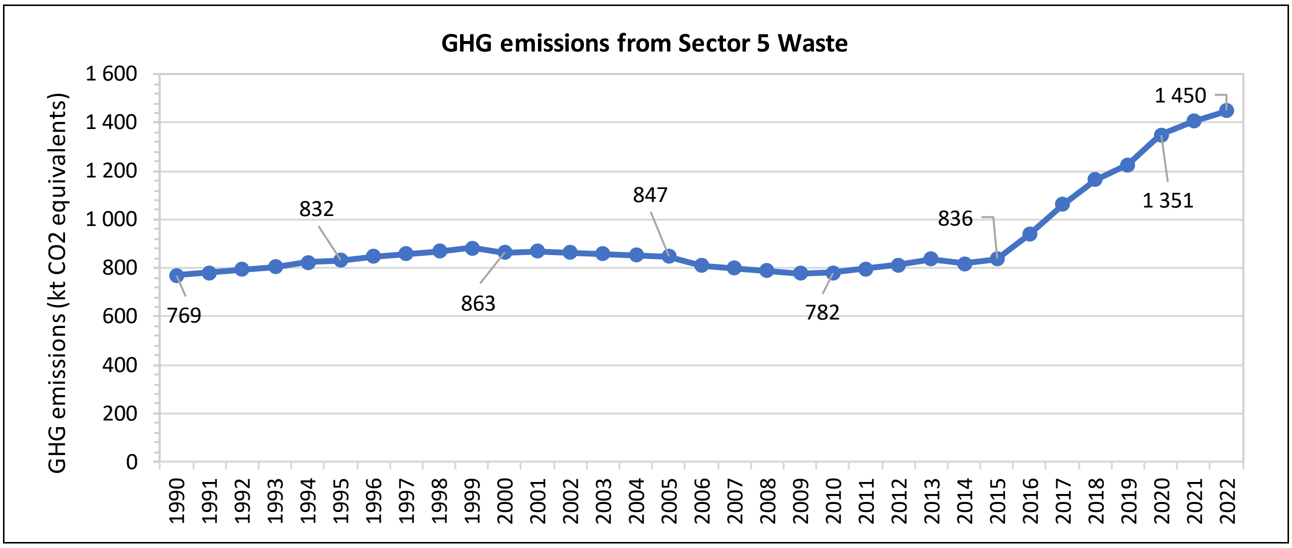


Figure 7-1 Trend of GHG emission of CRT sector 5 Waste for the period 1990 – 2022

In 2022, GHG emissions from CRT sector 5 *Waste* amounted to 1,450.17kt CO_2 equivalent, which correspond to ##% of total national emissions. In the period 1990 to 2022 GHG emissions from the CRT sector 5 *Waste* increased by 88.5% from 769.14 kt CO_2 eq in 1990 due to increasing landfilling activities (CRT category 5.A *Solid waste disposal*) as a result of decreasing population but significant growing waste generation rates. Also, the reduction of illegal disposal (sites) or open burning results in increasing landfilling. In the same period GHG emissions from the CRT category 5.D *Wastewater treatment and discharge* decreased due to decreasing number of population connected to sewage systems without treatment.

The most important categories of *Waste* are *solid waste disposal* followed by *wastewater treatment and discharge*. The most important greenhouse gas is CH_4.

Emissions from the categories 5.B *Biological Treatment of Solid Waste* was not estimated due to lack of data.

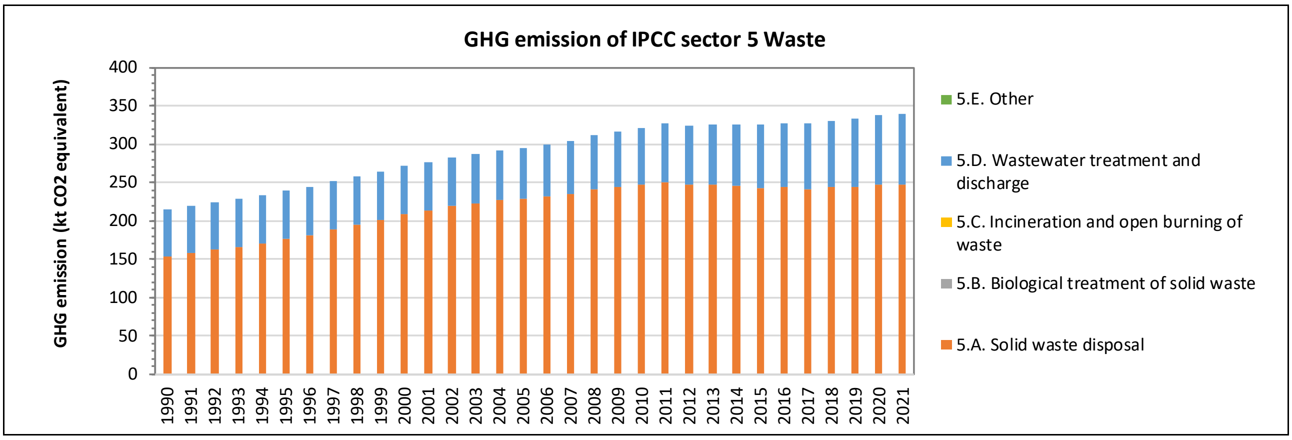


Figure 7-2 Trend of GHG emission of CRT sector 5 Waste by category for the period 1990 – 2022

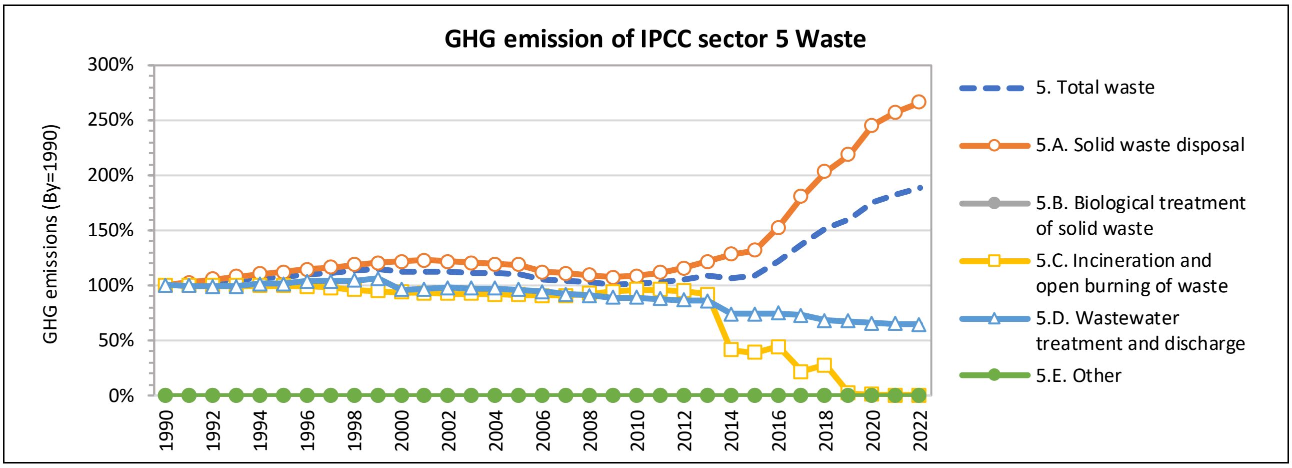


Figure 7-3 Trend of emissions from CRT sector 5 waste in index form (base year = 100) by category

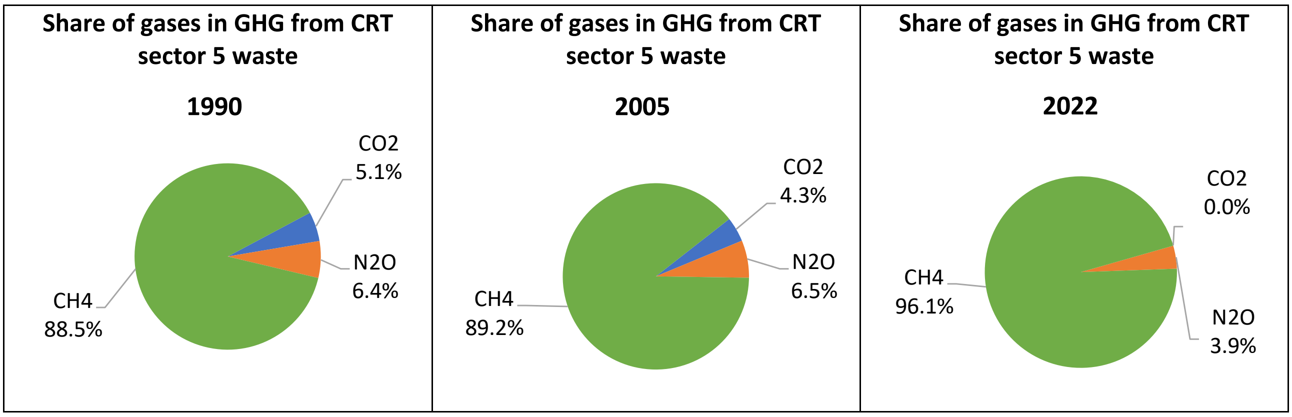


Figure 7-4 Share of gases in GHG from CRT sector 5 waste

Table 7-1 Emissions from CRT sector 5 Waste by gas

	TOTAL GHG	CO_2	CH_4	N_2O
	kt CO_2 equivalent	kt	kt	kt
1990	769.14	39.26	24.31	0.19
1991	780.46	39.24	24.71	0.19
1992	792.98	39.21	25.07	0.20
1993	805.74	39.18	25.47	0.20
1994	822.76	39.14	25.95	0.22
1995	831.90	39.10	26.35	0.21
1996	847.37	39.05	26.79	0.22
1997	857.50	38.55	27.26	0.21
1998	869.91	38.07	27.72	0.21
1999	881.83	37.60	28.07	0.22
2000	862.80	37.14	27.63	0.20
2001	869.07	36.99	27.82	0.20
2002	865.30	36.85	27.60	0.21
2003	859.40	36.70	27.44	0.20
2004	854.22	36.56	27.28	0.20
2005	847.13	36.42	26.99	0.21
2006	809.65	36.28	25.68	0.21
2007	798.98	36.15	25.32	0.20
2008	789.24	36.76	24.88	0.21
2009	777.86	37.35	24.45	0.21
2010	781.62	37.91	24.45	0.22
2011	796.10	37.99	24.93	0.23
2012	813.10	37.67	25.54	0.23
2013	837.83	36.52	26.46	0.23
2014	818.72	16.32	26.63	0.21
2015	836.23	15.44	27.27	0.22
2016	939.28	17.69	30.83	0.22
2017	1 061.42	8.74	35.55	0.22
2018	1 163.47	10.86	39.14	0.21
2019	1 226.69	0.85	41.77	0.21
2020	1 350.53	0.42	46.27	0.21
2021	1 407.33	0.01	48.25	0.21
2022	1 450.17	0.02	49.78	0.21
Trend				
1990 - 2022	*88.5%*	*-99.9%*	*104.7%*	*14.6%*
2005 - 2022	*71.2%*	*-99.9%*	*84.5%*	*2.3%*
2021 - 2022	*3.0%*	*25.5%*	*3.2%*	*0.0%*

Table 7-2 Total GHG Emissions from CRT sector Waste for the period 1990 - 2022

GHG emissions	5	5.A	5.B	5.C	5.D	5.E
	TOTAL Waste	Solid Waste Disposal	Biological Treatment of Solid Waste	Incineration and Open Burning of Waste	Wastewater Treatment and Discharge	Other
	kt CO_2 equivalent					
1990	769.14	486.99	NO	46.07	236.07	NO
1991	780.46	499.66	NO	46.04	234.76	NO
1992	792.98	513.77	NO	46.00	233.20	NO
1993	805.74	526.38	NO	45.96	233.40	NO
1994	822.76	536.68	NO	45.90	240.18	NO
1995	831.90	546.09	NO	45.84	239.97	NO
1996	847.37	556.53	NO	45.78	245.07	NO
1997	857.50	567.29	NO	45.08	245.12	NO
1998	869.91	578.48	NO	44.41	247.02	NO
1999	881.83	587.20	NO	43.76	250.87	NO
2000	862.80	593.46	NO	43.13	226.21	NO
2001	869.07	597.28	NO	42.92	228.87	NO
2002	865.30	591.53	NO	42.72	231.04	NO
2003	859.40	586.63	NO	42.52	230.24	NO
2004	854.22	582.18	NO	42.33	229.72	NO
2005	847.13	577.95	NO	42.13	227.05	NO
2006	809.65	545.21	NO	41.94	222.51	NO
2007	798.98	539.83	NO	41.75	217.40	NO
2008	789.24	531.73	NO	42.60	214.92	NO
2009	777.86	523.99	NO	43.41	210.46	NO
2010	781.62	527.80	NO	44.18	209.63	NO
2011	796.10	544.31	NO	44.30	207.49	NO
2012	813.10	564.24	NO	43.85	205.01	NO
2013	837.83	593.00	NO	42.26	202.57	NO
2014	818.72	625.27	NO	18.95	174.49	NO
2015	836.23	643.24	NO	17.93	175.06	NO
2016	939.28	742.60	NO	20.52	176.17	NO
2017	1 061.42	878.67	NO	10.12	172.63	NO
2018	1 163.47	990.30	NO	12.66	160.51	NO
2019	1 226.69	1 065.60	NO	0.98	160.11	NO
2020	1 350.53	1 195.36	NO	0.49	154.68	NO
2021	1 407.33	1 253.28	NO	0.01	154.03	NO
2022	1 450.17	1 297.81	NO	0.02	152.34	NO
Trend						
1990 - 2022	*88.5%*	*166.5%*	*NA*	*-99.9%*	*-35.5%*	*NA*
2005 - 2022	*71.2%*	*124.6%*	*NA*	*-99.9%*	*-32.9%*	*NA*
2021 - 2022	*3.0%*	*3.6%*	*NA*	*25.5%*	*-1.1%*	*NA*

Table 7-3 CH_4 Emissions from CRT sector 5 Waste for the period 1990 - 2022

CH_4 emissions	5	5.A	5.B	5.C	5.D	5.E
	TOTAL Waste	Solid Waste Disposal	Biological Treatment of Solid Waste	Incineration and Open Burning of Waste	Wastewater Treatment and Discharge	Other
	kt					
1990	24.31	17.39	NE	0.013	6.91	NO
1991	24.71	17.85	NE	0.013	6.85	NO
1992	25.07	18.35	NE	0.013	6.71	NO
1993	25.47	18.80	NE	0.013	6.66	NO
1994	25.95	19.17	NE	0.013	6.77	NO
1995	26.35	19.50	NE	0.013	6.83	NO
1996	26.79	19.88	NE	0.013	6.90	NO
1997	27.26	20.26	NE	0.013	6.99	NO
1998	27.72	20.66	NE	0.012	7.05	NO
1999	28.07	20.97	NE	0.012	7.09	NO
2000	27.63	21.19	NE	0.011	6.43	NO
2001	27.82	21.33	NE	0.011	6.48	NO
2002	27.60	21.13	NE	0.011	6.47	NO
2003	27.44	20.95	NE	0.011	6.48	NO
2004	27.28	20.79	NE	0.010	6.48	NO
2005	26.99	20.64	NE	0.010	6.34	NO
2006	25.68	19.47	NE	0.010	6.20	NO
2007	25.32	19.28	NE	0.010	6.03	NO
2008	24.88	18.99	NE	0.011	5.87	NO
2009	24.45	18.71	NE	0.011	5.73	NO
2010	24.45	18.85	NE	0.012	5.59	NO
2011	24.93	19.44	NE	0.012	5.48	NO
2012	25.54	20.15	NE	0.012	5.37	NO
2013	26.46	21.18	NE	0.010	5.27	NO
2014	26.63	22.33	NE	0.005	4.30	NO
2015	27.27	22.97	NE	0.004	4.29	NO
2016	30.83	26.52	NE	0.005	4.30	NO
2017	35.55	31.38	NE	0.002	4.17	NO
2018	39.14	35.37	NE	0.003	3.77	NO
2019	41.77	38.06	NE	<0.001	3.71	NO
2020	46.27	42.69	NE	<0.001	3.58	NO
2021	48.25	44.76	NE	NO	3.49	NO
2022	49.78	46.35	NE	NO	3.43	NO
Trend						
1990 - 2022	*104.7%*	*166.5%*	*NA*	*NA*	*-50.3%*	*NA*
2005 - 2022	*84.5%*	*124.6%*	*NA*	*NA*	*-45.9%*	*NA*
2021 - 2022	*3.2%*	*3.6%*	*NA*	*NA*	*-1.7%*	*NA*

Table 7-4 Total N_2O Emissions from CRT sector Waste for the period 1990 – 2022

N_2O emissions	5	5.A	5.B	5.C	5.D	5.E
	TOTAL Waste	Solid Waste Disposal	Biological Treatment of Solid Waste	Incineration and Open Burning of Waste	Wastewater Treatment and Discharge	Other
	kt					
1990	0.19	NA	NE	0.02	0.16	NO
1991	0.19	NA	NE	0.02	0.16	NO
1992	0.20	NA	NE	0.02	0.17	NO
1993	0.20	NA	NE	0.02	0.18	NO
1994	0.22	NA	NE	0.02	0.19	NO
1995	0.21	NA	NE	0.02	0.18	NO
1996	0.22	NA	NE	0.02	0.20	NO
1997	0.21	NA	NE	0.02	0.19	NO
1998	0.21	NA	NE	0.02	0.19	NO
1999	0.22	NA	NE	0.02	0.20	NO
2000	0.20	NA	NE	0.02	0.17	NO
2001	0.20	NA	NE	0.02	0.18	NO
2002	0.21	NA	NE	0.02	0.19	NO
2003	0.20	NA	NE	0.02	0.18	NO
2004	0.20	NA	NE	0.02	0.18	NO
2005	0.21	NA	NE	0.02	0.19	NO
2006	0.21	NA	NE	0.02	0.19	NO
2007	0.20	NA	NE	0.02	0.18	NO
2008	0.21	NA	NE	0.02	0.19	NO
2009	0.21	NA	NE	0.02	0.19	NO
2010	0.22	NA	NE	0.02	0.20	NO
2011	0.23	NA	NE	0.02	0.20	NO
2012	0.23	NA	NE	0.02	0.21	NO
2013	0.23	NA	NE	0.02	0.21	NO
2014	0.21	NA	NE	0.01	0.20	NO
2015	0.22	NA	NE	0.01	0.21	NO
2016	0.22	NA	NE	0.01	0.21	NO
2017	0.22	NA	NE	0.00	0.21	NO
2018	0.21	NA	NE	0.01	0.21	NO
2019	0.21	NA	NE	0.00	0.21	NO
2020	0.21	NA	NE	0.00	0.21	NO
2021	0.21	NA	NE	NE	0.21	NO
2022	0.21	NA	NE	NE	0.21	NO
Trend						
1990 - 2022	*14.6%*	*NA*	*NA*	*NA*	*31.9%*	*NA*
2005 - 2022	*2.3%*	*NA*	*NA*	*NA*	*13.5%*	*NA*
2021 - 2022	*0.0%*	*NA*	*NA*	*NA*	*0.0%*	*NA*

Table 7-5 Total CO_2 Emissions from CRT sector Waste for the period 1990 – 2022

CO_2 emissions	5	5.A	5.B	5.C	5.D	5.E
	TOTAL Waste	Solid Waste Disposal	Biological Treatment of Solid Waste	Incineration and Open Burning of Waste	Wastewater Treatment and Discharge	Other
	kt					
1990	39.26	NA	NA	39.26	NA	NO
1991	39.24	NA	NA	39.24	NA	NO
1992	39.21	NA	NA	39.21	NA	NO
1993	39.18	NA	NA	39.18	NA	NO
1994	39.14	NA	NA	39.14	NA	NO
1995	39.10	NA	NA	39.10	NA	NO
1996	39.05	NA	NA	39.05	NA	NO
1997	38.55	NA	NA	38.55	NA	NO
1998	38.07	NA	NA	38.07	NA	NO
1999	37.60	NA	NA	37.60	NA	NO
2000	37.14	NA	NA	37.14	NA	NO
2001	36.99	NA	NA	36.99	NA	NO
2002	36.85	NA	NA	36.85	NA	NO
2003	36.70	NA	NA	36.70	NA	NO
2004	36.56	NA	NA	36.56	NA	NO
2005	36.42	NA	NA	36.42	NA	NO
2006	36.28	NA	NA	36.28	NA	NO
2007	36.15	NA	NA	36.15	NA	NO
2008	36.76	NA	NA	36.76	NA	NO
2009	37.35	NA	NA	37.35	NA	NO
2010	37.91	NA	NA	37.91	NA	NO
2011	37.99	NA	NA	37.99	NA	NO
2012	37.67	NA	NA	37.67	NA	NO
2013	36.52	NA	NA	36.52	NA	NO
2014	16.32	NA	NA	16.32	NA	NO
2015	15.44	NA	NA	15.44	NA	NO
2016	17.69	NA	NA	17.69	NA	NO
2017	8.74	NA	NA	8.74	NA	NO
2018	10.86	NA	NA	10.86	NA	NO
2019	0.85	NA	NA	0.85	NA	NO
2020	0.42	NA	NA	0.42	NA	NO
2021	0.01	NA	NA	0.01	NA	NO
2022	0.02	NA	NA	0.02	NA	NO
Trend						
1990 - 2022	*-99.9%*	*NA*	*NA*	*-99.9%*	*NA*	*NA*
2005 - 2022	*-99.9%*	*NA*	*NA*	*-99.9%*	*NA*	*NA*
2021 - 2022	*25.5%*	*NA*	*NA*	*25.5%*	*NA*	*NA*

7.1.2 Waste generation in Albania

Please provide some important facts of

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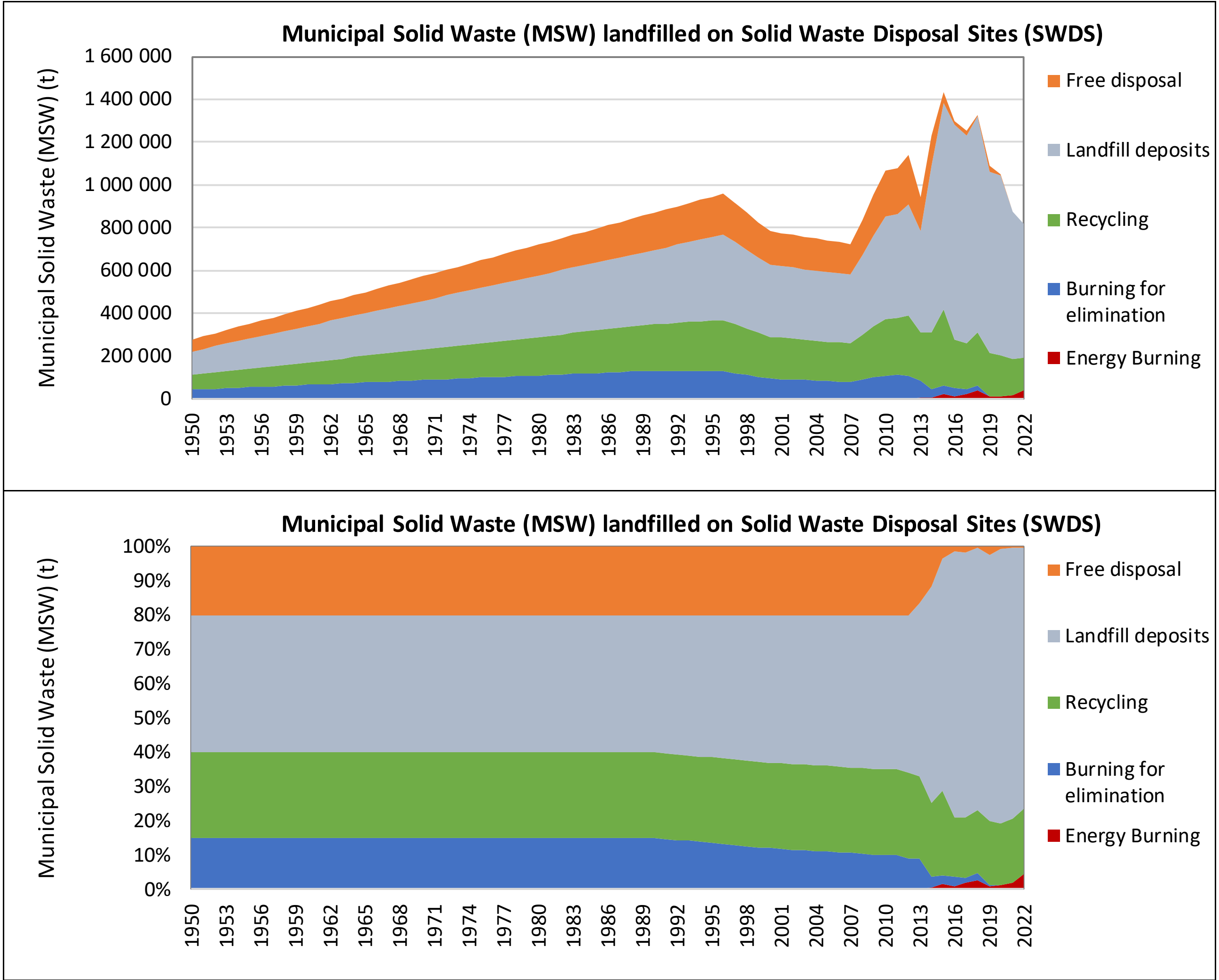


Figure 7-5 Management practices of Municipal solid wastes (MSW) for the period 1990 – 2022

Table 7-6 Municipal solid waste (MSW) landfilled on solid waste disposal sites (SWDS)

	Population	Source	Waste per capita	Source	Total Municipal Solid Waste (MSW)	Source
	capita		kg/cap/y		kt	
1950	1 252 582	UN statistics	220.00	EJ	275 568	Calculated based on Population and Waste per capita
1951	1 289 168		221.57	extrapolation	290 417	
1952	1 326 948		223.13		305 267	
1953	1 366 744		224.70		320 116	
1954	1 409 005		226.26		334 965	
1955	1 453 730		227.83		349 815	
1956	1 500 624		229.39		364 664	
1957	1 549 571		230.96		379 513	
1958	1 600 983		232.52		394 362	

	Population	Source	Waste per capita	Source	Total Municipal Solid Waste (MSW)	Source
	capita		kg/cap/y		kt	
1959	1 655 020		234.09		409 212	
1960	1 583 800		235.65		424 061	
1961	1 633 800		237.22		438 910	
1962	1 685 800		238.78		453 760	
1963	1 736 838		240.35		468 609	
1964	1 788 404		241.91		483 458	
1965	1 839 866		243.48		498 308	
1966	1 889 715		245.04		513 157	
1967	1 939 430		246.61		528 006	
1968	1 991 765		248.17		542 856	
1969	2 052 778		249.74		557 705	
1970	2 110 612	Eurostat	251.30		572 554	
1971	2 160 345		252.87		587 403	
1972	2 215 361		254.43		602 253	
1973	2 270 891		256.00		617 102	
1974	2 322 613		257.57		631 951	
1975	2 377 635		259.13		646 801	
1976	2 432 027		260.70		661 650	
1977	2 485 025		262.26		676 499	
1978	2 542 066		263.83		691 349	
1979	2 590 466		265.39		706 198	
1980	2 645 198		266.96		721 047	
1981	2 698 795		268.52		735 896	
1982	2 753 316		270.09		750 746	
1983	2 815 239		271.65		765 595	
1984	2 872 681		273.22		780 444	
1985	2 936 177		274.78		795 294	
1986	2 993 347		276.35		810 143	Calculated based on Population and Waste per capita
1987	3 051 923		277.91		824 992	
1988	3 115 286		279.48		839 842	
1989	3 169 386		281.04		854 691	
1990	3 286 500		282.61		869 540	
1991	3 259 814		284.17	extrapolation	884 389	
1992	3 190 103	Eurostat	285.74		899 239	
1993	3 167 478		287.30		914 088	
1994	3 220 310		288.87		928 937	
1995	3 248 836		290.43		943 787	
1996	3 283 000		292.00		958 636	
1997	3 324 317		282.88		914 338	
1998	3 354 341		273.75		870 041	

	Population	Source	Waste per capita	Source	Total Municipal Solid Waste (MSW)	Source
	capita		kg/cap/y		kt	
1999	3 373 445		264.63		825 743	
2000	3 058 497		255.50		781 446	
2001	3 063 318	INSTAT	253.63		773 058	
2002	3 057 018		251.75		764 670	
2003	3 044 993		249.88		756 282	
2004	3 034 231		248.01		747 895	
2005	3 019 634		246.13		739 507	
2006	3 003 329		244.26		731 119	
2007	2 981 755		242.38		722 731	
2008	2 958 266		283.26		836 926	
2009	2 936 355		324.13		951 121	
2010	2 918 674		365.00		1 065 316	
2011	2 907 368		371.00		1 078 634	
2012	2 903 008		392.00		1 137 979	
2013	2 897 770		325.00	INSTAT	940 160	INSTAT
2014	2 892 394		425.00		1 228 884	
2015	2 885 796		491.00		1 413 233	
2016	2 875 592		452.00		1 300 373	
2017	2 876 591		436.00		1 253 913	
2018	2 870 324		462.00		1 325 071	
2019	2 862 427		381.00		1 086 692	
2020	2 845 955		369.00		1 047 852	
2021	2 829 741		311.00		875 105	
2022	2 793 592		295.00		820 322	
Trend						
1950-2022	121.8%		34.1%		197.7%	
1990-2022	-15.5%		4.4%		-5.7%	
2005-2022	-8.0%		19.9%		10.9%	
2021-2022	-1.2%		-5.1%		-6.3%	

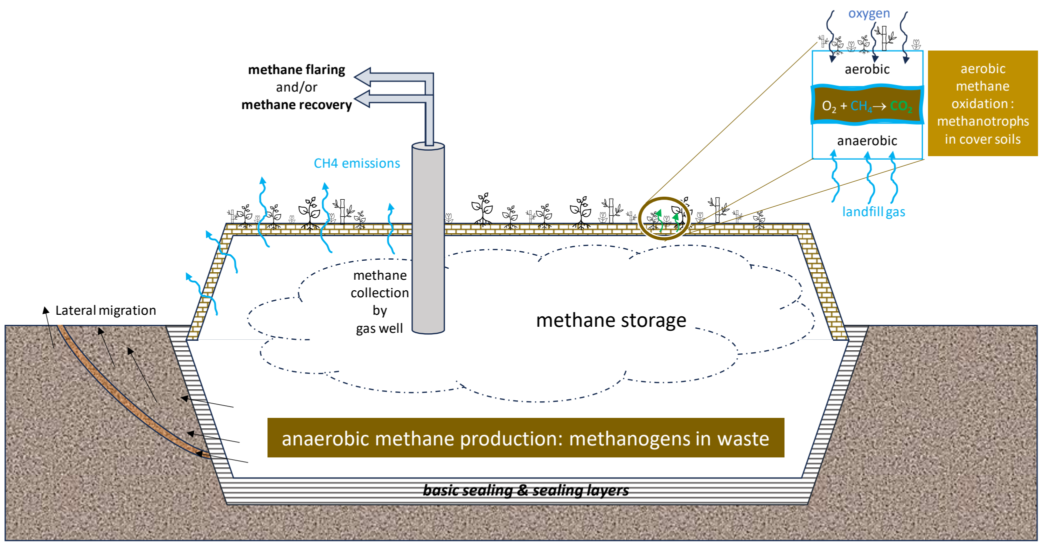
Table 7-7 Management practices of Municipal solid wastes (MSW) for the period 1990 – 2022

	Waste management practices										
	TOTAL	Energy Burning		Burning for elimination		Recycling		Landfill deposits		Free disposal	
	kt	kt	%	kt	%	kt	%	kt	%	kt	%
1950	275.6	NO	*0.0*	41.3	*15.0*	68.9	*25.0*	110.2	*40.0*	55.1	*20.0*
⇩											
1960	424.1	NO	*0.0*	63.6	*15.0*	106.0	*25.0*	169.6	*40.0*	84.8	*20.0*
⇩											
1970	572.6	NO	*0.0*	85.9	*15.0*	143.1	*25.0*	229.0	*40.0*	114.5	*20.0*
⇩											
1980	721.0	NO	*0.0*	108.2	*15.0*	180.3	*25.0*	288.4	*40.0*	144.2	*20.0*
⇩											
1990	869.5	NO	*0.0*	130.4	*15.0*	217.4	*25.0*	347.8	*40.0*	173.9	*20.0*
1991	884.4	NO	*0.0*	130.0	*14.7*	221.1	*25.0*	356.4	*40.3*	176.9	*20.0*
1992	899.2	NO	*0.0*	129.5	*14.4*	224.8	*25.0*	365.1	*40.6*	179.8	*20.0*
1993	914.1	NO	*0.0*	128.9	*14.1*	228.5	*25.0*	373.9	*40.9*	182.8	*20.0*
1994	928.9	NO	*0.0*	128.2	*13.8*	232.2	*25.0*	382.7	*41.2*	185.8	*20.0*
1995	943.8	NO	*0.0*	127.4	*13.5*	235.9	*25.0*	391.7	*41.5*	188.8	*20.0*
1996	958.6	NO	*0.0*	126.5	*13.2*	239.7	*25.0*	400.7	*41.8*	191.7	*20.0*
1997	914.3	NO	*0.0*	117.9	*12.9*	228.6	*25.0*	384.9	*42.1*	182.9	*20.0*
1998	870.0	NO	*0.0*	109.6	*12.6*	217.5	*25.0*	368.9	*42.4*	174.0	*20.0*
1999	825.7	NO	*0.0*	101.6	*12.3*	206.4	*25.0*	352.6	*42.7*	165.1	*20.0*
2000	781.4	NO	*0.0*	93.8	*12.0*	195.4	*25.0*	336.0	*43.0*	156.3	*20.0*
2001	773.1	NO	*0.0*	91.2	*11.8*	193.3	*25.0*	334.0	*43.2*	154.6	*20.0*
2002	764.7	NO	*0.0*	88.7	*11.6*	191.2	*25.0*	331.9	*43.4*	152.9	*20.0*
2003	756.3	NO	*0.0*	86.2	*11.4*	189.1	*25.0*	329.7	*43.6*	151.3	*20.0*
2004	747.9	NO	*0.0*	83.8	*11.2*	187.0	*25.0*	327.6	*43.8*	149.6	*20.0*
2005	739.5	NO	*0.0*	81.3	*11.0*	184.9	*25.0*	325.4	*44.0*	147.9	*20.0*
2006	731.1	NO	*0.0*	79.0	*10.8*	182.8	*25.0*	323.2	*44.2*	146.2	*20.0*
2007	722.7	NO	*0.0*	76.6	*10.6*	180.7	*25.0*	320.9	*44.4*	144.5	*20.0*
2008	836.9	NO	*0.0*	87.0	*10.4*	209.2	*25.0*	373.3	*44.6*	167.4	*20.0*
2009	951.1	NO	*0.0*	97.0	*10.2*	237.8	*25.0*	426.1	*44.8*	190.2	*20.0*
2010	1 065.3	NO	*0.0*	106.5	*10.0*	266.3	*25.0*	479.4	*45.0*	213.1	*20.0*
2011	1 078.6	0.5	*0.1*	107.9	*10.0*	269.7	*25.0*	484.8	*45.0*	215.7	*20.0*
2012	1 138.0	0.6	*0.1*	102.4	*9.0*	284.5	*25.0*	522.9	*46.0*	227.6	*20.0*
2013	940.2	0.9	*0.1*	82.7	*8.8*	225.6	*24.0*	475.7	*50.6*	155.1	*16.6*
2014	1 228.9	6.1	*0.5*	38.1	*3.1*	265.4	*21.6*	779.1	*63.4*	140.1	*11.4*
2015	1 413.2	21.7	*1.5*	35.9	*2.5*	357.5	*25.3*	970.2	*68.6*	49.7	*2.0*
2016	1 300.4	9.0	*0.7*	40.8	*3.2*	224.2	*17.2*	1 010.3	*77.7*	16.1	*1.2*
2017	1 253.9	22.9	*1.8*	19.8	*1.6*	218.2	*17.4*	971.6	*77.5*	21.5	*1.7*
2018	1 325.1	36.6	*2.8*	26.0	*2.0*	245.0	*18.5*	1 012.5	*76.4*	5.0	*0.4*
2019	1 086.7	9.7	*0.9*	1.7	*0.2*	203.4	*18.7*	847.2	*77.9*	24.5	*2.3*
2020	1 047.9	11.2	*1.1*	0.9	*0.1*	189.9	*18.1*	840.7	*80.2*	5.3	*0.5*

	Waste management practices										
	TOTAL	**Energy Burning**		**Burning for elimination**		**Recycling**		**Landfill deposits**		**Free disposal**	
	kt	**kt**	**%**	**kt**	**%**	**kt**	**%**	**kt**	**%**	**kt**	**%**
2021	875.1	17.2	*2.0*	0.3	*0.0*	164.4	*18.8*	691.4	*79.0*	1.8	*0.2*
2022	820.3	36.0	*4.4*	0.4	*0.1*	154.9	*18.9*	628.2	*76.6*	0.8	*0.1*
Trend											
1950 - 2022	197.7%	NA		-99.1%		124.9%		469.9%		-98.6%	
1990 - 2022	-5.7%	NA		-99.7%		-28.7%		80.6%		-99.6%	
2005 - 2022	10.9%	NA		-99.5%		-16.2%		93.1%		-99.5%	
2021 - 2022	-6.3%	109.4%		21.9%		-5.8%		-9.1%		-57.2%	
Remark											
	1950 - 2012 extrapolated					*2013 - 2022*		*INSTAT*			

7.2 Solid Waste Disposal (CRT category 5.A)

Methane gas is a by-product of landfilling municipal solid wastes (MSW). It is produced via methanogens mainly under anaerobic conditions. Most of the global MSW is dumped in non-managed landfills and the generated methane is emitted to the atmosphere. Some of the modern managed landfills attempt to capture and utilize landfill "bio"-gas, a renewable energy source, to generate electricity or heat.



simplified landfill methane mass balance

Methane (CH_4) produced (mass/time) = Σ(CH_4 collected (flared and/or recovered) + CH_4 emitted + CH_4 oxidized

Figure 7-6 Simplified landfill methane mass

The following section describes GHG emissions resulting from solid waste disposal on land. According to 2006 IPCC Guidelines, the solid waste disposal sites (SWDS) can be divided into five groups.

⇒ **5.A.1 Managed Waste Disposal Sites**

Anaerobic managed solid waste disposal sites must have controlled placement of waste (i.e., waste directed to specific deposition areas, a degree of control of scavenging and a degree of control of fires) and will include at least one of the following: (i) cover material; (ii) mechanical compacting; or (iii) levelling of the waste.

Semi-aerobic managed solid waste disposal sites must have controlled placement of waste and will include all of the following structures for introducing air to waste layer: (i) permeable cover material; (ii) leachate drainage system; (iii) regulating pondage; and (iv) gas ventilation system.

⇒ **5.A.2 Unmanaged Waste Disposal Sites**

Unmanaged solid waste disposal sites – deep and/or with high water table are all SWDS not meeting the criteria of managed SWDS and which have depths of greater than or equal to 5 *meters* and/or high-water table at near ground level. Latter situation corresponds to filling inland water, such as pond, river or wetland, by waste.

Unmanaged shallow solid waste disposal sites are all SWDS not meeting the criteria of managed SWDS *and* which have depths of less than 5 meters.

⇒ **5.A.3 Uncategorized Waste Disposal Sites**

Uncategorised solid waste disposal sites are those SWDS where countries cannot categorize their landfills into above four categories of managed and unmanaged SWDS.

The 2006 IPCC Guidelines present the ***basic concept of First Order Decay (FOD)*** *as "...The basis for the calculation is the amount of* ***Decomposable Degradable Organic Carbon (DDOCm)*** *as defined in Equation 3.2.*

$$DDOCm = W \times DOC \times DOC_f \times MCF$$

DDOCm is the part of the organic carbon that will degrade under the anaerobic conditions in SWDS. It is used in the equations and spreadsheet models as DDOCm. The index m is used for mass.

DDOCm equals the product of the ***waste amount (W)****, the* ***fraction of degradable organic carbon (DOC)*** *in the waste, the* ***fraction of the degradable organic carbon that decomposes (DOCf),*** *and the part of the waste that will decompose under aerobic conditions (prior to the conditions becoming anaerobic) in the SWDS, which is interpreted with the* ***methane correction factor (MCF)...****". The parameter that is related to aerobic condition is expressed in terms of MCF. 191*

The methodology used to estimate emissions from waste management activities requires country- specific knowledge on waste generation, composition, and management practice. The main parameters that influence the estimation of the emissions from landfills, apart from the amount of the disposed waste, is the waste composition.

These parameters are strictly dependent on the waste management policies throughout the waste streams which start from waste generation through collection and transportation, separation for resource recovery, recycling and energy recovery and terminate at landfill sites. Improvements of quality and quantity of data is needed. However, it with the available information and expert judgement it was possible to evaluate and compile data coming from different sources and adjust them to recommended IPCC methodology which is used for GHGs emissions estimation. Currently country specific data was used where they are available. Default values were used when country specific data were not available.

191 Source: 2006 IPCC Guidelines, Volume 5: Waste, Chapter 3: Solid Waste Disposal - 3.2.1.1 FIRST ORDER DECAY (FOD)

7.2.1 Category description

GHG emissions/ removals	CO_2		CH_4		N_2O	
	Estimated	Key category	Estimated	Key category	Estimated	Key category
5.A.1 Managed Waste Disposal Sites	NA	-	✓	LA 1990 LA 2021	NA	-
5.A.2 Unmanaged Waste Disposal Sites	NA	-	✓		NA	-
5.A.3 Uncategorized Waste Disposal Sites	NA	-	NO		NA	-
A '✓' indicates: emissions from this category have been estimated. Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential						
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF						

An overview of the GHG emissions from CRT category 5.A *Solid Waste Disposal* is provided in the following figure and table.

In 2022, the CH_4 emissions CRT category 5.A *Solid Waste Disposal* amounted to 26.39 kt and in the period 1990 – 2022 the CH_4 emissions increased by 199.4% from 8.92 kt CH4 in 1990. In the period 2005 – 2022 the CH_4 emissions increased by 160.7% mainly due to increasing landfilling activities which is a result of increasing population and growing waste generation rates. Also, the reduction of illegal disposal (sites) or open burning results in increasing landfilling.

Methane recovery (collection and flaring) does not take place in Albania.

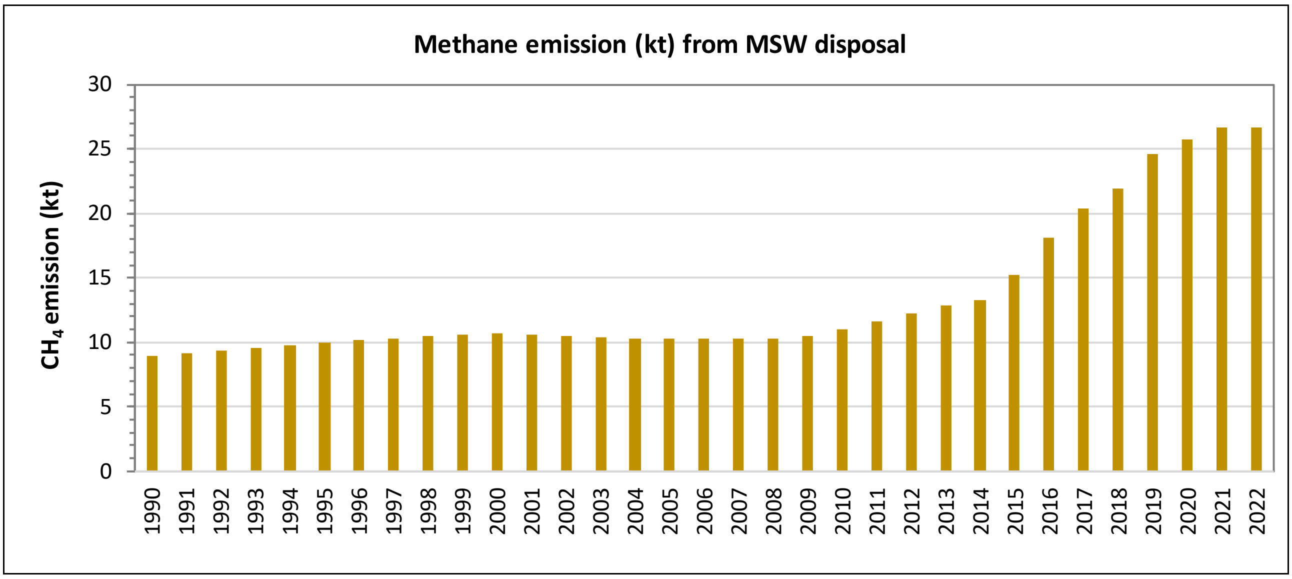


Figure 7-7 CH_4 emissions from CRT category 5.A *Solid Waste Disposal* for the period 1990 - 2022

Table 7-8 GHG emissions from CRT category 5.A Solid Waste Disposal for the period of 1990 - 2022

	GHG	CH_4					CO_2	N_2O
	5.A TOTAL	5.A TOTAL	5.A.1. Managed	5.A.2. Unmanaged	5.A.3. Uncategorized	Recovery (R)	5.A TOTAL	5.A TOTAL
			waste disposal sites					
	kt CO_2 eq	kt	kt	kt	kt	kt	kt	kt
1990	223.06	8.92	NO	8.92	NO	NO	NA	NA
1991	229.36	9.17	NO	9.17	NO	NO	NA	NA
1992	234.99	9.40	NO	9.40	NO	NO	NA	NA

	GHG	CH4					CO_2	N_2O
	5.A TOTAL	5.A TOTAL	5.A.1. Managed waste disposal sites	5.A.2. Unmanaged waste disposal sites	5.A.3. Uncategorized waste disposal sites	Recovery (R)	5.A TOTAL	5.A TOTAL
	kt CO_2 eq	kt	kt	kt	kt	kt	kt	kt
1993	239.59	9.58	NO	9.58	NO	NO	NA	NA
1994	243.79	9.75	NO	9.75	NO	NO	NA	NA
1995	248.45	9.94	NO	9.94	NO	NO	NA	NA
1996	253.26	10.13	NO	10.13	NO	NO	NA	NA
1997	258.25	10.33	NO	10.33	NO	NO	NA	NA
1998	262.14	10.49	NO	10.49	NO	NO	NA	NA
1999	264.94	10.60	NO	10.60	NO	NO	NA	NA
2000	266.64	10.67	NO	10.67	NO	NO	NA	NA
2001	264.08	10.56	NO	10.56	NO	NO	NA	NA
2002	261.89	10.48	NO	10.48	NO	NO	NA	NA
2003	259.90	10.40	NO	10.40	NO	NO	NA	NA
2004	258.01	10.32	NO	10.32	NO	NO	NA	NA
2005	256.21	10.25	1.02	9.22	NO	NO	NA	NA
2006	256.38	10.26	1.23	9.02	NO	NO	NA	NA
2007	256.62	10.26	1.54	8.73	NO	NO	NA	NA
2008	257.06	10.28	1.85	8.43	NO	NO	NA	NA
2009	263.27	10.53	2.21	8.32	NO	NO	NA	NA
2010	274.57	10.98	2.53	8.46	NO	NO	NA	NA
2011	290.15	11.61	3.06	8.55	NO	NO	NA	NA
2012	304.94	12.20	3.22	8.98	NO	NO	NA	NA
2013	321.53	12.86	3.39	9.47	NO	NO	NA	NA
2014	330.77	13.23	3.49	9.74	NO	NO	NA	NA
2015	381.86	15.27	4.03	11.25	NO	NO	NA	NA
2016	451.84	18.07	4.77	13.31	NO	NO	NA	NA
2017	509.24	20.37	5.37	15.00	NO	NO	NA	NA
2018	547.96	21.92	5.78	16.14	NO	NO	NA	NA
2019	614.69	24.59	6.48	18.10	NO	NO	NA	NA
2020	644.48	25.78	6.80	18.98	NO	NO	NA	NA
2022	667.37	26.69	7.04	19.66	NO	NO	NA	NA
Trend								
1990-2022	199.4%	199.4%	NA	120.5%	NA	NA	NA	NA
2005-2022	160.7%	160.7%	587.5%	113.3%	NA	NA	NA	NA
202 -2022	0.1%	0.1%	0.1%	0.1%	NA	NA	NA	NA

7.2.2 Methodological issues

7.2.2.1 Choice of methods

CH_4 Emissions from solid waste disposal on land have been calculated using the First Order Decay (FOD) method, the IPCC Tier 1 method, given in the 2006 IPCC Guidelines. Even if country specific data for waste generation, waste composition and waste management practices were used, these data were only available for the period 2013 - 2022. The choice of a *good practice* method depends on national circumstances.

- Tier 1: The estimations of the Tier 1 methods are based on the IPCC FOD method using mainly default activity data and default parameters.
- Tier 2: Tier 2 methods use the IPCC FOD method and some default parameters but require good quality country-specific activity data on current and historical waste disposal at SWDS. Historical waste disposal data for 10 years or more should be based on country-specific statistics, surveys or other similar sources. Data are needed on amounts disposed at the SWDS.

Influencing factors of CH_4 Emissions generation and relevant data required:

- Waste amounts deposited / waste generated (starting year 1950)
- Waste treatment (collection, deposition/landfilling, composting, incineration/burning, recycling)
- Management practices at landfill sites – Methane correction factor (MCF)
- Conditions at landfill sites + Composition of waste deposited
- Organic carbon in landfill sites – degradable organic carbon (DOC)
- Methane generation rate constant (k)
- Landfill gas recovery, Oxidation
- National waste management policy

For estimating the CH_4 emissions the 2006 IPCC Guidelines Tier 1 approach192 has been applied:

CH_4 emission from Solid Waste Disposal Sites (SWDS)

EQUATION 3.1 (2006 IPCC GL, Vol. 5, Chap.3)

$$CH_4\ Emissions = \left[\sum CH_4\ generated_{x,T} - R_T\right] \times (1 - OX_T)$$

Where:

CH_4 Emissions	= CH_4 emitted in year T (Gg)
T	= inventory year
x	= waste category or type /material
R_T	= recovered CH_4 in year T (Gg)
OX_T	= oxidation factor in year T (fraction)

Methane generation: The CH_4 generation potential of the waste that is disposed in a certain year will decrease gradually throughout the following decades. In this process, the release of CH_4 from this specific amount of waste decreases gradually. The FOD model is built on an exponential factor that describes the fraction of degradable material which each year is degraded into CH_4.

The quantity of CH_4 emitted during decomposition process is directly proportional to the fraction of degradable organic carbon (DOC), which is defined as the carbon content of different types of organic biodegradable wastes such as paper and textiles, garden and park waste, food waste, wood and straw waste. The equations for estimating the CH_4 generation are given below. As the mathematics are the same for

192 Source: 2006 IPCC Guidelines, Volume 5: Waste, Chapter 3: Solid Waste Disposal - 3.2.1.1 FIRST ORDER DECAY (FOD)

estimating the CH_4 emissions from all waste categories/waste types/materials, no indexing referring to the different categories/waste materials/types is used in the equations below.

Decomposable DOC from waste disposal data

Equation 3.2 (2006 IPCC GL, Vol. 5, Chap.3)

$$DDOCm = W \times DOC \times DOC_f \times MCF$$

Where

	DDOCm	= mass of decomposable DOC deposited (Gg)
	W	= mass of waste deposited (Gg)
	DOC	= degradable organic carbon in the year of deposition, fraction (Gg C/Gg waste)
	DOC_f	= fraction of DOC that can decompose (fraction)
	MCF	= CH_4 correction factor for aerobic decomposition in the year of deposition (fraction)

Although CH_4 generation potential (Lo)[2] is not used explicitly in the 2006 IPCC Guidelines, it equals the product of DDOCm, the CH_4 concentration in the gas (F) and the molecular weight ratio of CH_4 and C.

Transformation from DDOCm to L_O

Equation 3.2 (2006 IPCC GL, Vol. 5, Chap.3)

$$L_o = DDOCm \times F \times \frac{16}{12}$$

Where:

	Lo	= CH_4 generation potential (Gg CH_4)
	DDOCm	= mass of decomposable DOC (Gg)
	F	= fraction of CH_4 in generated landfill gas (volume fraction)
	16/12	= molecular weight ratio CH_4/C (ratio)

FIRST ORDER DECAY BASICS

With a first order reaction, the amount of product is always proportional to the amount of reactive material. This means that the year in which the waste material was deposited in the SWDS is irrelevant to the amount of CH_4 generated each year. It is only the total mass of decomposing material currently in the site that matters.

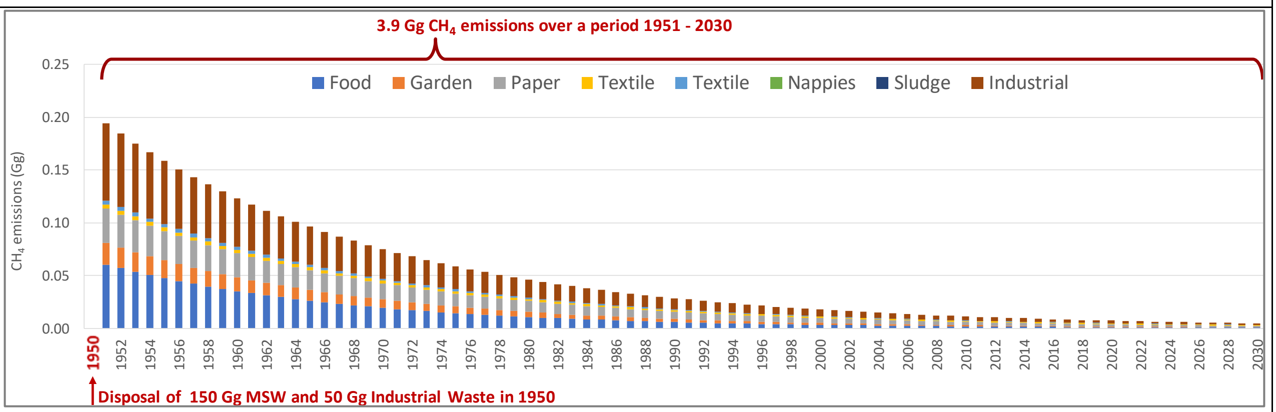


Figure 7-8 CH_4 emissions from CRT category 5.A Solid Waste Disposal of the disposal of waste in 1950 (as an example)

This also means that when the amount of decomposing material in the SWDS at the start of the year is known, every year can be regarded as year number 1 in the estimation method, and the **basic first order calculations** can be done by these two simple equations, with the decay reaction beginning on the 1st of January the year after deposition.

DDOCm accumulated in the SWDS at the end of year T

Equation 3.4 (2006 IPCC GL, Vol. 5, Chap.3)

$$DDOCma_T = DDOCmd_T + \left(DDOCmd_T \times e^{-k}\right)$$

DDOCm decomposed in the SWDS at the end of year T

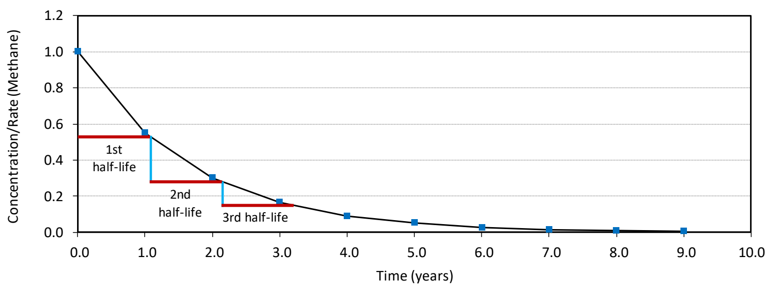
Equation 3.5 (2006 IPCC GL, Vol. 5, Chap.3)

$$DDOCm\ decomp_T = DDOCma_{T-1} \times \left(1 - e^{-k}\right)$$

Where:

T	= inventory year
DDOCmaT	= DDOCm accumulated in the SWDS at the end of year T (Gg)
DDOCmaT-1	= DDOCm accumulated in the SWDS at the end of year (T-1) (Gg)
DDOCmdT	= DDOCm deposited into the SWDS in year T (Gg)
DDOCm decompT	= DDOCm decomposed in the SWDS in year T (Gg)
k	= reaction constant,
k	= ln(2)/$t_{1/2}$ (y-1)
$t_{1/2}$	= half-life time (y)

The half-life of a reaction, $t_{1/2}$, is the amount of time needed for a reactant concentration to decrease by half compared to its initial concentration.



In a First order reactions, the graph represents the half-life is different from zero order reaction in a way that the slope continually decreases as time progresses until it reaches zero. We can also easily see that the length of half-life will be constant, independent of concentration. For example, it takes the same amount of time for the concentration to decrease from one point to another point.

Figure 7-9 First order reaction

CH_4 GENERATED FROM DECOMPOSABLE DDOCm

The amount of CH_4 formed from decomposable material is found by multiplying the CH_4 fraction in generated landfill gas and the CH_4 /C molecular weight ratio.

CH_4 generated from decayed DDOCm

Equation 3.6 (2006 IPCC GL, Vol. 5, Chap.3)

$$CH_4\ generated_T = DDOCm\ decomp_T \times F \times \frac{16}{12}$$

Where:

CH_4 generated$_T$	= amount of CH_4 generated from decomposable material

DDOCm decomp$_T$ = DDOCm decomposed in year T (Gg)
F = fraction of CH_4, by volume, in generated landfill gas (fraction)
16/12 = molecular weight ratio CH_4/C (ratio)

7.2.2.2 Choice of activity data and emission factor

7.2.2.2.1 Amount of Municipal Solid Waste (MSW)

No national data on amounts of municipal waste generation and disposal were available for the years 1950 to 2022. For the period 2013 – 2022, information of population, Municipal Solid Waste (MSW), Waste per capita rate, and share of MSW landfilled on Solid Waste Disposal Sites (SWDS) were taken from Urban solid waste statistics of INSTAT[193]. Based on the national population and country specific waste generation rates for total population, the total amount of waste which is disposed on land could be estimated.

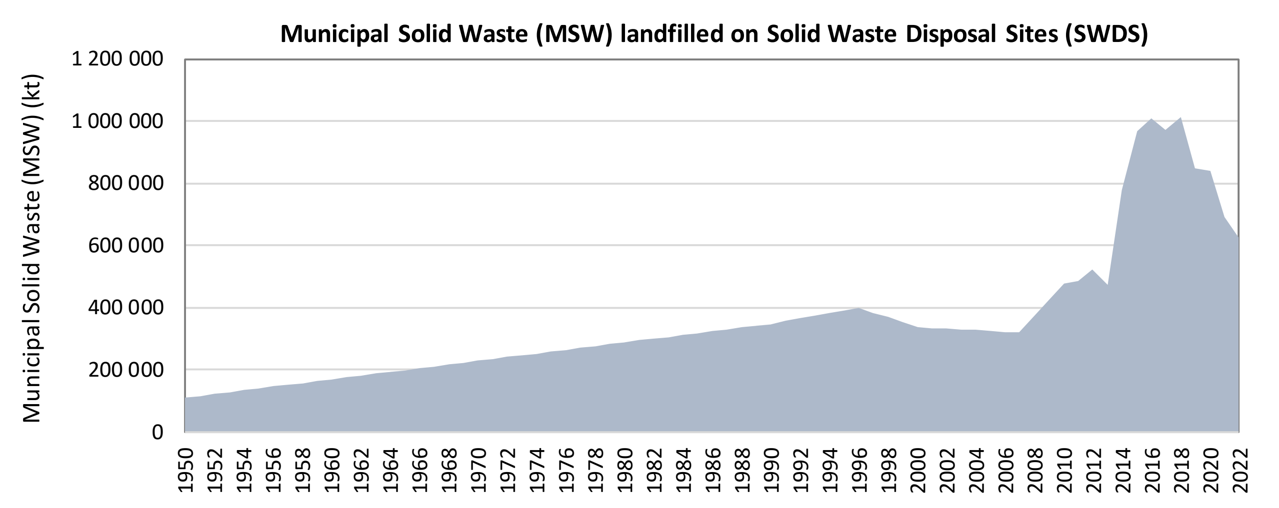


Figure 7-10 Municipal solid waste (MSW) landfilled on solid waste disposal sites (SWDS)

Table 7-9 Municipal solid waste (MSW) landfilled on solid waste disposal sites (SWDS)

	Population	Source	Waste per capita	Source	Total Municipal Solid Waste (MSW)	Source	% to Solid Waste Disposal Sites (SWDS)	Source	Total amount of waste to SWDS	Source
	capita		kg/cap/y		kt		%		kt	
1950	1 252 582	UN statistics	220.00	EJ	275 568	Calculated based on Population and Waste per capita	40.0	D	110 227	Calculated based on Total MSW and % to Solid Waste Disposal Sites
1951	1 289 168		221.57	extrapolation	290 417		40.0	D	116 167	
1952	1 326 948		223.13		305 267		40.0	D	122 107	
1953	1 366 744		224.70		320 116		40.0	D	128 046	
1954	1 409 005		226.26		334 965		40.0	D	133 986	
1955	1 453 730		227.83		349 815		40.0	D	139 926	
1956	1 500 624		229.39		364 664		40.0	D	145 866	
1957	1 549 571		230.96		379 513		40.0	D	151 805	
1958	1 600 983		232.52		394 362		40.0	D	157 745	
1959	1 655 020		234.09		409 212		40.0	D	163 685	
1960	1 583 800	Eurostat	235.65		424 061		40.0	D	169 624	
1961	1 633 800		237.22		438 910		40.0	D	175 564	

193 Available (18.01.2024) on https://www.instat.gov.al/en/themes/environment-and-energy/environment/#tab3

	Population	Source	Waste per capita	Source	Total Municipal Solid Waste (MSW)	Source	% to Solid Waste Disposal Sites (SWDS)	Source	Total amount of waste to SWDS	Source
	capita		kg/cap/y		kt		%		kt	
1962	1 685 800		238.78		453 760		40.0	D	181 504	
1963	1 736 838		240.35		468 609		40.0	D	187 444	
1964	1 788 404		241.91		483 458		40.0	D	193 383	
1965	1 839 866		243.48		498 308		40.0	D	199 323	
1966	1 889 715		245.04		513 157		40.0	D	205 263	
1967	1 939 430		246.61		528 006		40.0	D	211 202	
1968	1 991 765		248.17		542 856		40.0	D	217 142	
1969	2 052 778		249.74		557 705		40.0	D	223 082	
1970	2 110 612		251.30		572 554		40.0	D	229 022	
1971	2 160 345		252.87		587 403		40.0	D	234 961	
1972	2 215 361		254.43		602 253		40.0	D	240 901	
1973	2 270 891		256.00		617 102		40.0	D	246 841	
1974	2 322 613		257.57		631 951		40.0	D	252 781	
1975	2 377 635		259.13		646 801		40.0	D	258 720	
1976	2 432 027		260.70		661 650		40.0	D	264 660	
1977	2 485 025		262.26		676 499		40.0	D	270 600	
1978	2 542 066		263.83		691 349		40.0	D	276 539	
1979	2 590 466		265.39		706 198		40.0	D	282 479	
1980	2 645 198		266.96		721 047		40.0	D	288 419	
1981	2 698 795		268.52		735 896		40.0	D	294 359	
1982	2 753 316		270.09		750 746		40.0	D	300 298	
1983	2 815 239		271.65		765 595		40.0	D	306 238	
1984	2 872 681		273.22		780 444		40.0	D	312 178	
1985	2 936 177		274.78		795 294		40.0	D	318 117	
1986	2 993 347		276.35		810 143		40.0	D	324 057	
1987	3 051 923		277.91		824 992		40.0	D	329 997	
1988	3 115 286		279.48		839 842		40.0	D	335 937	
1989	3 169 386		281.04		854 691		40.0	D	341 876	
1990	3 286 500		282.61		869 540		40.0	D	347 816	
1991	3 259 814		284.17		884 389		40.3		356 409	
1992	3 190 103		285.74		899 239		40.6		365 091	
1993	3 167 478	Eurostat	287.30	extrapolation	914 088		40.9		373 862	
1994	3 220 310		288.87		928 937	Calculated based on Population and Waste per capita	41.2		382 722	Calculated based on Total MSW and % to Solid Waste Disposal Sites (SWDS
1995	3 248 836		290.43		943 787		41.5		391 671	
1996	3 283 000		292.00		958 636		41.8	extrapolation	400 710	
1997	3 324 317		282.88		914 338		42.1		384 937	
1998	3 354 341		273.75		870 041		42.4		368 897	
1999	3 373 445		264.63		825 743		42.7		352 592	
2000	3 058 497		255.50		781 446		43.0		336 022	
2001	3 063 318	INS TAT	253.63		773 058		43.2		333 961	

	Population	Source	Waste per capita	Source	Total Municipal Solid Waste (MSW)	Source	% to Solid Waste Disposal Sites (SWDS)	Source	Total amount of waste to SWDS	Source
	capita		kg/cap/y		kt		%		kt	
2002	3 057 018		251.75		764 670		43.4		331 867	
2003	3 044 993		249.88		756 282		43.6		329 739	
2004	3 034 231		248.01		747 895		43.8		327 578	
2005	3 019 634		246.13		739 507		44.0		325 383	
2006	3 003 329		244.26		731 119		44.2		323 155	
2007	2 981 755		242.38		722 731		44.4		320 893	
2008	2 958 266		283.26		836 926		44.6		373 269	
2009	2 936 355		324.13		951 121		44.8		426 102	
2010	2 918 674		365.00		1 065 316		45.0		479 392	
2011	2 907 368		371.00		1 078 634		45.0		484 846	
2012	2 903 008		392.00		1 137 979		46.0		522 901	
2013	2 897 770		325.00		940 160		50.6		475 721	
2014	2 892 394		425.00		1 228 884		63.4		779 112	
2015	2 885 796		491.00		1 413 233		68.6		970 157	
2016	2 875 592		452.00		1 300 373		77.7		1 010 335	
2017	2 876 591		436.00	INSTAT	1 253 913	INSTAT	77.5	INSTAT	971 572	INSTAT
2018	2 870 324		462.00		1 325 071		76.4		1 012 517	
2019	2 862 427		381.00		1 086 692		77.9		847 208	
2020	2 845 955		369.00		1 047 852		80.2		840 658	
2021	2 829 741		311.00		875 105		79.0		691 352	
2022	2 793 592		295.00		820 322		76.6		628 239	
Trend										
1950-2022	121.8%		34.1%		197.7%		91.5%		469.9%	
1990-2022	-15.5%		4.4%		-5.7%		91.5%		80.6%	
2005-2022	-8.0%		19.9%		10.9%		74.1%		93.1%	
2021-2022	-1.2%		-5.1%		-6.3%		-3.0%		-9.1%	
Remarks: EJ – Expert judgement, D – IPCC default										

7.2.2.2.2 Waste composition

Waste composition is one of the main factors influencing emissions from solid waste treatment, as different waste types contain different amount of degradable organic carbon (DOC) and fossil carbon.

Waste types such as food waste, garden waste, paper and cardboard, wood, textiles, and nappies (disposable diapers) contain most of the DOC in MSW. Ash, dust, rubber, and leather contain also certain amounts of non-fossil carbon, but this is hardly degradable. Some textiles, plastics (including plastics in disposable nappies), rubber and electronic waste contain the bulk part of fossil carbon in MSW. Paper (with coatings) and leather (synthetic) can also include small amounts of fossil carbon.

Table 7-10 Decomposition duration of different trash in the Municipal Solid Waste (MSW)

Waste	Decomposition duration	Waste	Decomposition duration
Vegetables	5 days –1 month	Leather shoes	25–40 years
Paper	2–5 months	Nylon fabric	30–40 years
Cotton T-shirt	6 months	Tin cans	50–100 years
Orange peels	6 months	Aluminium cans	80–100 years
Tree leaves	1 year	Glass bottles	1 million years
Wool socks	1–5 years	Styrofoam cup	500 years to forever
Plastic-coated paper milk cartons	5 years	Plastic bags	500 years to forever

Source: Science Learning Hub New Zealand 194

For Albania it was possible to collect country specific data on waste composition. In the following table the IPCC default value is also provided for comparison. The country specific data on waste composition is in the range of the IPCC default.

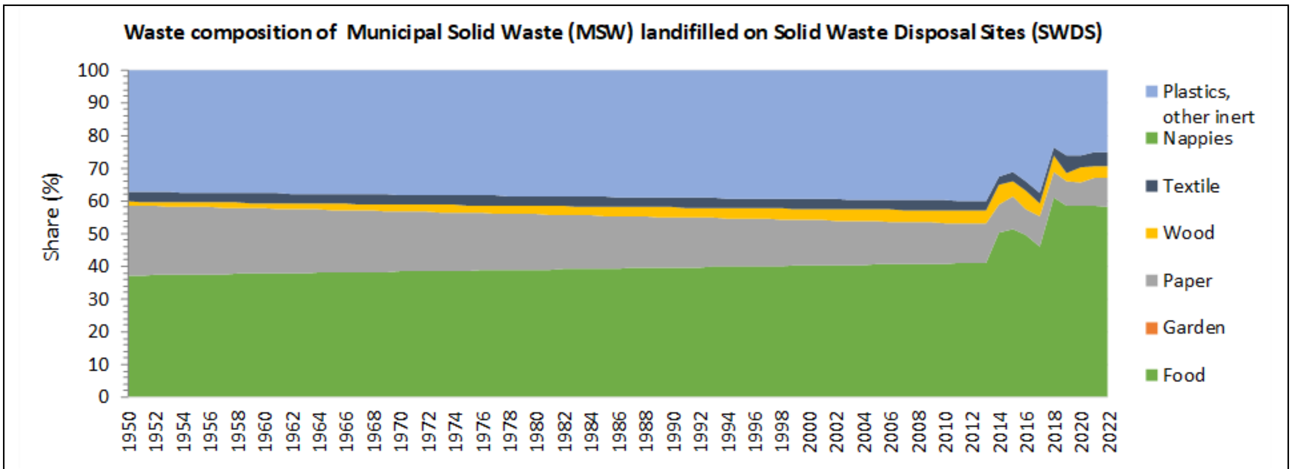


Figure 7-11 Composition of waste going to solid waste disposal sites for the period of 1990-2022

Table 7-11 Composition of waste going to solid waste disposal sites for the period of 1990-2022

	Waste composition							Source
	Food	Garden	Paper	Wood	Textile	Disposable napples	Plastisc, other	
	Share (%)							
IPCC default	36.00	1.00	21.00	1.00	3.00	1.00	36.00	Table 2.3, 2006 IPCC GL, Vol. 5, Chap. 2
1950	37.20	IE	21.40	1.20	3.00	IE	37.20	Based on IPCC default
1951	:	:	:	:	:	:	:	
:	interpolation							
2012	:	:	:	:	:	:	:	
2013	41.00	IE	12.00	4.00	3.00	IE	40.00	INSTAT

194 Available (23.01.2020) on https://www.sciencelearn.org.nz/resources/1543-measuring-biodegradability

	Waste composition							Source
	Food	Garden	Paper	Wood	Textile	Disposable napples	Plastisc, other	
	Share (%)							
2014	50.20	IE	8.70	6.10	2.60	IE	32.40	
2015	51.40	IE	9.90	4.60	2.90	IE	31.21	
2016	49.50	IE	7.90	5.80	2.80	IE	33.83	
2017	45.90	IE	9.50	3.90	3.20	IE	36.51	
2018	61.20	IE	7.70	5.10	2.20	IE	23.80	
2019	58.40	IE	7.60	2.40	5.60	IE	26.00	
2020	58.50	IE	7.20	4.60	3.70	IE	26.08	
2021	58.60	IE	8.50	3.70	4.00	IE	25.14	
2022	58.10	IE	8.90	3.60	4.50	IE	24.78	

7.2.2.2.3 Degradable organic carbon (DOC)

The IPCC default values of Degradable organic carbon (DOC) were applied and is in the following table presented.

Estimates DOC using default carbon content values.

EQUATION 3.7 (2006 IPCC GL, Vol. 5, Chap.3)

$$\boldsymbol{DOC = \sum_{i} DOC_i \times W_i}$$

Where:

DOC = fraction of degradable organic carbon in bulk waste, Gg C/Gg waste

DOCi = fraction of degradable organic carbon in waste type i

Wi = fraction of waste type i by waste category

Table 7-12 Degradable organic carbon (DOC)

Degradable organic carbon (DOC)	Food	Garden	Paper	Wood	Textile	Disposable nappies	Plastics, other inert	Source
	(weight fraction, wet basis)							
IPCC Default	0.15	0.2	0.4	0.43	0.24	0.24	0.15	Based on TABLE 2.4, Chapter 2, and EQUATION 3.7, Chap. 3, Vol. 5, 2006 IPCC GL

Table 7-13 Default dry matter content, DOC content, total carbon content and fossil carbon fraction of different MSW components

MSW component	Dry matter content in % of wet weight [1]	DOC content in % of wet waste		DOC content in % of dry waste		Total carbon content in % of dry weight		Fossil carbon fraction in % of total carbon	
	Default	Default	Range	Default	Range [2]	Default	Range	Default	Range
Paper/cardboard	90	40	*36 - 45*	44	*40 - 50*	46	*42 - 50*	1	*0 - 5*
Textiles [3]	80	24	*20 - 40*	30	*25 - 50*	50	*25 - 50*	20	*0 - 50*
Food waste	40	15	*8 - 20*	38	*20 - 50*	38	*20 - 50*	-	-
Wood	85 4	43	*39 - 46*	50	*46 - 54*	50	*46 - 54*	-	-

MSW component	Dry matter content in % of wet weight [1]	DOC content in % of wet waste		DOC content in % of dry waste		Total carbon content in % of dry weight		Fossil carbon fraction in % of total carbon	
	Default	Default	Range	Default	Range [2]	Default	Range	Default	Range
Garden & Park waste	40	20	*18 - 22*	49	*45 - 55*	49	*45 - 55*	0	*0*
Nappies	40	24	*18 - 32*	60	*44 - 80*	70	*54 - 90*	10	*10*
Rubber and Leather	84	(39) [5]	*(39)* [5]	(47) [5]	*(47)* [5]	67	*67*	20	*20*
Plastics	100	-	-	-	-	75	*67 - 85*	100	*95 - 100*
Metal [6]	100	-	-	-	-	NA	*NA*	NA	*NA*
Glass [6]	100	-	-	-	-	NA	*NA*	NA	*NA*
Other, inert waste	90	-	-	-	-	3	*0 - 5*	100	*50 - 100*
Remark: for footnotes see 2006 IPCC Guidelines						Source: Table 2.4, Vol. 5, Chapter 2, 2006 IPCC Guidelines			

7.2.2.2.4 Methane Correction Factor (MCF)

The Methane Correction Factor (MCF) reflects the way in which MSW is managed and the effect of management practices on CH_4 generation. MCF accounts for the fact that unmanaged SWDS produce less CH_4 from a given amount of waste than anaerobic managed SWDS. The methodology requires countries to provide data or estimates of the quantity of waste that is disposed of to each of categories of solid waste disposal sites. Default values for MCF from 2019 Refinements 2006 IPCC Guidelines were used.

Table 7-14 SWDS classification and methane correction factors (MCF)

	Type of Site		Methane Correction Factor (MCF)	Source
			IPCC Default Values	
1	Managed	anaerobic	1.0	TABLE 3.1, Vol. 5, Chapter 3, 2019 Refinements 2006 IPCC Guidelines
2		well – semi-aerobic	0.5	
3		poorly – semi-aerobic	0.7	
4		well – active-aeration	0.4	
5		poorly – active-aeration	0.7	
6	Unmanaged	deep (>5 m waste) and /or high-water table	0.8	
7		shallow (<5 m waste)	0.4	
8	Uncategorised SWD 5		0.6	
⇩	⇩ ⇩	⇩ ⇩	⇩ ⇩ ⇩	⇩
1	**Anaerobic managed solid waste disposal sites:** These must have controlled placement of waste (i.e., waste directed to specific deposition areas, a degree of control of scavenging and a degree of control of fires) and will include at least one of the following: (i) cover material; (ii) mechanical compacting; or (iii) levelling of the waste.			
2	**Semi-aerobic managed solid waste disposal sites:** These SWDS are managed under one of the following condition, it is regarded as well magement; (i) permeable cover material; (ii) leachate drainage system without sunk; (iii) regulating pondage; and (iv) gas ventilation system without cap, (v) connection of leachate drainage system and gas ventilation system.			
3	**Semi-aerobic managed solid waste disposal sites:** These SWDS are managed under one of the following condition, it is regarded as poor management; (i) condition of sunk of leachate drainage system; (ii) closing of valve of drainage or atmosphere-unopening of drainage exit; (iii) capping of gas ventilation exit.			
4	**Active aeration of managed landfills:** These SWDS includes the technology of in-situ low pressure aeration, air sparging, bioventing, passive ventilation with extraction (suction). These must have controlled placement of waste and will include leachate drainage system to avoid the blockage of air penetration, and (i) cover material; (ii) air injection or gas extraction system without drying of waste.			

	Type of Site	Methane Correction Factor (MCF)	Source
		IPCC Default Values	
5	**Managed poorly – active-aeration SWDS:** When SWDS, that is equipped as well as active aeration of managed SWDS, is managed under one of the following condition, it is judged as poor management; (i) blockage of aeration system due to failure of drainage; (ii) lack of available moisture for microorganisms due to high- pressure aeration.		
6	**Unmanaged solid waste disposal sites – deep and/or with high water table:** All SWDS not meeting the criteria of managed SWDS and which have depths of greater than or equal to 5 meters and/or high-water table at near ground level. Latter situation corresponds to filling inland water, such as pond, river or wetland, by waste.		
7	**Unmanaged shallow solid waste disposal sites:** All SWDS not meeting the criteria of managed SWDS and which have depths of less than 5 meters.		
8	**Uncategorised solid waste disposal sites:** Only if countries cannot categorise their SWDS into above four categories of managed and unmanaged SWDS, the MCF for this category can be used.		

7.2.2.2.5 Distribution of Waste by Waste Management Type

In the following table is provided the distribution of waste by waste management types. It is assumed that un-managed Solid Waste Disposal Sites (SWDS) are divided equally into shallow and deep un-managed SWDS. Furthermore, as no further information was available, managed SWDS are not further categorized. Information on managed SWDS were taken from National Integrated Waste Management Plan 2020-2035[195].

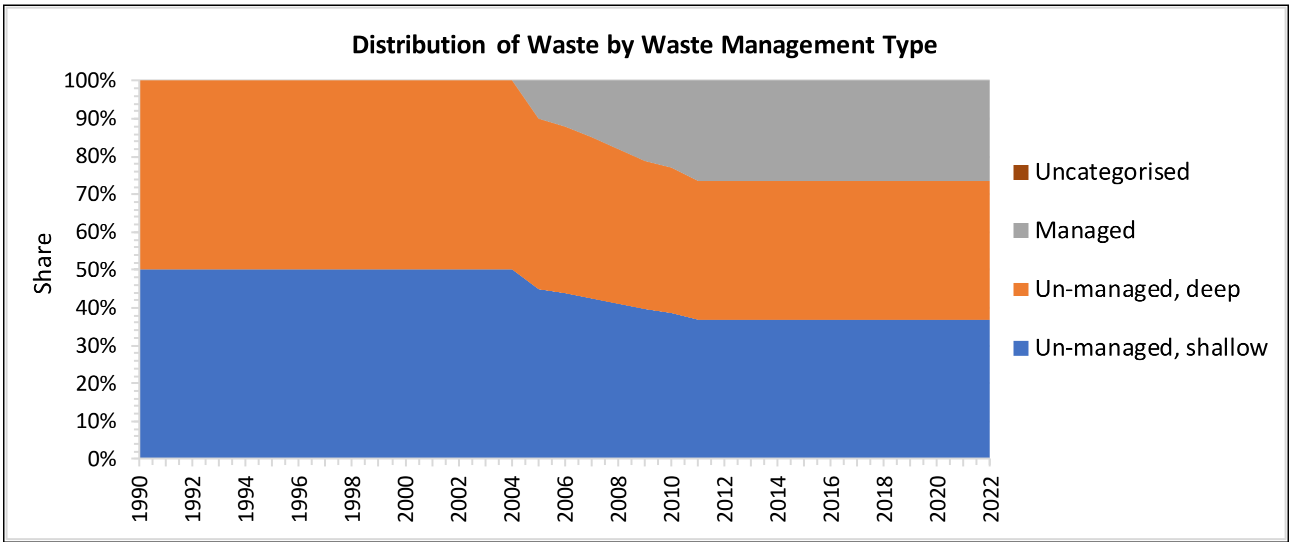


Figure 7-12 Distribution of Waste by Waste Management Type for the period of 1990-2022

Table 7-15 Distribution of Waste by Waste Management Type for the period of 1950-2022

	Total un-managed SWDS	Un-managed SWDS		Total managed SWDS	Managed SWDS				Un-cate-gorised
		shallow	deep		Managed well – semi aerobic	Managed poorly – semi-aerobic	Managed well – active-aeration	Managed poorly – active-aeration	
1950	100%	50%	50%	0%	0%	0%	0%	0%	0.0%
⋮	*constant*	*constant*	*constant*	*constant*	*constant*	*constant*	*constant*	*constant*	*constant*
2004	100%	50%	50%	0%	0%	0%	0%	0%	0.0%
2005	90%	45%	45%	10%	0%	0%	0%	0%	0.0%

195 PLANI KOMBËTAR I MENAXHIMIT TË INTEGRUAR TË MBETJEVE 2020-2035
Available (13.01.2024) on https://faolex.fao.org/docs/pdf/alb204067.pdf or https://www.kryeministria.al/strategjite/

	Total un-managed SWDS	Un-managed SWDS		Total managed SWDS	Managed SWDS				Un-cate-gorised
		shallow	deep		Managed well – semi aerobic	Managed poorly – semi-aerobic	Managed well – active-aeration	Managed poorly – active-aeration	
2006	88%	44%	44%	12%	0%	0%	0%	0%	0.0%
2007	85%	43%	43%	15%	0%	0%	0%	0%	0.0%
2008	82%	41%	41%	18%	0%	0%	0%	0%	0.0%
2009	79%	40%	40%	21%	0%	0%	0%	0%	0.0%
2010	77%	39%	39%	23%	0%	0%	0%	0%	0.0%
2011	74%	37%	37%	26%	0%	0%	0%	0%	0.0%
2012	74%	37%	37%	26%	0%	0%	0%	0%	0.0%
2013	74%	37%	37%	26%	0%	0%	0%	0%	0.0%
2014	74%	37%	37%	26%	0%	0%	0%	0%	0.0%
2015	74%	37%	37%	26%	0%	0%	0%	0%	0.0%
2016	74%	37%	37%	26%	0%	0%	0%	0%	0.0%
2017	74%	37%	37%	26%	0%	0%	0%	0%	0.0%
2018	74%	37%	37%	26%	0%	0%	0%	0%	0.0%
2019	74%	37%	37%	26%	0%	0%	0%	0%	0.0%
2020	74%	37%	37%	26%	0%	0%	0%	0%	0.0%
2021	74%	37%	37%	26%	0%	0%	0%	0%	0.0%
2022	74%	37%	37%	26%	0%	0%	0%	0%	0.0%

7.2.2.2.6 IPCC Default parameter

Furthermore, the following IPCC default parameter were applied.

DOC dissimilated (DOCf)

Fraction of DOC dissimilated (DOCf) is an estimate of the fraction of carbon that is ultimately degraded and released from SWDS, and reflects the fact that some organic carbon does not degrade, or degrades very slowly, when deposited in SWDS. It is *good practice* to use a value of 0.5 (including lignin C) as the default (TABLE 3.1, Vol. 5, Chapter 3, 2006 IPCC Guidelines).

Fraction of methane (F) in developed gas

Most waste in SWDS generates a gas with approximately 50% CH_4. Only material including substantial amounts of fat or oil can generate gas with substantially more than 50% CH_4. Albania is using the IPCC default value 0.5 for the fraction of CH_4 in landfill gas. (Vol. 5, Chapter 3, 2006 IPCC GL, page 3.15)

Delay time

In most solid waste disposal sites, waste is deposited continuously throughout the year, usually on a daily basis. However, there is evidence that production of CH_4 does not begin immediately after deposition of the waste. Albania uses the default delay of six months. (Vol. 5, Chapter 3, 2006 IPCC GL, page 3.19).

Oxidation factor (OX)

The oxidation factor (OX) reflects the amount of CH_4 from SWDS that is oxidized in the soil or other material covering the waste. (TABLE 3.2, Vol. 5, Chapter 3, 2006 IPCC Guidelines)

Type of Site	Oxidation Factor (OX) Default Values	Source
Managed [1], unmanaged and uncategorised SWDS	0	TABLE 3.2, Vol. 5, Chapter 3, 2006 IPCC Guidelines
Managed covered with CH4 oxidising material [2]	0.1	
[1] Managed but not covered with aerated material ; [2] Examples: soil, compost		

Methane generation rate (k)

The default methane generation rate for the temperate – wet climate zone is used.

Table 7-16 Recommended default methane generation rate (k) values under Tier 1

Type of Waste		Climate Zone*			
		Boreal and Temperate (MAT ≤ 20°C)			
		Dry (MAP/PET < 1)		Wet (MAP/PET > 1)	
		Default	Range[2]	Default	Range[2]
Slowly degrading waste	Paper/textiles waste	**0.04**	0.03[3,5] – 0.05[3,4]	0.06	0.05 – 0.07[3,5]
	Wood/ straw waste	**0.02**	0.01[3,4] – 0.03[6,7]	0.03	0.02 – 0.04
Moderately degrading waste	Other (non – food) organic putrescible/ Garden and park waste	**0.05**	0.04 – 0.06	0.1	0.06 – 0.1[8]
Rapidly degrading waste	Food waste/Sewage sludge	**0.06**	0.05 – 0.08	0.185[4]	0.1[3,4] – 0.2[9]
Bulk Waste		**0.05**	0.04 – 0.06	0.09	0.08[8] – 0.1
Remark: for footnotes see 2006 IPCC Guidelines;		Source: Table 3.3, Vol. 5, Chapter 3, 2006 IPCC Guidelines			

Half-life ($t_{1/2}$)

The default half-life (t1/2) for the temperate – wet climate zone is used.

Table 7-17 Recommended default half-life ($t_{1/2}$) values (YR) under Tier 1

Type of Waste		Climate Zone*			
		Boreal and Temperate (MAT ≤ 20°C)			
		Dry (MAP/PET < 1)		Wet (MAP/PET > 1)	
		Default	Range[2]	Default	Range[2]
Slowly degrading waste	Paper/textiles waste	**17**	14[3,5] –23[3,4]	12	10 – 14[3,5]
	Wood/ straw waste	**35**	23[3,4] –69[6,7]	23	17 – 35
Moderately degrading waste	Other (non – food) organic putrescible/ Garden & park waste	**14**	12 – 17	7	6 – 9[8]
Rapidly degrading waste	Food waste/Sewage sludge	**12**	9 – 14	44	3[3,4] – 6[9]
Bulk Waste		**14**	12 – 17	7	6 – 9[8]
Remark: for footnotes see 2006 IPCC Guidelines,		Source: Table 3.4, Vol. 5, Chapter 3, 2006 IPCC Guidelines			

7.2.2.2.7 Methane recovery (R)

CH4 generated at SWDS can be recovered and combusted in a flare or energy device. No methane recovery takes place in Albania.

7.2.3 Description of any flexibility applied

No flexibility was applied.

7.2.4 Uncertainties and time-series consistency

The uncertainties for activity data and emission factors used for CRT category 5.A *Solid Waste Disposal* are presented in the following table.

Table 7-18 Uncertainty for CRT category 5.A Solid Waste Disposal.

Uncertainty	**CH_4**	**Reference** 2006 IPCC GL, Vol. 5, Chap. 3.7
Activity data (AD)	139%	Based on Table 3.5
Emission factor (EF)	122%	Based on Table 3.4 & 3.5
Combined Uncertainty (U)	184%	$U_{total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

The time-series are considered to be consistent.

7.2.5 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed out:

⇒ Checked of calculations by spreadsheets
- consistent use of energy balance data (energy statistic questionnaires),
- documented sources,
- use of units,
- strictly defined interfaces between spreadsheets/calculation modules,
- unique structure of sheets which do the same,
- record keeping, use of write protection,
- unique use of formulas, special cases are documented/highlighted,
- quick-control checks for data consistency through all steps of calculation.

⇒ cross-checked from three sources: national statistic and EUROST data

⇒ cross checks with other relevant sectors are performed to avoid double counting or omissions;

⇒ time series consistency

⇒ plausibility checks of dips and jumps.

7.2.6 Category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category *5.A Solid Waste Disposal*.

Table 7-19 Recalculations done in CRT category 5.A Solid Waste Disposal

GHG source & sink category	Revisions of data	Type of revision	Type of improvement
5.A.	Waste statistics based on INSTAT	AD	Accuracy
5.A.	Application of model provided with the 2019 Refinements to the 2006 IPCC Guidelines	AD	Accuracy

7.2.7 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 7-20 Planned improvements for CRT category 5.A Solid Waste Disposal

GHG source & sink category	Planned improvement	Type of improvement		Priority
5.A, 5.B., 5.C	Investigation on waste flow: collection, disposal, recycling, incineration with energy and without energy recovery, open burning, composting, etc. • Urban population • Rural population	AD	Accuracy Transparency Comparability Completeness Consistency	high
5.A, 5.B., 5.C	Investigation on waste generation (rate) • by urban and rural population • by composition	AD		high
5.A, 5.B., 5.C	Investigation on waste composition by urban/rual population	AD		

5.A	Investigation on management practices
	• managed SWDS
	  ○ well/poorly – semi aerobic,
	  ○ well/poorly – active-aeration
	• unmanaged SWDS
	  ○ deep
	  ○ shallow
		AD		high

5.A, 5.B., 5.C	Investigation on amount and waste management practices regarding clinic waste, sludge, hazardous waste, etc.	AD		high
5.A, 5.B., 5.C	Investigation on industrial waste generation and industrial waste management practices	AD		high
5.A, 5.B., 5.C	Investigation on illegal dumping in districts/ villages - garbage pit, illegal dumping in rivers / lakes, backyard dumping Investigation on littering	Meth		high
5.A, 5.B., 5.C	Investigation on imports of municipal solid waste (MSW), and other waste	AD		high
5.A	Application of TIER 2 methodology for times series 1950-2022	AD		Medium

7.3 Biological treatment of solid waste (CRT category 5.B)

The following section describes GHG emissions resulting from biological treatment of solid waste, which originates from three different processes:

- Composting,
- anaerobic digestion of organic waste, and
- mechanical-biological (MB) treatment.

Composting and anaerobic digestion of organic waste, such as food waste, garden and park waste and sludge, is common in many countries. Advantages of the biological treatment include:

- reduced volume in the waste material,
- stabilization of the waste,
- destruction of pathogens in the waste material, and
- production of biogas for energy use.

The end products of the biological treatment can, depending on its quality, be recycled as fertilizer and soil amendment, or be disposed in Solid waste disposal sites (SWDS).

Anaerobic treatment is usually linked with methane (CH_4) recovery and combustion for energy, and thus the greenhouse gas emissions from the process should be reported in the Energy Sector.

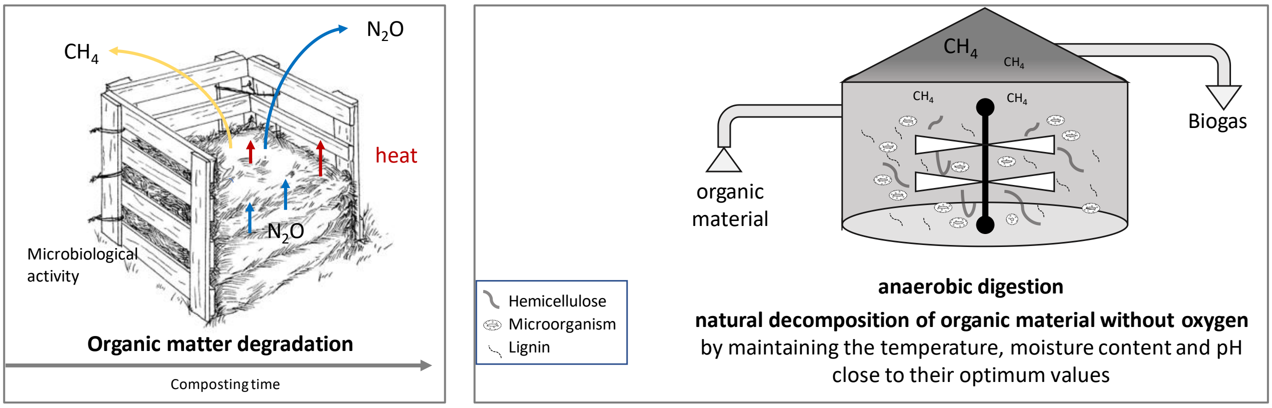


Figure 7-13 Scheme of composting and anaerobic digestion

7.3.1 Composting (CRT category 5.B.1.)

7.3.1.1 Category description

GHG emissions/ removals	CO_2	CH_4	N_2O
5.B.1.a. Municipal solid waste	NA	NE	NE
5.B.1.b. Other	NA	NE	NE
Key Category	-	-	-
A '✓' indicates: emissions from this category have been estimated. Notation keys: IE - included elsewhere, NO – not occurrent, NE - not estimated, NA - not applicable, C – confidential			
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF			

Composting is a preferred method of solid waste disposal in rural area, mainly due to the high percentage of organic material in the waste composition. As no country specific information on composting activities in Albania were available, this category has not been estimated.

7.3.1.2 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored..

Table 7-21 Planned improvements for CRT category Composting (CRT category 5.B.1.).

GHG source & sink category	Planned improvement	Type of improvement		Priority
5.B.1	Investigation on composting activities especially in the rural area and the use of compost in agriculture	AD	Accuracy Completeness	High
5.B.1	Literature study on GHG emissions from (small-scale) illegal dumping and backyard dumping	EF		High

7.3.2 Anaerobic digestion at biogas facilities (CRT category 5.B.2.)

7.3.2.1 Category description

GHG emissions/ removals	CO_2	CH_4	N_2O
5.B.2.a. Municipal solid waste	NA	NO	NO
5.B.2.b. Other (please specify) [5]	NA	NE	NE
Key Category	-	-	-
A '✓' indicates: emissions from this category have been estimated. Notation keys: IE - included elsewhere, NO – not occurrent, NE - not estimated, NA - not applicable, C – confidential			
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF			

7.3.2.2 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 7-22 Planned improvements for CRT category Anaerobic digestion at biogas facilities (CRT category 5.B.2.).

GHG source & sink category	Planned improvement	Type of improvement		Priority
5.B.2.	Investigation on biogas production in agriculture and/or waste sector	AD	Accuracy Completeness	High

7.4 Incineration and Open Burning of Waste (CRT category 5.C)

The following section describes GHG emissions resulting from waste incineration and open burning of waste.

	CO2		CH4		N2O	
	Estimated	Key category	Estimated	Key category	Estimated	Key category
5.C.1. Waste Incineration						
5.C.1.a. Biogenic						
5.C.1.a.i. Municipal solid waste	NO*		NO		NO	
5.C.1.a.ii. Other						
5.C.1.a.ii.1. Industrial solid waste	NE		NE		NE	
5.C.1.a.ii.2. Hazardous waste	NE		NE		NE	
5.C.1.a.ii.3. Clinical waste	✓		✓		✓	
5.C.1.a.ii.4. Sewage sludge	NE		NE		NE	
5.C.1.a.ii.5. Other	NO		NO		NO	
5.C.1.b. Non-biogenic						
5.C.1.b.i. Municipal solid waste	NO*		NO		NO	
5.C.1.b.ii. Other						
5.C.1.b.ii.1. Industrial solid waste	NE		NE		NE	
5.C.1.b.ii.2. Hazardous waste	NE		NE		NE	
5.C.1.b.ii.3. Clinical waste	✓		✓		✓	
5.C.1.b.ii.4. Sewage sludge	NE		NE		NE	
5.C.1.b.ii.5. Fossil liquid waste	NO		NO		NO	
5.C.1.b.ii.6. Other						
5.C.2. Open burning of waste						
5.C.2.a. Biogenic						
5.C.2.a.i. Municipal solid waste	✓		IE	-	IE	
5.C.2.a.ii. Other	NE		NE		NE	
5.C.2.b. Non-biogenic						
5.C.2.b.i. Municipal solid waste	✓		✓		✓	
5.C.2.b.ii. Other	NE		NE		NE	

* CO2 emissions from combustion of biomass materials (e.g. paper, food and wood waste) contained in waste are biogenic emissions and should not be included in the national totals.

A '✓' indicates: emissions from this category have been estimated.
Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential

LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF

In the period 1990 to 2022 GHG emissions from the CRT category 5.C. Waste incineration and Open burning of waste (biogenic/non-biogenic) decreased significantly due to stop of incineration of clinical waste and the ban of open burning of waste.

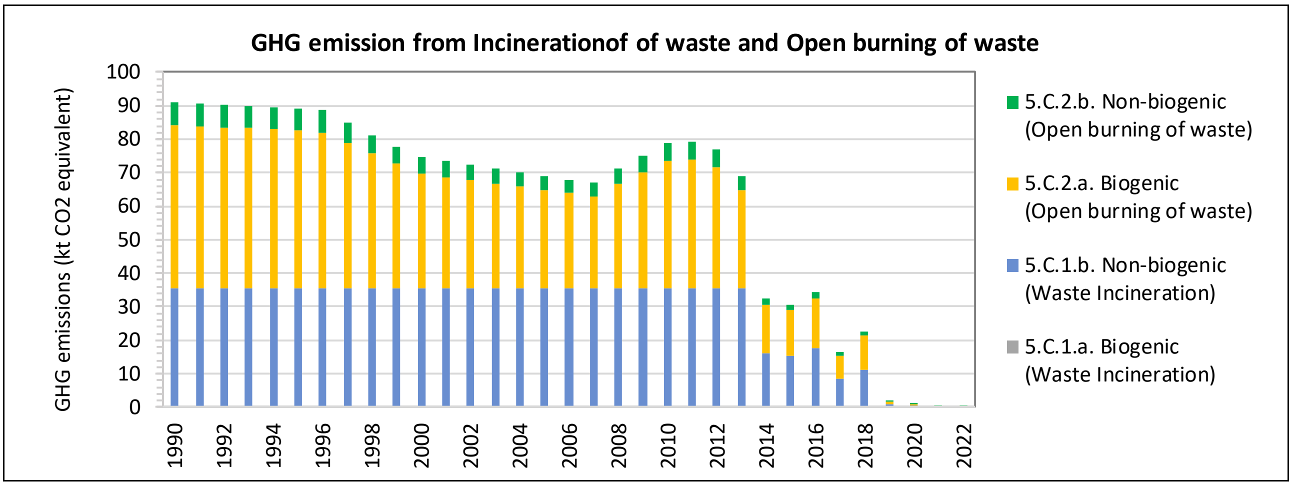


Figure 7-14 GHG emissions IPCC categories 5.C. Waste incineration and Open burning of waste

7.4.1 Waste Incineration

7.4.1.1 Waste Incineration - Municipal solid waste (IPCC categories 5.C.1.a.i and 5.C.1.a.ii)

GHG Emissions from incineration of municipal solid waste (MSW) (biogenic/non-biogenic) without energy recovery are reported in this category, both with a distinction between biogenic/non-biogenic and biogenic emissions.

	CO2		CH4		N2O	
	Estimated	Key category	Estimated	Key category	Estimated	Key category
5.C.1. Waste Incineration						
5.C.1.a. Biogenic (1)						
5.C.1.a.i. Municipal solid waste	NO*	-	NO	-	NO	-
5.C.1.b. Non-biogenic						
5.C.1.b.i. Municipal solid waste	NO*	-	NO	-	NO	-

* CO2 emissions from combustion of biomass materials (e.g. paper, food and wood waste) contained in waste are biogenic emissions and should not be included in the national totals.

A '✓' indicates: emissions from this category have been estimated.

Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential

LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF

The IPCC subcategories 5.C.1.a.i and 5.C.1.a.ii *Waste Incineration - Municipal solid waste (biogenic/non-biogenic)* do not exist in Albania.

7.4.1.2 Waste Incineration - Industrial solid waste (IPCC categories 5.C.1.a.ii.1. and 5.C.1.b.ii.1.)

7.4.1.2.1 Category description

GHG Emissions from incineration of industrial solid waste (biogenic/non-biogenic) without energy recovery are reported in this category, both with a distinction between non-biogenic and biogenic emissions.

	CO2		CH4		N2O	
	Estimated	Key category	Estimated	Key category	Estimated	Key category
5.C.1. Waste Incineration						
5.C.1.a. Biogenic (*)						
5.C.1.a.ii.1. Industrial solid waste	NE*	-	NE	-	NE	-
5.C.1.b. Non-biogenic						
5.C.1.a.ii.1. Industrial solid waste	NE*	-	NE	-	NE	-
* CO2 emissions from combustion of biomass materials (e.g. paper, food and wood waste) contained in waste are biogenic emissions and should not be included in the national totals.						
A '✓' indicates: emissions from this category have been estimated. Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential						
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF						

The IPCC subcategories 5.C.1.a.ii.1. and 5.C.1.b.ii.1. *Industrial solid waste (biogenic/non-biogenic)* were not estimated due to lack of data and resources.

7.4.1.2.2 Description of any flexibility applied

No flexibility was applied.

7.4.1.2.3 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 7-23 Planned improvements for Waste Incineration - Industrial solid waste (CRT category 5.C.1.a.ii.1. and 5.C.1.b.ii.1.).

GHG source & sink category	Planned improvement	Type of improvement		Priority
5.C.1.a.ii.1.	Investigation on incineration of Industrial solid waste (biogenic/non-biogenic)	AD	Completeness	medium

7.4.1.3 Waste Incineration - Hazardous waste (IPCC categories 5.C.1.a.ii.2. and 5.C.1.b.ii.2.)

7.4.1.3.1 Category description

GHG Emissions from incineration of hazardous waste (biogenic/non-biogenic) without energy recovery are reported in this category, both with a distinction between non-biogenic and biogenic emissions.

	CO2		CH4		N2O	
	Estimated	Key category	Estimated	Key category	Estimated	Key category
5.C.1. Waste Incineration						
5.C.1.a. Biogenic (*)						
5.C.1.a.ii.2. Hazardous waste	NE*	-	NE	-	NE	-
5.C.1.b. Non-biogenic						
5.C.1.a.ii.2. Hazardous waste	NE*	-	NE	-	NE	-
* CO2 emissions from combustion of biomass materials (e.g. paper, food and wood waste) contained in waste are biogenic emissions and should not be included in the national totals.						
A '✓' indicates: emissions from this category have been estimated. Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential						
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF						

In general, hazardous waste is landfilled in Albania. However, in the past some landfills burned but no information on amount hazardous waste burned, and number of fires were available. Furthermore, it is possible that hazardous waste is incinerated as it is done with clinical waste in Albania. Therefore IPCC categories 5.C.1.a.ii.2. and 5.C.1.b.ii.2. *Hazardous waste (biogenic/non-biogenic)* are not estimated due to lack of data and resources.

7.4.1.3.2 Description of any flexibility applied

No flexibility was applied.

7.4.1.3.3 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 7-24 Planned improvements for Waste Incineration - Hazardous waste (IPCC categories 5.C.1.a.ii.2. and 5.C.1.b.ii.2.).

GHG source & sink category	Planned improvement	Type of improvement		Priority
5.C.1.a.ii.2.	Investigation on incineration of Hazardous waste (biogenic/non-biogenic)	AD	Completeness	medium

7.4.1.4 Waste Incineration - Clinical waste (IPCC categories 5.C.1.a.ii.3. and 5.C.1.b.ii.3.)

7.4.1.4.1 Source category description

GHG Emissions from incineration of Clinical waste (biogenic/non-biogenic) without energy recovery are reported in this category, both with a distinction between non-biogenic and biogenic emissions.

	CO2		CH4		N2O	
	Estimated	Key category	Estimated	Key category	Estimated	Key category
5.C.1. Waste Incineration						
5.C.1.a. Biogenic (*)						
5.C.1.a.ii.3. Clinical waste	IE	-	IE	-	IE	-
5.C.1.b. Non-biogenic						
5.C.1.a.ii.3. Clinical waste	✓	-	✓	-	✓	-
* CO2 emissions from combustion of biomass materials (e.g. paper, food and wood waste) contained in waste are biogenic emissions and should not be included in the national totals.						
A '✓' indicates: emissions from this category have been estimated. Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential						
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF						

In the period 1990 to 2022 GHG emissions from the CRT category 5.C.1.a.ii.3. and 5.C.1.b.ii.3.Waste Incineration - Clinical waste (biogenic/non-biogenic) decreased significantly and stopped in 2021.

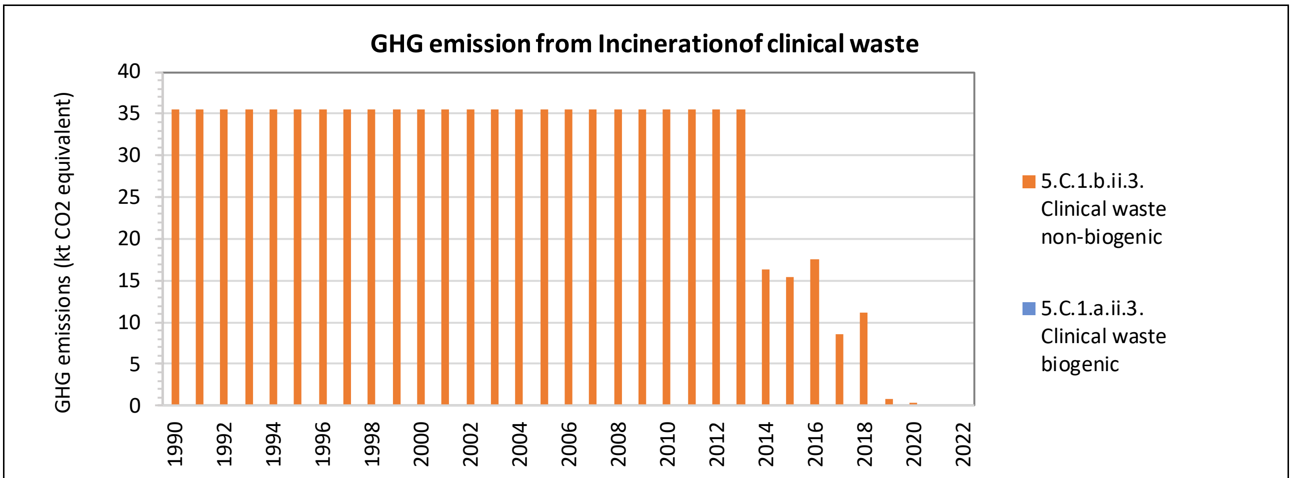


Figure 7-15 GHG emissions IPCC categories 5.C.1.a.ii.3. and 5.C.1.b.ii.3.Waste Incineration - Clinical waste

Table 7-25 GHG emissions and amount of clinical waste incinerated from IPCC categories 5.C.1.a.ii.3. and 5.C.1.b.ii.3.Waste Incineration - Clinical waste

	GHG emissions		CO2 emissions		CH_4 emissions		N_2O emissions		Amount of clinic waste incinerated	
	biogenic	non-biogenic	biogenic	non-biogenic	biogenic	non-biogenic	biogenic	non-biogenic		
Unit	kt CO_2 equivalent		kt						kt	Source
1990	IE	31.65	IE	35.53	IE	0.005	IE	0.014	83.00	As of 2013
1991	IE	31.65	IE	35.53	IE	0.005	IE	0.014	83.00	
1992	IE	31.65	IE	35.53	IE	0.005	IE	0.014	83.00	
1993	IE	31.65	IE	35.53	IE	0.005	IE	0.014	83.00	
1994	IE	31.65	IE	35.53	IE	0.005	IE	0.014	83.00	
1995	IE	31.65	IE	35.53	IE	0.005	IE	0.014	83.00	
1996	IE	31.65	IE	35.53	IE	0.005	IE	0.014	83.00	
1997	IE	31.65	IE	35.53	IE	0.005	IE	0.014	83.00	

	GHG emissions		CO2 emissions		CH_4 emissions		N_2O emissions		Amount of clinic waste incinerated	
	biogenic	non-biogenic	biogenic	non-biogenic	biogenic	non-biogenic	biogenic	non-biogenic		
Unit	kt CO_2 equivalent		kt						kt	Source
1998	IE	31.65	IE	35.53	IE	0.005	IE	0.014	83.00	
1999	IE	31.65	IE	35.53	IE	0.005	IE	0.014	83.00	
2000	IE	31.65	IE	35.53	IE	0.005	IE	0.014	83.00	
2001	IE	31.65	IE	35.53	IE	0.005	IE	0.014	83.00	
2002	IE	31.65	IE	35.53	IE	0.005	IE	0.014	83.00	
2003	IE	31.65	IE	35.53	IE	0.005	IE	0.014	83.00	
2004	IE	31.65	IE	35.53	IE	0.005	IE	0.014	83.00	
2005	IE	31.65	IE	35.53	IE	0.005	IE	0.014	83.00	
2006	IE	31.65	IE	35.53	IE	0.005	IE	0.014	83.00	
2007	IE	31.65	IE	35.53	IE	0.005	IE	0.014	83.00	
2008	IE	31.65	IE	35.53	IE	0.005	IE	0.014	83.00	
2009	IE	31.65	IE	35.53	IE	0.005	IE	0.014	83.00	
2010	IE	31.65	IE	35.53	IE	0.005	IE	0.014	83.00	
2011	IE	31.65	IE	35.53	IE	0.005	IE	0.014	83.00	
2012	IE	31.65	IE	35.53	IE	0.005	IE	0.014	83.00	
2013	IE	31.65	IE	35.53	IE	0.005	IE	0.014	83.00	INSTAT
2014	IE	14.49	IE	16.27	IE	0.002	IE	0.006	38.00	
2015	IE	13.73	IE	15.41	IE	0.002	IE	0.006	36.00	
2016	IE	15.63	IE	17.55	IE	0.002	IE	0.007	41.00	
2017	IE	7.63	IE	8.56	IE	0.001	IE	0.003	20.00	
2018	IE	9.91	IE	11.13	IE	0.002	IE	0.004	26.00	
2019	IE	0.76	IE	0.86	IE	<0.001	IE	<0.001	2.00	
2020	IE	0.38	IE	0.43	IE	<0.001	IE	<0.001	1.00	
2021	NO	NO	NO	NO	NO	NO	NO	NO	NO	
2022	NO	NO	NO	NO	NO	NO	NO	NO	NO	
Trend										
1990 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	
2005 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	
2021 - 2022	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	

7.4.1.4.2 Methodological issues

7.4.1.4.2.1 Choice of methods for estimating CO2 emissions

For estimating the CO_2 emissions, the 2006 IPCC Guidelines Tier 1 approach[196] has been applied.

CO_2 Emission estimate based on the total amount of waste combusted

EQUATION 5.1 (2006 IPCC Guidelines, Volume 5: Waste, Chap. 5)

$$CO_2\ emissions = M \sum_i (SW_i \times dm_i \times CF_i \times FCF_i \times OF_i) \times \frac{44}{12}$$

Where:

CO2 emissions	= $CO2_4$ emissions in inventory year (Gg)
SF_i	= amount of clinic waste (as wet weight incinerated)
dm_i	= dry matter content in the waste (wet weight) incinerated (fraction)
CF_i	= fraction of carbon in the dry matter (total carbon content) (fraction)
FCF_i	= fraction of fossil carbon in the total carbon, (fraction)
OF_i	= oxidation factor (fraction)
44/12	= conversion factor from C to CO_2
i	= clinical waste incinerated

7.4.1.4.2.2 Choice of CO2 emission factor

CO2 emissions from incineration of waste depending on the carbon content in the waste. Country specific information for Albania was not available. Default parameter provided in the 2006 IPCC guidelines were used and presented in the following table.

Table 7-26 Default dry matter content, DOC content, total carbon content and fossil carbon fraction of different MSW components

MSW component	Dry matter content in % of wet weight [1]	DOC content in % of wet waste		DOC content in % of dry waste		Total carbon content in % of dry weight		Fossil carbon fraction in % of total carbon	
	Default	Default	Range	Default	Range [2]	Default	Range	Default	Range
Paper/cardboard	90	40	*36 - 45*	44	*40 - 50*	46	*42 - 50*	1	*0 - 5*
Textiles [3]	80	24	*20 - 40*	30	*25 - 50*	50	*25 - 50*	20	*0 - 50*
Food waste	40	15	*8 - 20*	38	*20 - 50*	38	*20 - 50*	-	-
Wood	85 4	43	*39 - 46*	50	*46 - 54*	50	*46 - 54*	-	-
Garden & Park waste	40	20	*18 - 22*	49	*45 - 55*	49	*45 - 55*	0	*0*
Nappies	40	24	*18 - 32*	60	*44 - 80*	70	*54 - 90*	10	*10*
Rubber and Leather	84	(39) [5]	*(39)* [5]	(47) [5]	*(47)* [5]	67	*67*	20	*20*
Plastics	100	-	-	-	-	75	*67 - 85*	100	*95 - 100*
Metal [6]	100	-	-	-	-	NA	*NA*	NA	*NA*
Glass [6]	100	-	-	-	-	NA	*NA*	NA	*NA*
Other, inert waste	90	-	-	-	-	3	*0 - 5*	100	*50 - 100*

Remark: for footnotes see 2006 IPCC Guidelines Source: Table 2.4, Vol. 5, Chapter 2, 2006 IPCC Guidelines

[196] Source: 2006 IPCC Guidelines, Volume 5: Waste, Chapter 5: Incineration and Open Burning of Waste - 5.2.1 Choice of method for estimating CO_2 emissions

7.4.1.4.2.3 Choice of methods for estimating CH4 emissions

The calculation of CH4 emissions is based on the amount of clinal waste incinerated and on the related emission factor. For estimating the CH4 emissions, the 2006 IPCC Guidelines Tier 1 approach[197] has been applied.

CH4 Emission estimate based on the total amount of waste combusted

EQUATION 5.1 (2006 IPCC Guidelines, Volume 5: Waste, Chap. 5)

$$CH_4\ emissions = \sum_i (IW_i \times EF_i \times 10^{-6})$$

Where:

CH_4 emissions = CH_4 emissions in inventory year (Gg)

IW_i = amount of solid waste of type i incinerated

EF_i = aggregate CH4 emission factor (kg CH4/kt of waste)

i = clinical waste incinerated

7.4.1.4.2.4 Choice of CH4 emission factor

As presented in the 2006 IPCC Guidelines, CH4 emissions from waste incineration are much dependent on the continuity of the incineration process, the incineration technology, and management practices. As no information on technology applied in Albania, the default parameter for batch type incineration using a stoker was chosen and is presented in the following table.

Table 7-27 Default parameter on total carbon content and Fossil carbon fraction in total carbon in clinical waste

Type of incineration/technology		CH_4 Emission Factors	Source
		kg/Gg waste incinerated on a wet weight basis	
Continuous incineration	stoker	0.2	Table 5.3 CH4 emission factors for incineration of MSW; 2006 IPCC Guidelines, Volume 5: Waste, Chapter 5: Incineration and Open Burning of Waste – Section 5.4.2 CH4 emission factors
	fluidised bed	~0	
Semi-continuous incineration	stoker	6	
	fluidised bed	188	
Batch type incineration	stoker	60	
	fluidised bed	237	

[197] Source: 2006 IPCC Guidelines, Volume 5: Waste, Chapter 5: Incineration and Open Burning of Waste - 5.2.2 Choice of method for estimating CH4 emissions

7.4.1.4.2.5 Choice of methods for estimating N2O emissions

The calculation of N2O emissions is based on the amount of clinal waste incinerated and on the related emission factor. For estimating the N2O emissions, the 2006 IPCC Guidelines Tier 1 approach[198] has been applied.

N2O Emission estimate based on the total amount of waste combusted

EQUATION 5.1 (2006 IPCC Guidelines, Volume 5: Waste, Chap. 5)

$$N_2O\ emissions = \sum_i (IW_i \times EF_i \times 10^{-6})$$

Where:

N2O emissions = N2O emissions in inventory year (Gg)

IW_i = amount of solid waste of type i incinerated

EF_i = aggregate CH4 emission factor (kg N2O/kt of waste)

i = clinical waste incinerated

7.4.1.4.2.6 Choice of N2O emission factor

As presented in the 2006 IPCC Guidelines, N2O emissions from waste incineration are much dependent on incineration condition and technology. As no information on technology applied in Albania, the default parameter for plastic waste assuming that plastic waste has a high share in clinic waste was chosen and is presented in the following table.

Table 7-28 Default parameter on total carbon content and Fossil carbon fraction in total carbon in clinical waste

Type of incineration/technology		N2O Emission Factors	Source
		N2O / t waste (wet weight)	
Type of Waste	waste plastics	170	Table 5.5 N2O emission factors for incineration of sludge and industrial waste; 2006 IPCC Guidelines, Volume 5: Waste, Chapter 5: Incineration and Open Burning of Waste – Section 5.4.3 N2O emission factors

7.4.1.4.2.7 Choice of activity data

The amount of clinical waste incinerated was taken from waste statistics of INSTAT. As no data for the period 1990-2012 was available, the data from 2013 was used for this period. In 2021 and 2022 no waste was incinerated anymore as this waste was treated in autoclaves. or exported, landfilled??? The activity data are presented in the Table 7-25 above. As no information on the share of biogenic and non-biogenic content was available, the emissions were estimated based on 100% non-biogenic content (conservative approach).

7.4.1.4.3 Description of any flexibility applied

No flexibility was applied.

[198] Source: 2006 IPCC Guidelines, Volume 5: Waste, Chapter 5: Incineration and Open Burning of Waste - 5.2.3 Choice of method for estimating N2O emissions

7.4.1.4.4 Uncertainties and time-series consistency

The uncertainties for activity data and emission factors used for CRT category 5.C.1.a.ii.3 *Waste Incineration - Clinical waste (biogenic/non-biogenic)* are presented in the following table.

Table 7-29 Uncertainty for IPCC categories 5.C.1.a.ii.3. and 5.C.1.b.ii.3. Waste Incineration - Clinical waste.

Uncertainty		CH_4	N2O	Reference 2006 IPCC GL, Vol. 5
Activity data (AD)	139%	139%	139%	Based on Table 3.5, Chapter 2
Emission factor (EF)	40%	100%	100%	Section 5.7, Chapter 5
Combined Uncertainty (U)	145%	171%	171%	$U_{total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

The time-series are considered to be consistent.

7.4.1.4.5 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed out:

⇒ Checked of calculations by spreadsheets
- consistent use of energy balance data (energy statistic questionnaires),
- documented sources,
- use of units,
- strictly defined interfaces between spreadsheets/calculation modules,
- unique structure of sheets which do the same,
- record keeping, use of write protection,
- unique use of formulas, special cases are documented/highlighted,
- quick-control checks for data consistency through all steps of calculation.

⇒ cross checks with other relevant sectors are performed to avoid double counting or omissions;

⇒ time series consistency

⇒ plausibility checks of dips and jumps.

7.4.1.4.6 Category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category 5.C.1.a.ii.4 *Waste Incineration - Clinical waste (biogenic/non-biogenic)*.

Table 7-30 Recalculations done in IPCC categories 5.C.1.a.ii.3. and 5.C.1.b.ii.3. Waste Incineration - Clinical waste

GHG source & sink category	Revisions of data	Type of revision	Type of improvement
5.C.1.a.ii.3	Change of default parameter	EF	Accuracy

7.4.1.4.7 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 7-31 Planned improvements for Waste Incineration - Clinical waste (IPCC categories 5.C.1.a.ii.3. and 5.C.1.b.ii.3.)

GHG source & sink category	Planned improvement	Type of improvement		Priority
5.C.1.a.ii.3.	Investigation on incineration of Clinical waste • time series 1990 – 2023 • biogenic/non-biogenic content	AD	Completeness	medium

7.4.1.5 Waste Incineration - Sewage sludge (IPCC categories 5.C.1.a.ii.4. and 5.C.1.b.ii.4.)

7.4.1.5.1 Source category description

GHG Emissions from incineration of sewage sludge (biogenic/non-biogenic) without energy recovery are reported in this category, both with a distinction between non-biogenic and biogenic emissions.

	CO2		CH4		N2O	
	Estimated	Key category	Estimated	Key category	Estimated	Key category
5.C.1. Waste Incineration						
5.C.1.a. Biogenic (*)						
5.C.1.a.ii.4. Sewage sludge	NO*	-	NO	-	NO	-
5.C.1.b. Non-biogenic						
5.C.1.a.ii.4. Sewage sludge	NO *	-	NO	-	NO	-

* CO2 emissions from combustion of biomass materials (e.g. paper, food and wood waste) contained in waste are biogenic emissions and should not be included in the national totals.

A '✓' indicates: emissions from this category have been estimated.
Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential

LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF

The IPCC categories 5.C.1.a.ii.4. and 5.C.1.b.ii.4.*Waste Incineration - Sewage sludge(biogenic/non-biogenic)* do not exist in Albania.

7.4.1.5.2 Description of any flexibility applied

No flexibility was applied.

7.4.1.5.3 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 7-32 Planned improvements for Waste Incineration - Sewage sludge (IPCC categories 5.C.1.a.ii.4. and 5.C.1.b.ii.4.)

GHG source & sink category	Planned improvement	Type of improvement		Priority
5.C.1.a.ii.4.	Investigation if incineration of sewage sludge (biogenic/non-biogenic) took place.	AD	Completeness	medium

7.4.1.6 Waste Incineration - Fossil liquid waste (IPCC categories 5.C.1.b.ii.5.)

7.4.1.6.1 Source category description

GHG Emissions from incineration of sewage sludge (biogenic/non-biogenic) without energy recovery are reported in this category, both with a distinction between non-biogenic and biogenic emissions.

	CO2		CH4		N2O	
	Estimated	Key category	Estimated	Key category	Estimated	Key category
5.C.1. Waste Incineration						
5.C.1.a. Biogenic (*)						
5.C.1.a.ii.5. Fossil liquid waste	NA	-	NA	-	NA	-
5.C.1.b. Non-biogenic						
5.C.1.a.ii.5. Fossil liquid waste	NE*	-	NE	-	NE	-

* CO2 emissions from combustion of biomass materials (e.g. paper, food and wood waste) contained in waste are biogenic emissions and should not be included in the national totals.

A '✓' indicates: emissions from this category have been estimated.
Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential

LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF

The CRT category 5.C.1.b.ii.5.*Waste Incineration - Fossil liquid waste* does not exist in Albania.

7.4.1.7 Waste Incineration - Other (CRT category 5.C.1.a.ii.6. and 5.C.1.b.ii.6.)

GHG Emissions from incineration of Other waste mentioned above without energy recovery are reported in this category, both with a distinction between fossil and biogenic emissions.

	CO2		CH4		N2O	
	Estimated	Key category	Estimated	Key category	Estimated	Key category
5.C.1. Waste Incineration						
5.C.1.a. Biogenic (*)						
5.C.1.a.ii.6. Other	NO*	-	NO	-	NO	-
5.C.1.b. Non-biogenic						
5.C.1.a.ii.6. Other	NO *	-	NO	-	NO	-

* CO2 emissions from combustion of biomass materials (e.g. paper, food and wood waste) contained in waste are biogenic emissions and should not be included in the national totals.

A '✓' indicates: emissions from this category have been estimated.
Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential

LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF

The IPCC categories 5.C.1.a.ii.6. and 5.C.1.b.ii.6. *Waste Incineration – Other waste* does not exist in Albania.

7.4.2 Open burning of waste (CRT category 5.C.2)

As described in the 2006 IPCC Guidelines, open burning of waste can be defined as the combustion of unwanted combustible materials such as paper, wood, plastics, textiles, rubber, waste oils and other debris in nature (open-air) or in open dumps, where smoke and other emissions are released directly into the air without passing through a chimney or stack. Open burning of municipal solid waste (MSW) is not well described and an underestimated source of air pollution in developing countries due to lack of information and country specific data. Besides open burned municipal solid waste (MSW) sometimes also industrial solid waste, hazardous waste, clinical waste, sewage sludge, fossil liquid waste, and other waste not mentioned above is open burned.
According to the 2006 IPCC Guidelines waste incineration and open burning of waste produces emissions of CO_2, CH_4 and N_2O.

7.4.2.1 Open burning - Municipal solid waste (IPCC categories 5.C.2.a.i and 5.C.2.b.i)

7.4.2.1.1 Source category description

GHG Emissions from open burning of municipal solid waste (MSW) are reported in this category, both with a distinction between non-biogenic and biogenic emissions.

	CO2		CH4		N2O	
	Estimated	Key category	Estimated	Key category	Estimated	Key category
5.C.1. Open burning						
5.C.2.a.i. Biogenic [(1)]						
5.C.2.a.i. Municipal solid waste	✓*	-	IE	-	IE	-
5.C.2.b. Non-biogenic						
5.C.2.b.i. Municipal solid waste	✓*	-	✓	-	✓	-
* CO2 emissions from combustion of biomass materials (e.g. paper, food and wood waste) contained in waste are biogenic emissions and should not be included in the national totals.						
A '✓' indicates: emissions from this category have been estimated. Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential						
LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF						

In the period 1990 to 2022 GHG emissions from the IPCC categories 5.C.2.a.i and 5.C.2.b.i 6.4.2.1 *Open burning - Municipal solid waste (MSW)* decreased by -99.7% from 48.66 kt CO2 equivalent in 1990 to 0.15 kt CO2 equivalent in 2022. The N2O and CH4 emissions with biogenic origin are included N2O and CH4 emission of non-biogenic origin, as no accurate information on the amount of biogenic waste incinerated was available. See here chapter planned improvements.

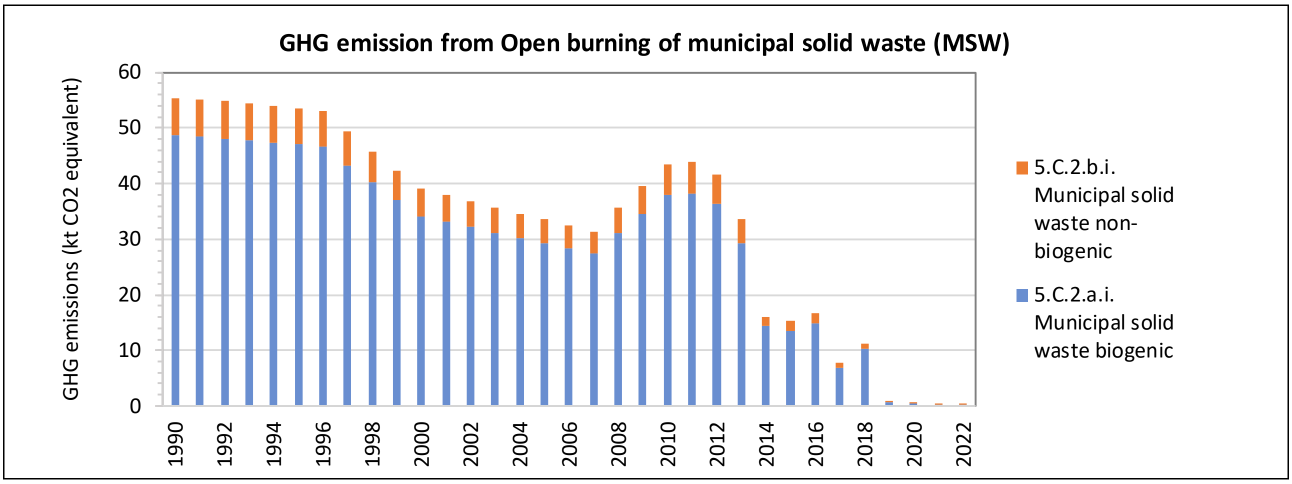


Figure 7-16 GHG emissions CRT category 5.C.2.a.i and 5.C.2.b.i 6.4.2.1 Open burning - Municipal solid waste (MSW)

Table 7-33 GHG emissions and amount of clinical waste incinerated from CRT category 5.C.2.a.i and 5.C.2.b.i 6.4.2.1 *Open burning - Municipal solid waste (MSW)*

	GHG emissions		CO2 emissions		CH_4 emissions		N_2O emissions	
	biogenic	non-biogenic	biogenic	non-biogenic	biogenic	non-biogenic	biogenic	non-biogenic
Unit	kt CO_2 equivalent		kt					
1990	48.66	6.74	48.66	3.81	IE	0.008	IE	0.010
1991	48.39	6.72	48.39	3.79	IE	0.008	IE	0.010
1992	48.09	6.69	48.09	3.78	IE	0.008	IE	0.010
1993	47.75	6.66	47.75	3.76	IE	0.008	IE	0.010
1994	47.39	6.63	47.39	3.75	IE	0.008	IE	0.010
1995	46.99	6.59	46.99	3.72	IE	0.008	IE	0.010
1996	46.56	6.55	46.56	3.70	IE	0.008	IE	0.010
1997	43.30	6.10	43.30	3.45	IE	0.008	IE	0.009
1998	40.15	5.67	40.15	3.21	IE	0.007	IE	0.009
1999	37.11	5.26	37.11	2.97	IE	0.007	IE	0.008
2000	34.18	4.85	34.18	2.75	IE	0.006	IE	0.007
2001	33.17	4.72	33.17	2.67	IE	0.006	IE	0.007
2002	32.18	4.59	32.18	2.60	IE	0.006	IE	0.007
2003	31.20	4.47	31.20	2.53	IE	0.006	IE	0.007
2004	30.24	4.34	30.24	2.46	IE	0.005	IE	0.007
2005	29.30	4.22	29.30	2.39	IE	0.005	IE	0.006
2006	28.37	4.09	28.37	2.32	IE	0.005	IE	0.006
2007	27.46	3.97	27.46	2.25	IE	0.005	IE	0.006
2008	31.12	4.51	31.12	2.56	IE	0.006	IE	0.007
2009	34.61	5.03	34.61	2.85	IE	0.006	IE	0.008
2010	37.91	5.53	37.91	3.13	IE	0.007	IE	0.008
2011	38.29	5.60	38.29	3.17	IE	0.007	IE	0.008
2012	36.27	5.31	36.27	3.01	IE	0.007	IE	0.008
2013	29.23	4.29	29.23	2.43	IE	0.005	IE	0.006
2014	14.29	1.77	14.29	0.91	IE	0.002	IE	0.003

	GHG emissions		CO2 emissions		CH_4 emissions		N_2O emissions	
	biogenic	non-biogenic	biogenic	non-biogenic	biogenic	non-biogenic	biogenic	non-biogenic
Unit	kt CO_2 equivalent		kt					
2015	13.56	1.66	13.56	0.86	IE	0.002	IE	0.003
2016	14.76	1.94	14.76	1.03	IE	0.003	IE	0.003
2017	6.86	1.00	6.86	0.55	IE	0.001	IE	0.002
2018	10.25	1.06	10.25	0.47	IE	0.002	IE	0.002
2019	0.65	0.08	0.65	0.04	IE	<0.001	IE	<0.001
2020	0.34	0.04	0.34	0.02	IE	<0.001	IE	<0.001
2021	0.12	0.01	0.12	0.01	IE	<0.001	IE	<0.001
2022	0.15	0.02	0.15	0.01	IE	<0.001	IE	<0.001
Trend								
1990 - 2022	*-99.7%*	*-99.7%*	*-99.7%*	*-99.7%*	*NA*	*-99.7%*	*NA*	*-99.7%*
2005 - 2022	*-99.5%*	*-99.6%*	*-99.5%*	*-99.6%*	*NA*	*-99.5%*	*NA*	*-99.5%*
2021 - 2022	*23.2%*	*23.6%*	*23.2%*	*23.6%*	*NA*	*21.9%*	*NA*	*21.9%*

7.4.2.1.2 Methodological issues

7.4.2.1.2.1 Choice of methods for estimating CO2 emissions

For estimating the CO_2 emissions, the 2006 IPCC Guidelines Tier 1 approach[199] has been applied.

CO_2 Emission estimate based on the total amount of waste combusted

EQUATION 5.1 (2006 IPCC Guidelines, Volume 5: Waste, Chap. 5)

$$CO_2\ emissions = M \sum_i (SW_i \times dm_i \times CF_i \times FCF_i \times OF_i) \times \frac{44}{12}$$

Where:

CO2 emissions = $CO2_4$ emissions in inventory year (Gg)
SF_i = amount of MSW (as wet weight incinerated)
dm_i = dry matter content in the waste (wet weight) open burned (fraction)
CF_i = fraction of carbon in the dry matter (total carbon content) (fraction)
FCF_i = fraction of fossil carbon in the total carbon, (fraction)
OF_i = oxidation factor (fraction)
44/12 = conversion factor from C to CO_2
i = MSW open burned

7.4.2.1.2.2 Choice of CO2 emission factor

CO2 emissions from open burning depending on the carbon content in the MSW. Country specific information for Albania was available for the period 2013-2022 in waste statistics of INSTAT. For the period 1990-2012 data were extrapolated. Further information is presented on chapter 7.1.2. Default parameter provided in the 2006 IPCC guidelines were used and presented in the following table.

Additionally, the IPCC default oxidation factor of 58% of carbon input is used.[200]

[199] Source: 2006 IPCC Guidelines, Vol. 5: Waste, Chap. 5: Incineration and Open Burning of Waste - 5.2.1 Choice of method for estimating CO_2 emissions

[200] Source: Table 5.2 Default data for CO2 emission factors for incineration and open burning of waste, 2006 IPCC Guidelines, Vol.e 5: Waste, Chap. 5: Incineration and Open Burning of Waste, section 5.4.1 CO2 emission factors

Table 7-34 Default dry matter content, DOC content, total carbon content and fossil carbon fraction of different MSW components

MSW component	Dry matter content in % of wet weight [1]	DOC content in % of wet waste		DOC content in % of dry waste		Total carbon content in % of dry weight		Fossil carbon fraction in % of total carbon	
	Default	Default	Range	Default	Range [2]	Default	Range	Default	Range
Paper/cardboard	90	40	*36 - 45*	44	*40 - 50*	46	*42 - 50*	1	*0 - 5*
Textiles [3]	80	24	*20 - 40*	30	*25 - 50*	50	*25 - 50*	20	*0 - 50*
Food waste	40	15	*8 - 20*	38	*20 - 50*	38	*20 - 50*	-	-
Wood	85 4	43	*39 - 46*	50	*46 - 54*	50	*46 - 54*	-	-
Garden & Park waste	40	20	*18 - 22*	49	*45 - 55*	49	*45 - 55*	0	*0*
Nappies	40	24	*18 - 32*	60	*44 - 80*	70	*54 - 90*	10	*10*
Rubber and Leather	84	(39) [5]	*(39)* [5]	(47) [5]	*(47)* [5]	67	*67*	20	*20*
Plastics	100	-	-	-	-	75	*67 - 85*	100	*95 - 100*
Metal [6]	100	-	-	-	-	NA	*NA*	NA	*NA*
Glass [6]	100	-	-	-	-	NA	*NA*	NA	*NA*
Other, inert waste	90	-	-	-	-	3	*0 - 5*	100	*50 - 100*

Remark: for footnotes see 2006 IPCC Guidelines Source: Table 2.4, Vol. 5, Chapter 2, 2006 IPCC Guidelines

7.4.2.1.2.3 Choice of methods for estimating CH4 emissions

The calculation of CH4 emissions is based on the amount of municipal solid waste (MSW) open burned and on the related emission factor. For estimating the CH4 emissions, the 2006 IPCC Guidelines Tier 1 approach[201] has been applied.

CH4 Emission estimate based on the total amount of waste combusted

EQUATION 5.1 (2006 IPCC Guidelines, Volume 5: Waste, Chap. 5)

$$CH_4\ emissions = \sum_i (IW_i \times EF_i \times 10^{-6})$$

Where:

CH_4 emissions = CH_4 emissions in inventory year (Gg)

IW_i = amount of solid waste of type i open burned

EF_i = aggregate CH4 emission factor (kg CH4/kt of waste)

i = municipal solid waste (MSW) open burned

7.4.2.1.2.4 Choice of CH4 emission factor

For open burning of waste, the default a CH4 emission factor has been used as recommended by the 2006 IPCC Guidelines and presented below.

[201] Source: 2006 IPCC Guidelines, Volume 5: Waste, Chapter 5: Incineration and Open Burning of Waste - 5.2.2 Choice of method for estimating CH4 emissions

Table 7-35 CH4 emission factors for MSW and open burning

Type of incineration		CH4 Emission Factors		Source
		CH4 / t waste (wet weight)	Type of EF	
MSW	Open burning	6500	default	5.4.2 CH4 emission factors; 2006 IPCC Guidelines, Vol. 5: Waste, Chap. 5: Incineration and Open Burning of Waste – Section 5.4.3 N2O emission factors

7.4.2.1.2.5 Choice of methods for estimating N2O emissions

The calculation of N2O emissions is based on the amount of municipal solid waste (MSW) open burned and on the related emission factor. For estimating the N2O emissions, the 2006 IPCC Guidelines Tier 1 approach[202] has been applied.

N2O Emission estimate based on the total amount of waste combusted

EQUATION 5.1 (2006 IPCC Guidelines, Volume 5: Waste, Chap. 5)

$$N_2O\ emissions = \sum_i (IW_i \times EF_i \times 10^{-6})$$

Where:

N2O emissions = N2O emissions in inventory year (Gg)

IW_i = amount of solid waste of type i open burned

EF_i = aggregate CH4 emission factor (kg N2O/kt of waste)

i = municipal solid waste (MSW) open burned

7.4.2.1.2.6 Choice of N2O emission factor

For open burning of waste, the default a CH4 emission factor has been used as recommended by the 2006 IPCC Guidelines and presented below.

Table 7-36 Default parameter on total carbon content and Fossil carbon fraction in total carbon in clinical waste

Type of incineration/technology		N2O Emission Factors	Source
		N2O / t waste (dry weight)	
MSW	Open burning	150	Table 5.6 default N2O emission factors for different types of waste and management practices; 2006 IPCC Guidelines, Volume 5: Waste, Chapter 5: Incineration and Open Burning of Waste – Section 5.4.3 N2O emission factors

7.4.2.1.2.7 Choice of activity data

The amount municipal solid waste (MSW) open burned were taken from waste statistics of INSTAT and are presented in the table below. As no data for the period 1990-2012 was available, the data were extrapolated. For more information see Chapter 7.1.2.

[202] Source: 2006 IPCC Guidelines, Volume 5: Waste, Chapter 5: Incineration and Open Burning of Waste - 5.2.3 Choice of method for estimating N2O emissions

Table 7-37 Management practices of Municipal solid wastes (MSW) for the period 1990 – 2022

	Population	Source	Waste per capita	Source	Total Municipal Solid Waste (MSW)	Source	% to Open Burning for elimination	Source	Amount of waste to Open Burning for elimination	Source
	capita		kg/cap/y		t		%		t	
1990	3 286 500		282.61	extrapolation	869 540	Calculated based on Population and Waste per capita	*15.0*	D	130 431	calculated
1991	3 259 814		284.17		884 389		*14.7*	extrapolation	130 005	
1992	3 190 103		285.74		899 239		*14.4*		129 490	
1993	3 167 478		287.30		914 088		*14.1*		128 886	
1994	3 220 310		288.87		928 937		*13.8*		128 193	
1995	3 248 836		290.43		943 787		*13.5*		127 411	
1996	3 283 000		292.00		958 636		*13.2*		126 540	
1997	3 324 317		282.88		914 338		*12.9*		117 950	
1998	3 354 341		273.75		870 041		*12.6*		109 625	
1999	3 373 445		264.63		825 743		*12.3*		101 566	
2000	3 058 497		255.50		781 446		*12.0*		93 774	
2001	3 063 318	INSTAT	253.63		773 058		*11.8*		91 221	
2002	3 057 018		251.75		764 670		*11.6*		88 702	
2003	3 044 993		249.88		756 282		*11.4*		86 216	
2004	3 034 231		248.01		747 895		*11.2*		83 764	
2005	3 019 634		246.13		739 507		*11.0*		81 346	
2006	3 003 329		244.26		731 119		*10.8*		78 961	
2007	2 981 755		242.38		722 731		*10.6*		76 609	
2008	2 958 266		283.26		836 926		*10.4*		87 040	
2009	2 936 355		324.13		951 121		*10.2*		97 014	
2010	2 918 674		365.00		1 065 316		*10.0*		106 532	
2011	2 907 368		371.00		1 078 634		*10.0*		107 863	
2012	2 903 008		392.00		1 137 979		*9.0*		102 418	
2013	2 897 770		325.00	INSTAT	940 160	INSTAT	*8.8*	calculated	82 734	INSTAT
2014	2 892 394		425.00		1 228 884		*3.1*		38 095	
2015	2 885 796		491.00		1 413 233		*2.5*		35 875	
2016	2 875 592		452.00		1 300 373		*3.2*		40 783	
2017	2 876 591		436.00		1 253 913		*1.6*		19 816	
2018	2 870 324		462.00		1 325 071		*2.0*		25 978	
2019	2 862 427		381.00		1 086 692		*0.2*		744	
2020	2 845 955		369.00		1 047 852		*0.1*		896	
2021	2 829 741		311.00		875 105		*0.0*		311	
2022	2 793 592		295.00		820 322		*0.1*		379	
Trend										
1990-2022	-15.5%		4.4%		-5.7%				-99.7%	
2005-2022	-8.0%		19.9%		10.9%				-99.5%	
2021-2022	-1.2%		-5.1%		-6.3%				21.9%	

7.4.2.1.3 Uncertainties and time-series consistency

The uncertainties for activity data and emission factors used for CRT category 5.C.2.a.i and 5.C.2.b.i are presented in the following table.

Table 7-38 Uncertainty for IPCC categories 5.C.2.a.i and 5.C.2.b.i 6.4.2.1 *Open burning - Municipal solid waste (MSW).*

Uncertainty		CH_4	N2O	**Reference** 2006 IPCC GL, Vol. 5
Activity data (AD)	139%	139%	139%	Based on Table 3.5, Chapter 2
Emission factor (EF)	40%	100%	100%	Section 5.7, Chapter 5
Combined Uncertainty (U)	145%	171%	171%	$U_{total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

The time-series are considered to be consistent.

7.4.2.1.4 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed out:

⇒ Checked of calculations by spreadsheets
  - consistent use of energy balance data (energy statistic questionnaires),
  - documented sources,
  - use of units,
  - strictly defined interfaces between spreadsheets/calculation modules,
  - unique structure of sheets which do the same,
  - record keeping, use of write protection,
  - unique use of formulas, special cases are documented/highlighted,
  - quick-control checks for data consistency through all steps of calculation.

⇒ cross checks with other relevant sectors are performed to avoid double counting or omissions;

⇒ time series consistency

⇒ plausibility checks of dips and jumps.

7.4.2.1.5 Category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category *5.C.2.a.i and 5.C.2.b.i Open burning of MSW*.

Table 7-39 Recalculations done in IPCC categories 5.C.2.a.i and 5.C.2.b.i 6.4.2.1 *Open burning - Municipal solid waste (MSW)*

GHG source & sink category	Revisions of data	Type of revision	Type of improvement
5.C.2.a.i, 5.C.2.b.i	Based on expert judgment recalculation of amount of waste open burned for 1990-2012	AD	Accuracy

7.4.2.1.6 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 7-40 Planned improvements for *Open burning - Municipal solid waste (MSW)* (CRT category 5.C.2.a.i and 5.C.2.b.i)

GHG source & sink category	Planned improvement	Type of improvement		Priority
5.C.1.a.ii.3.	Investigation on Municipal solid waste (MSW) open burned • time series 1990 – 2012 • biogenic/non-biogenic content	AD	Completeness	high

7.4.2.2 Open burning - Other (CRT category 5.C.2.a.ii. and 5.C.2.b.ii.)

7.4.2.2.1 Source category description

This category contains GHG emissions from open burning of other waste than municipal solid waste (MSW):

- Industrial solid wastes
- Hazardous waste
- Clinical waste
- Sewage sludge
- Fossil liquid waste
- Other

In general, these types of waste were not open burned in Albania. This waste was landfilled partly/mainly together with MSW. However, according to literature, in the past some landfills burned but no information on amount waste burned, and number of fires were available.

	CO2		CH4		N2O	
	Estimated	Key category	Estimated	Key category	Estimated	Key category
5.C.1. Waste Incineration						
5.C.1.a. Biogenic (*)						
5.C.2.a.ii. Other	NE*	-	NE	-	NE	-
5.C.1.b. Non-biogenic						
5.C.2.b.ii. Other	NE *	-	NE	-	NE	-

* CO2 emissions from combustion of biomass materials (e.g. paper, food and wood waste) contained in waste are biogenic emissions and should not be included in the national totals.

A '✓' indicates: emissions from this category have been estimated.
Notation keys: IE -included elsewhere, NO – not occurrent, NE -not estimated, NA -not applicable, C – confidential

LA – Level Assessment (in year) without LULUCF; TA – Trend Assessment without LULUCF

The IPCC categories 5.C.2.a.ii. and 5.C.2.b.ii. *Open burning - Other waste* was not estimated due to lack of data and resources.

7.4.2.2.2 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 7-41 Planned improvements for Open burning of Other waste (CRT category 5.C.2.a.ii and 5.C.2.b.ii)

GHG source & sink category	Planned improvement	Type of improvement		Priority
5.C.1.a.ii.3.	Investigation on amount open burned waste such as industrial solid wastes, hazardous waste, clinical waste, sewage sludge, fossil liquid waste, other waste • time series 1990 – 2023 • biogenic/non-biogenic content	AD	Completeness	medium

7.5 Wastewater Treatment and Discharge (CRT category 5.D)

7.5.1 Category description

The following section describes GHG emissions resulting from Wastewater Treatment and Discharge. According to 2006 IPCC Guidelines wastewater can be a source of methane (CH_4) when treated or disposed anaerobically. It can also be a source of nitrous oxide (N_2O) emissions. Carbon dioxide (CO_2) emissions from wastewater are not considered because these are of biogenic origin and should not be included in national total emissions.

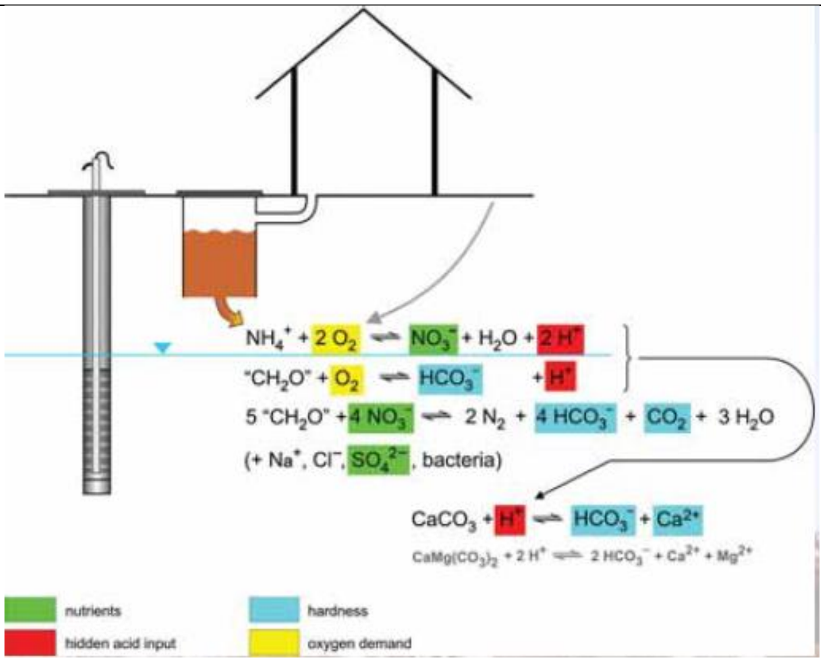


Figure 7-17 Main process of wastewater influence on shallow groundwater[203]

<u>Nitrous Oxide (N_2O)</u>

There are two sources of N_2O emissions:

- Indirect N_2O emissions from discharge of effluent into waterways, lakes and sea;
- Direct N_2O emissions from treatment plants which are low compared to indirect emissions.

Nitrous oxide (N_2O) is associated with the degradation of nitrogen components in the wastewater, e.g., urea, nitrate and protein. Domestic wastewater includes human sewage mixed with other household wastewater, which can include effluent from shower drains, sink drains, washing machines, etc.

<u>Methane (CH_4)</u>

Wastewater as well as its sludge components can produce CH_4 if it degrades anaerobically. The extent of CH_4 production depends primarily on the quantity of degradable organic material in the wastewater, the temperature, and the type of treatment system. With increases in temperature, the rate of CH_4 production increases. This is especially important in uncontrolled systems and in warm climates.

203 Source: Federal Institute for Geosciences and Natural Resources (BGR): Groundwater resources at risk. Germany

The term “sanitation chain” which refers to the sequence according to which wastewater is “handled” along the way from production at the level of the households until its disposal is shown in in the following figures.

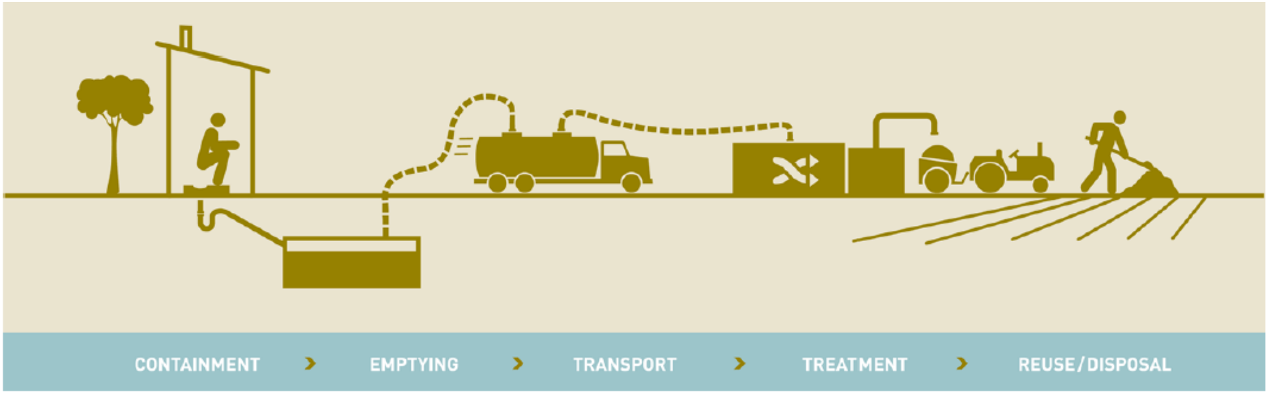


Figure 7-18 The Sanitation Chain

Wastewater is defined as

- domestic effluent consisting of blackwater (excreta, urine and fecal sludge) and grey-water (kitchen and bathing wastewater), or
- water from commercial establishments and institutions, including hospitals, or
- industrial effluent, storm water and other urban run-off.

Sanitation services have, mainly understandably, been given less priority than water supply since people tend to grant more urgency to the provision of water. Access to improved sanitation can have different interpretations from one country to another. Septic tanks, latrines, river and lake discharge and sewer are om many developing countries the main domestic treatment and discharge facilities. In 2016, among the five treatment and discharge systems, latrine facilities were the commonest.

In most developing countries, data on urban and rural areas are generally scarce and, if available, reliable only for the last year. However, according to available data, wastewater collection in rural areas is very low compared to urban areas.

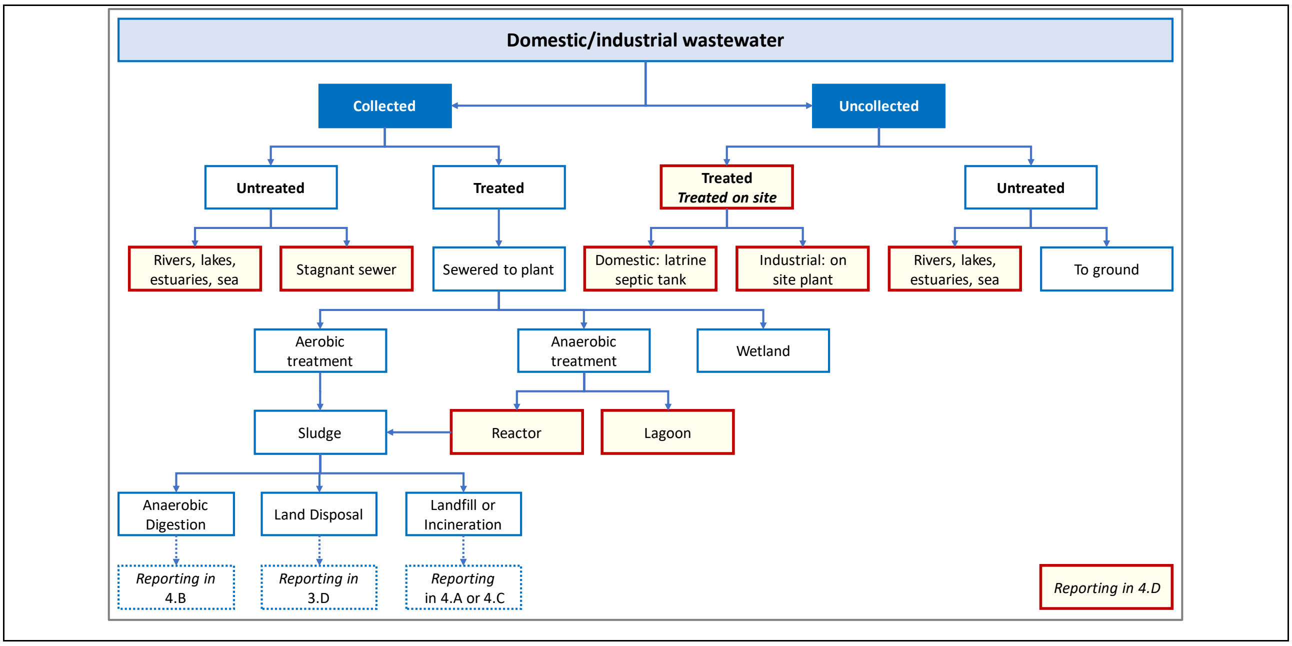


Figure 7-19 Wastewater treatment systems and discharge pathways204

204 Source: 2006 IPCC Guidelines, Volume 5: Waste, Chapter 6: Wastewater Treatment and Discharge - Figure 6.1

In the period 1990 to 2022 GHG emissions from the CRT category 5.D *Wastewater treatment and discharge* decreased by -35.5% from 236.07 kt CO_2 eq in 1990 to 152.34 kt CO_2 eq in 2022. In the period 2005 to 2022 GHG emissions from the Waste sector decreased by -32.9%.

In the period 1990 to 2022 N2O emissions from the CRT category 5.D *Wastewater treatment and discharge* increased by 31.9%from 42.65 kt CO_2 eq in 1990 to 56.27 kt CO_2 eq in 2022. The increase of N_2O emissions is a result of the increased protein supply which is an important parameter for nitrogen generation in the wastewater. In the same period the N2O emissions from 5.C. Incineration and open burning of waste decreased due to stop of incineration of clinical waste and banning of open burning.

In the period 1990 to 2022 CH4 emissions from the CRT category 5.D *Wastewater treatment and discharge* decreased by -50.3% from 193.42 kt CO_2 eq in 1990 to 96.07 kt CO_2 eq in 2022. The decrease of CH4 emissions is a result of the increased share of population connected to waste water treatment plants.

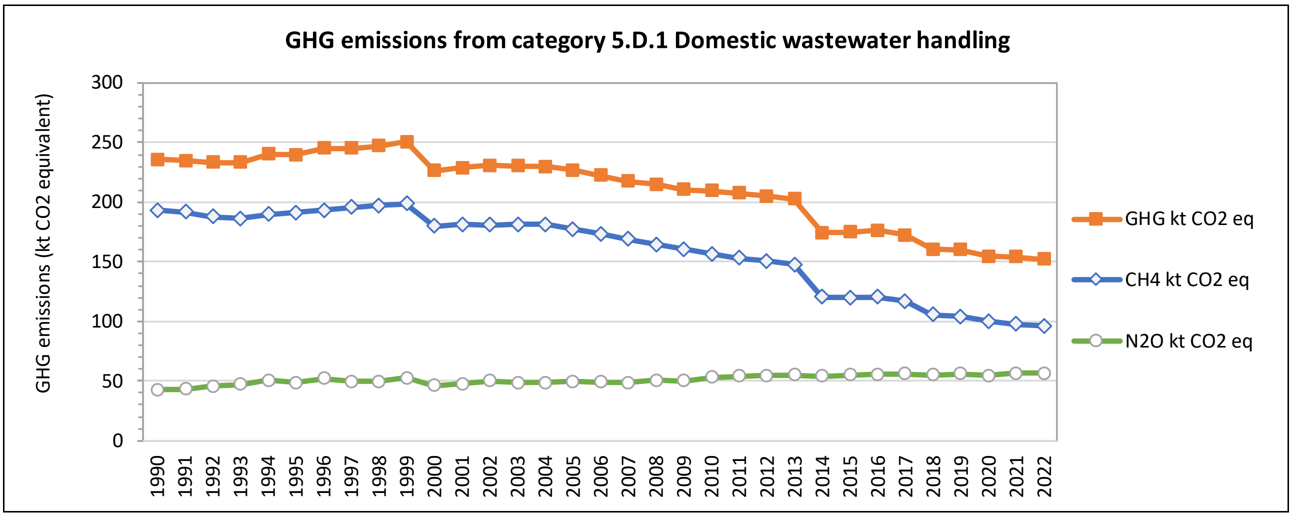


Figure 7-20 GHG emissions CRT category 5.D Wastewater Treatment and Discharge by gas

Table 7-42 CH_4 and N_2O emission from CRT category 5.D Wastewater Treatment and Discharge

	GHG emissions	CH_4 emissions	N_2O emissions
Unit	**kt CO_2 equivalent**	**kt**	**kt**
1990	236.07	6.908	0.161
1991	234.76	6.852	0.162
1992	233.20	6.705	0.172
1993	233.40	6.658	0.177
1994	240.18	6.769	0.191
1995	239.97	6.829	0.184
1996	245.07	6.900	0.196
1997	245.12	6.987	0.187
1998	247.02	7.050	0.187
1999	250.87	7.091	0.197
2000	226.21	6.429	0.174
2001	228.87	6.477	0.179
2002	231.04	6.465	0.189
2003	230.24	6.482	0.184

	GHG emissions	CH_4 emissions	N_2O emissions
Unit	kt CO_2 equivalent	kt	kt
2004	229.72	6.478	0.182
2005	227.05	6.338	0.187
2006	222.51	6.195	0.185
2007	217.40	6.032	0.183
2008	214.92	5.874	0.190
2009	210.46	5.730	0.189
2010	209.63	5.587	0.201
2011	207.49	5.476	0.204
2012	205.01	5.375	0.206
2013	202.57	5.272	0.207
2014	174.49	4.297	0.204
2015	175.06	4.289	0.207
2016	176.17	4.303	0.210
2017	172.63	4.168	0.211
2018	160.51	3.770	0.207
2019	160.11	3.714	0.212
2020	154.68	3.581	0.205
2021	154.03	3.491	0.212
2022	152.34	3.431	0.212
Trend			
1990 - 2022	*-35.5%*	*31.9%*	*-50.3%*
2005 - 2022	*-32.9%*	*13.5%*	*-45.9%*
2021 - 2022	*-1.1%*	*0.0%*	*-1.7%*

7.5.2 Methodological issues

7.5.2.1 Choice of methods – CH_4 emissions

The steps for *good practice* in inventory preparation for CH_4 from domestic wastewater are as follows:

Step 1: Use Equation 6.3 to estimate total organically degradable carbon in wastewater (TOW).

Step 2: Select the pathway and systems (See Figure 7-19 Wastewater treatment systems and discharge pathways (Figure 6.1 in 2006 IPCC GL, Vol. 5, Chapter 6) according to country activity data. Use Equation 6.2 to obtain the emission factor for each domestic wastewater treatment/discharge pathway or system.

Step 3: Use Equation 6.1 to estimate emissions, adjust for possible sludge removal and/or CH_4 recovery and sum the results for each pathway/system.

Total CH4 emissions from domestic wastewater

Equation 6.1, 2006 IPCC GL, Vol. 5, Chapter 6, page 6.11

$$CH_4\ emissions = \left[\sum_{i,j}\left(U_i * T_{i,j} * EF_j\right)\right](TOW - S) - R$$

where

CH_4 Emissions	=	CH_4 emissions in inventory year, kg CH_4/yr
TOW	=	total organics in wastewater in inventory year, kg BOD/yr
S	=	organic component removed as sludge in inventory year, kg BOD/yr
Ui	=	fraction of population in income group i in inventory year, See Table 6.5.
Ti,j	=	degree of utilisation of treatment/discharge pathway or system, j, for each income group fraction i in inventory year, See Table 6.5.
i	=	income group: rural, urban high income and urban low income
j	=	each treatment/discharge pathway or system
EFj	=	emission factor, kg CH_4 / kg BOD
R	=	amount of CH_4 recovered in inventory year, kg CH_4/yr

7.5.2.2 Choice of CH_4 emission factor

The following emission factor provided in the 2006 IPCC guidelines was used. As no information on 'maximum CH4 producing capacity – (Bo)' and 'methane correction factor (MCF)' was available for Albania, the default parameter given in the 2006 IPCC guidelines were use.

CH4 Emission Factor for each Domestic Wastewater Treatment/Discharge Pathway or System

Equation 6.2, 2006 IPCC GL, Vol. 5, Chapter 6, page 6.12

$$EF_J = B_o * MCF_j$$

where

EFj	= emission factor, kg CH_4/kg BOD
j	= each treatment/discharge pathway or system
Bo	= maximum CH_4 producing capacity, kg CH_4/kg BOD
MCFj	= methane correction factor (fraction) (MCF = 0)

Table 7-43 Producing capacity (B_o) for domestic wastewater.

Parameter	Value	Source
Bo Producing capacity for domestic wastewater	0.6 kg CH_4/kg BOD	Table 6.2, 2006 IPCC GL, Vol. 5, Chap. 6, page 6.12

Table 7-44 Type of treatment and discharge pathway or system

Type of treatment and discharge pathway or system	Comments	MCF Default values for domestic wastewater
Untreated system		
Sea, river and lake discharge	Rivers with high organics loadings can turn anaerobic.	0.1
Stagnant sewer	Open and warm	0.5
Flowing sewer (open or closed)	Fast moving, clean. (Insignificant amounts of CH_4 from pump stations, etc)	0
Treated system		
Centralized, aerobic treatment plant	Must be well managed. Some CH_4 can be emitted from settling basins and other pockets.	0
Centralized, aerobic treatment plant	Not well managed. Overloaded.	0.3
Anaerobic digester for sludge	CH_4 recovery is not considered here.	0.8
Anaerobic reactor	CH_4 recovery is not considered here.	0.8
Anaerobic shallow lagoon	Depth less than 2 meters, use expert judgment.	0.2
Anaerobic deep lagoon	Depth more than 2 meters	0.8
Septic system	Half of BOD settles in anaerobic tank.	0.5
Latrine	Dry climate, ground water table lower than latrine, small family (3-5 persons)	0.1
Latrine	Dry climate, ground water table lower than latrine, communal (many users)	0.5
Latrine	Wet climate/flush water use, ground water table higher than latrine	0.7
Latrine	Regular sediment removal for fertilizer	0.1
Source : TABLE 6.3, 2006 IPCC GL, Vol. 5, Chapter 6, page 6.13		

7.5.2.3 Choice of activity data – CH_4 emission

The activity data presented below are taken from the following sources.

	Information	Source	Remark
1.	Population	INSTAT	1990-2022
2.	Population connected to WWTP (treated)	EUROSTAT	1990-2013: NE 2014-2021 2022: as of 2021
3.	Population connected, but untreated	WHO/UNICEF WASH[205] (Joint Monitoring Programme for Water Supply, Sanitation and Hygiene)	1990-1999: as of 2000 2000-2022
4.	Population using septic tanks		
5.	Population using latrines and similar		
6.	Population using unimproved sanitation		
7.	Population using open defecation		

205 Available (15.01.2024) on https://washdata.org/

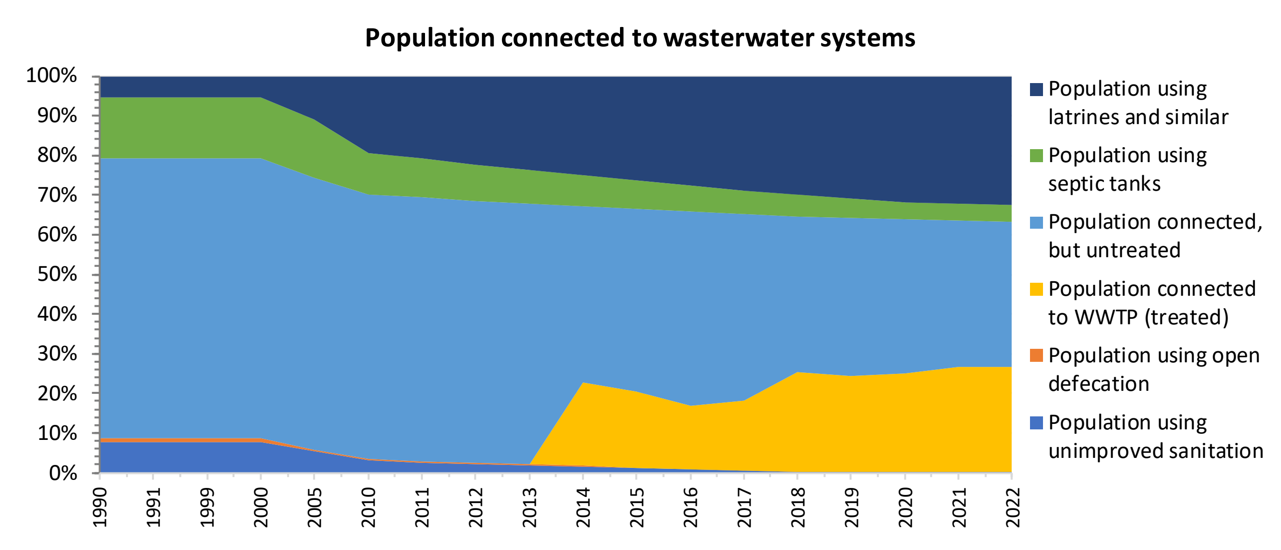


Figure 7-21 Share of population connected to WWTP, using septic tanks or latrines for the period of 1990-2022

Table 7-45 Total population and share of population connected to WWTP, using septic tanks or latrines

	Total population	Population					
		connected to WWTP (treated)	connected, but untreated	using septic tanks	using latrines and similar	using unimproved sanitation	using open defecation
Source	INSTAT	EUROSTAT	WASH				
Unit	heads	%					
1990	3 286 500	NO	70.6	15.4	5.3	7.8	0.9
1991	3 259 814	NO	70.6	15.4	5.3	7.8	0.9
1992	3 190 103	NO	70.6	15.4	5.3	7.8	0.9
1993	3 167 478	NO	70.6	15.4	5.3	7.8	0.9
1994	3 220 310	NO	70.6	15.4	5.3	7.8	0.9
1995	3 248 836	NO	70.6	15.4	5.3	7.8	0.9
1996	3 283 000	NO	70.6	15.4	5.3	7.8	0.9
1997	3 324 317	NO	70.6	15.4	5.3	7.8	0.9
1998	3 354 341	NO	70.6	15.4	5.3	7.8	0.9
1999	3 373 445	NO	70.6	15.4	5.3	7.8	0.9
2000	3 058 497	NO	70.6	15.4	5.3	7.8	0.9
2001	3 063 318	NO	70.0	15.5	6.4	7.3	0.8
2002	3 057 018	NO	69.5	15.4	7.5	6.8	0.8
2003	3 044 993	NO	69.1	15.5	8.5	6.2	0.7
2004	3 034 231	NO	68.7	15.5	9.4	5.7	0.7
2005	3 019 634	NO	68.3	14.7	11.1	5.3	0.6
2006	3 003 329	NO	67.9	13.9	12.8	4.8	0.6
2007	2 981 755	NO	67.6	13.0	14.6	4.3	0.5
2008	2 958 266	NO	67.2	12.2	16.2	3.9	0.5
2009	2 936 355	NO	67.0	11.4	17.8	3.4	0.4
2010	2 918 674	NO	66.7	10.6	19.3	3.0	0.4
2011	2 907 368	NO	66.4	9.9	20.8	2.6	0.3

	Total population	Population					
		connected to WWTP (treated)	connected, but untreated	using septic tanks	using latrines and similar	using unimproved sanitation	using open defecation
Source	**INSTAT**	**EUROSTAT**	**WASH**				
Unit	**heads**	**%**					
2012	2 903 008	NO	66.0	9.2	22.3	2.2	0.3
2013	2 897 770	NO	65.7	8.5	23.7	1.9	0.2
2014	2 892 394	20.9	44.6	7.8	25.0	1.5	0.2
2015	2 885 796	19.0	46.2	7.2	26.3	1.2	0.1
2016	2 875 592	16.0	48.9	6.5	27.6	0.9	0.1
2017	2 876 591	17.5	47.3	5.9	28.8	0.5	0.1
2018	2 870 324	25.0	39.5	5.3	30.0	0.2	NO
2019	2 862 427	24.2	39.8	4.8	31.0	0.2	NO
2020	2 845 955	24.8	39.0	4.2	31.9	0.1	NO
2021	2 829 741	26.5	37.0	4.2	32.2	0.1	NO
2022	2 793 592	26.5	36.7	4.1	32.6	0.1	NO
Trend							
1990-2022	-15.0%	NA	-48.0%	-73.4%	515.1%	-98.7%	NA
2005-2022	-7.5%	NA	-46.3%	-72.1%	193.7%	-98.1%	NA
2021-2022	-1.3%	0.0%	-0.8%	-2.4%	1.2%	0.0%	NA

Additionally, the total amount of organically degradable material in the wastewater (TOW) is needed. This parameter is a function of human population and BOD generation per person. It is expressed in terms of biochemical oxygen demand (kg BOD/year). The equation for TOW is:

Total Organically Degradable Material in Domestic Wastewater

Equation 6.3, 2006 IPCC GL, Vol. 5, Chapter 6, page 6.13

$$TOW = P * BOD * 0.001 * I * 365$$

where

- TOW = total organics in wastewater in inventory year, kg BOD/yr
- P = country population in inventory year, (person)
- BOD = country-specific per capita BOD in inventory year, g/person/day
- 0.001 = conversion from grams BOD to kg BOD
- I = correction factor for additional industrial BOD discharged into sewers (for collected the default is 1.25, for uncollected the default is 1.00.)

A country specific BOD was not available. A biochemical oxygen demand of 60 g/person/day was used and was taken from the 2006 IPCC Guidelines[206]

[206] 2006 IPCC Guidelines, Volume 5, Chapter 6, section 6.3.1.1

7.5.2.4 Choice of methods – N_2O emissions

The N_2O emissions are estimated according to TIER 1 methodology from 2006 IPCC GL:

Total N_2O emissions from wastewater effluent

Equation 6.7, 2006 IPCC GL, Vol. 5, Chapter 6, page 6.25

$$N_2O\ emissions = N_{effluent} * EF_{effluent} * \frac{44}{28}$$

Where

N_2O emissions = N_2O emissions in inventory year, kg N_2O/yr

$N_{EFFLUENT}$ = nitrogen in the effluent discharged to aquatic environments, kg N/yr

$EF_{EFFLUENT}$ = emission factor for N_2O emissions from discharged to wastewater, kg N_2O-N/kg N

44/28 = The factor 44/28 is the conversion of kg N_2O-N into kg N_2O.

7.5.2.5 Choice of N_2O emission factor

The total annual amount of nitrogen in the wastewater effluent is estimated according to Default emission factors from the 2019 Refinement to the 2006 IPCC Guidelines were applied and are presented in the following table.

Table 7.46 Tier 1 emission factors for category 5.A Solid waste disposal on land.

Pollutant	Value	Unit	Type pf EF	Source
N_2O	0.005	kg N2O-N/kg N	Default	2019 Refinement to the 2006 IPCC Guidelines, Vol. 5, Chap. 6, section 6.3.1.2 Choice of emission factors

7.5.2.6 Choice of activity data – N_2O emission

The total nitrogen in the effluent is estimated according to TIER 1 methodology from 2006 IPCC GL:

Total nitrogen in the effluent

Equation 6.8, 2006 IPCC GL, Vol. 5, Chapter 6, page 6.25

$$N_{Effluent} = (P * Protein * F_{NRP} * F_{non-con}) - N_{sludge}$$

Where:

$N_{EFFLUENT}$ = total annual amount of nitrogen in the wastewater effluent, kg N/yr

P = human population

Protein = annual per capita protein consumption, kg/person/yr

F_{NPR} = fraction of nitrogen in protein, default = 0.16, kg N/kg protein

$F_{NON-CON}$ = factor for non-consumed protein added to the wastewater

$F_{IND-COM}$ = factor for industrial and commercial co-discharged protein into the sewer system

N_{SLUDGE} = nitrogen removed with sludge (default = zero), kg N/yr

The number of populations is taken from INSTAT. The per capita protein consumption is taken from the food balances of FAO207

207 Available (21.01.2024) on https://www.fao.org/faostat/en/#data/FBS

Table 7-47 Total population and pPer capita protein consumption

	Total population	Per capita protein consumption	
Source	INSTAT	FAO	Calculated based on FAO
Unit	heads	(g/person/ day)	(kg/person/ year)
1990	3 286 500	77.62	28.33
1991	3 259 814	78.73	28.74
1992	3 190 103	85.22	31.11
1993	3 167 478	88.73	32.39
1994	3 220 310	94.08	34.34
1995	3 248 836	89.78	32.77
1996	3 283 000	94.47	34.48
1997	3 324 317	89.02	32.49
1998	3 354 341	88.45	32.28
1999	3 373 445	92.78	33.86
2000	3 058 497	90.37	32.99
2001	3 063 318	92.80	33.87
2002	3 057 018	97.86	35.72
2003	3 044 993	95.74	34.95
2004	3 034 231	95.29	34.78
2005	3 019 634	98.22	35.85
2006	3 003 329	97.65	35.64
2007	2 981 755	97.29	35.51
2008	2 958 266	101.97	37.22
2009	2 936 355	101.91	37.20
2010	2 918 674	109.02	39.79
2011	2 907 368	111.43	40.67
2012	2 903 008	112.32	41.00
2013	2 897 770	113.40	41.39
2014	2 892 394	112.03	40.89
2015	2 885 796	113.90	41.57
2016	2 875 592	115.80	42.27
2017	2 876 591	116.27	42.44
2018	2 870 324	114.52	41.80
2019	2 862 427	117.28	42.81
2020	2 845 955	114.34	41.73
2021	2 829 741	118.93	43.41
2022	2 793 592	118.93	43.41

7.5.3 Uncertainties and time-series consistency

The uncertainties for activity data and emission factors used for CRT category 5.D *Wastewater Treatment and Discharge* are presented in the following table.

Table 7-48 Uncertainty for CRT category 5.D Wastewater Treatment and Discharge.

Uncertainty	CH_4	N2O	**Reference** 2006 IPCC GL, Vol. 5, Chap. 6
Activity data (AD)	62%		Based on Table 6.7
		150%	Based on Table 6.11
Emission factor (EF)	66%		Based on Table 6.7
		250%	Based on Table 6.11
Combined Uncertainty (U)	91%	292%	$U_{total} = \sqrt{U_{AD}^2 + U_{EF}^2}$

The time-series are considered to be consistent with the data reported in the population statistics.

7.5.4 Category-specific QA/QC and verification

The following source-specific QA/QC activities were performed out:

⇒ Checked of calculations by spreadsheets
  - consistent use of energy balance data (energy statistic questionnaires),
  - documented sources,
  - use of units,
  - strictly defined interfaces between spreadsheets/calculation modules,
  - unique structure of sheets which do the same,
  - record keeping, use of write protection,
  - unique use of formulas, special cases are documented/highlighted,
  - quick-control checks for data consistency through all steps of calculation.

⇒ cross checks with other relevant sectors are performed to avoid double counting or omissions;

⇒ time series consistency

⇒ plausibility checks of dips and jumps.

7.5.5 Category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends

The following table presents the main category-specific recalculations including explanatory information and justifications for recalculations, changes made in response to the review process and impacts on emission trends done since the last submission to the UNFCCC and relevant to CRT category 5.D *Wastewater Treatment and Discharge*.

Table 7-49 Recalculations done in CRT category 5.D *Wastewater Treatment and Discharge*

GHG source & sink category	Revisions of data	Type of revision	Type of improvement
5.D	Revision of share of Wastewater Treatment and Discharge system as WASH data and EUROSTAT data were used	AD	Accuracy
5.D	Revision of protein supply	AD	Accuracy

7.5.6 Category-specific planned improvements including tracking of those identified in the review process

The following table presents the main category-specific planned improvements including tracking of those identified in the review process. Considering the potential contribution of identified improvements in the total GHG emissions and removals and the corresponding resources needed to make these improvements effective, will be explored.

Table 7-50 Planned improvements for CRT category 5.D Wastewater Treatment and Discharge

<table>
<tr><th>GHG source & sink category</th><th>Planned improvement</th><th colspan="2">Type of improvement</th><th>Priority</th></tr>
<tr><td>5.D</td><td>Investigation on wastewater flow: collection – treatment and discharge pathways and systems
• in general
• for Urban population (high / low income)
• for Rural population</td><td>AD</td><td rowspan="5">Accuracy
Transparency
Comparability
Completeness
Consistency</td><td>High</td></tr>
<tr><td>5.D</td><td>Estimation of amount of wastewater treated
• in general
• for urban population (high / low income)
• for rural population</td><td>AD</td><td>High</td></tr>
<tr><td>5.D</td><td>Investigation on and use of metadata prepared for and submitted to WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP)</td><td>AD</td><td>High</td></tr>
<tr><td>5.D</td><td>Investigation of flow and amount of industrial wastewater</td><td>AD</td><td>High</td></tr>
<tr><td>5.D</td><td>Sludge separation and annual amount of sludge removal that is
• dumped
• applied to soil (agriculture)
• incinerated</td><td>AD</td><td>Medium</td></tr>
<tr><td>5.D</td><td>Estimation of emissions from plant; application of guidance provided in the 2019 Refinements to the 2006 IPCC Guidelines</td><td>method</td><td>Completeness
Accuracy</td><td>High</td></tr>
</table>

8 Other (CRT sector 6)

Albania does not report any emissions under CRT sector 6 Other.

9 Indirect carbon dioxide and nitrous oxide emissions

10 Recalculations and Improvements

Recalculations of previously submitted inventory data are performed with the only purpose to improve the GHG inventory. This chapter quantifies the changes in emissions for all greenhouse gases compared to the previous submission.

10.1.1 Explanations and justifications for recalculations

Compiling an emission inventory includes data collecting, data transfer and data processing. Data has to be collected from different sources, for instance national statistics, plant operators, studies, personal information or other publications. The provided data must be transferred from different data formats and units into a unique electronic format to be processed further. The calculation of emissions by applying methodologies on the collected data and the final computing of time series into a predefined reporting format are further steps in the preparation of the final submission.

Finally, the submission must be delivered in due time. Even though a QA/QC system gives assistance so that potential error sources are minimized it is sometimes necessary to make some revisions (called recalculations) under the following circumstances:

- An emission source was not considered in the previous inventory.
- A source/data supplier has delivered new data. The causes might be: Previous data were preliminary data only (by estimation, extrapolation), improvements in methodology.
- Occurrence of errors in data transfer or processing: wrong data, unit-conversion, software errors, etc.
- Methodological changes: a new methodology must be applied to fulfil the reporting obligations caused by one of the following reasons:
    - to decrease uncertainties.
    - an emission source becomes a key source.
    - consistent input data needed for applying the methodology is no longer accessible.
    - input data for more detailed methodology is now available.
    - the methodology is no longer appropriate.

Detailed information on recalculations and their justifications can be found in the following subchapters as well as the corresponding Sector-specific Chapters of the sectors Energy, IPPU, Agriculture, LULUCF and Waste, in which all methodological changes and activity data updates that led to recalculations of emissions with respect to the previous submission are listed.

10.1.2 Recalculations including explanatory information and justifications

GHG source & sink category	Revisions of data	Type of revision	Type of improvement
	•		

10.1.3 Implications for emission and removal levels

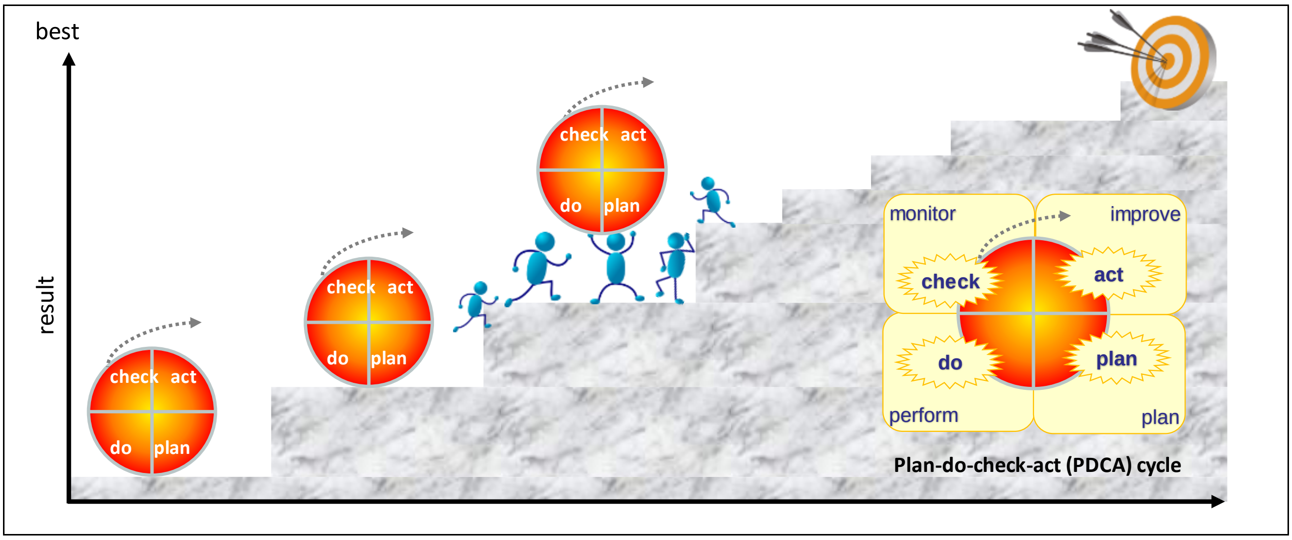
An analysis on the implications for emission and removal levels was not performed.

10.1.4 Implications for emission and removal trends, including time-series consistency

An analysis on the implications for emission and removal levels trends was not performed.

10.1.5 Planned improvements

In the following table the planned improvements are listed. Depending on the resources and priorities, the improvements will be implemented within the next inventory cycles.


best
result
check act
do plan
check act
do plan
check act
do plan
monitor
improve
check
act
do
plan
perform
plan
Plan-do-check-act (PDCA) cycle

10.1.6 Planned improvements for Cross-cutting topics

ITEM	Planned improvement	Type of improvement		Priority

10.1.7 Planned improvements for CRT sector 1 Energy

GHG source & sink category	Planned improvement	Type of improvement		Priority
	(1)			

10.1.8 Planned improvements for CRT sector 2 IPPU

GHG source & sink category	Planned improvement	Type of improvement		Priority

10.1.9 Planned improvement for CRT sector 3 Agriculture

GHG source & sink category	Planned improvement	Type of improvement		Priority

10.1.10 Planned improvements for CRT sector 4 LULUCF

GHG source & sink category	Planned improvement	Type of improvement		Priority

10.1.11 Planned improvements for CRT sector 5 Waste

GHG source & sink category	Planned improvement	Type of improvement		Priority
	•			
	•			
	•			
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11 Annexes to the National Inventory Report (NID)

11.1 Annex I: Key categories

In the following are provided

(1) Description of the approach used for identifying key categories, if different from the IPCC tier 1 approach
(2) Information on the level of disaggregation
(3) Tables 4.2–4.3 of volume 1 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, including and excluding LULUCF

Table 11-1 Level Assessment - excluding LULUCF 1990

CRT category Code	CRT category	GHG	Year 1990 Estimate $E_{x,t}$	Level Assessment $L_{x,t}$	Cumulative Total of $L_{x,t}$
			kt CO_2-equivalent		

Table 11-2 Level Assessment - excluding LULUCF 2022

CRT category Code	CRT category	GHG	Year 1990 Estimate $E_{x,t}$	Level Assessment $L_{x,t}$	Cumulative Total of $L_{x,t}$
			kt CO_2-equivalent		

Table 11-3 Trend Assessment: Key categories excluding LULUCF 1990 - 2022

Trend Assessment		GHG	Base Year (1990) Estimate $E_{x,0}$	Latest Year (2022) Estimate $E_{x,t}$	Trend Assessment $L_{x,t}$	% Contribution to the trend	Cumulative Total of $L_{x,t}$
IPCC Code	IPCC Category		Gg CO_2-equivalent		$L_{x,t}$		

T

able 11-4 Level Assessment - including LULUCF 1990

CRT category Code	CRT category	GHG	Year 1990 Estimate $E_{x,t}$	Level Assessment $L_{x,t}$	Cumulative Total of $L_{x,t}$
			kt CO_2-equivalent		

Table 11-5 Level Assessment - including LULUCF 2022

CRT category Code	CRT category	GHG	Year 1990 Estimate $E_{x,t}$	Level Assessment $L_{x,t}$	Cumulative Total of $L_{x,t}$
			kt CO_2-equivalent		

Table 11-6 Trend Assessment: Key categories including LULUCF 1990 - 2022

Trend Assessment		GHG	Base Year (1990) Estimate $E_{x,0}$	Latest Year (2022) Estimate $E_{x,t}$	Trend Assessment $L_{x,t}$	% Contribution to the trend	Cumulative Total of $L_{x,t}$
IPCC Code	IPCC Category		Gg CO_2-equivalent		$L_{x,t}$		

11.2 Annex II: Uncertainty analysis

In the following table is provided detailed information on the Approach 1 uncertainty analysis using the IPCC tool of the 2019 Refinement to the 2006 IPCC Guidelines.

Table 11-7 Approach 1 uncertainty analysis for the period 1990 - 2022

CRT category code	CRT category name	Gas	Base year emissions or removals	Year t emissions or removals	Activity data uncertainty	Emission factor uncertainty [208]	Combined uncertainty	Contribution to variance by category in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend [209] in national emissions introduced by EF uncertainty	Uncertainty in trend [210] in national emissions introduced by AD uncertainty	Uncertainty introduced into the trend in total national emissions
			kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%

208 Emission factor /estimation parameter uncertainty

209 Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty

210 Uncertainty in trend in national emissions introduced by activity data uncertainty

CRT category code	CRT category name	Gas	Base year emissions or removals	Year t emissions or removals	Activity data uncertainty	Emission factor uncertainty 208	Combined uncertainty	Contribution to variance by category in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend 209 in national emissions introduced by EF uncertainty	Uncertainty in trend 210 in national emissions introduced by AD uncertainty	Uncertainty introduced into the trend in total national emissions
			kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
Total			4 510.13	3 424.66			10 298	42.25					10.66
					Percentage uncertainty in total inventory			6.5				Trend uncertainty	3.3

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12.1 Units and abbreviations

12.2 Units and abbreviations, and standard equivalents

Unit	Abbreviation	Equivalents	Equivalents
1 tonne of oil equivalent (toe)	1 toe	1 x 10^{10} calories	1 x 10^{10} cal
1 ktoe		41.868 terajoules	41.868 TJ
1 short ton	1 sh t	0.9072 tonne	0.9072 t
1 tonne	1 t	1.1023 short tons	1.1023 sh t
1 kilogram	1 kg	2.2046 pounds	2.2046 lb
1 hectare	1 ha	10^4 square meters	10^4 m^2
1 $calorie_{IT}$	1 cal_{IT}	4.1868 Joules	4.1868 J
1 atmosphere	1 atm	101.325 kilopascal	101.325 kPa
1 gram	1 g	0.002205 pounds	0.00205 lb
1 pound	1 lb	453.6 gram	453.6 g
1 terajoule	1 TJ	2.78 x 10^5 kilo Watt hour	2.78 x 10^5 kWh
1 kilowatt hour	1 kWh	3.6 x 10^6 Joules	3.6 x 10^6 J

Source: 2006 IPCC Guidelines, Volume 1: General Guidance and Reporting, Annex 8A.1: Prefixes, units and abbreviations, standard equivalents

12.3 Derived units

Tons			Grams			Equivalents*				
Multiple	Name	Symbol	Multiple	Name	Symbol	Tonnes (t)	Kilograms (kg)	Grams (g)	US/short tons (ST)†	Imperial/long tons (LT)†
10^0	tonne	t	10^6	megagram	Mg	1 t	1 000 kg	1 million g	1.1023 ST	0.98421 LT
10^3	kilotonne	kt	10^9	gigagram	Gg	1 000 t	1 million kg	1 billion g	1 102.3 ST	984.21 LT
10^6	megatonne	Mt	10^{12}	teragram	Tg	1 million t	1 billion kg	1 trillion g	1.1023 million ST	984,210 LT
10^9	gigatonne	Gt	10^{15}	petagram	Pg	1 billion t	1 trillion kg	1 quadrillion g	1.1023 billion ST	984.21 million LT
10^{12}	teratonne	Tt	10^{18}	exagram	Eg	1 trillion t	1 quadrillion kg	1 quintillion g	1.1023 trillion ST	984.21 billion LT
10^{15}	petatonne	Pt	10^{21}	zettagram	Zg	1 quadrillion t	1 quintillion kg	1 sextillion g	1.1023 quadrillion ST	984.21 trillion LT
10^{18}	exatonne	Et	10^{24}	yottagram	Yg	1 quintillion t	1 sextillion kg	1 septillion g	1.1023 quintillion ST	984.21 quadrillion LT

(*The equivalent units columns use the short scale large-number naming system currently used in most English-language countries, e.g. 1 billion = 1 000 million = 1 000 000 000)

Source: https://en.wikipedia.org/wiki/Tonne

12.4 Prefixes and multiplication factors

Multiplication Factor	Abbreviation	Prefix	Symbol
1 000 000 000 000 000	10^{15}	peta	P
1 000 000 000 000	10^{12}	tera	T
1 000 000 000	10^{9}	giga	G
1 000 000	10^{6}	mega	M
1 000	10^{3}	kilo	k
100	10^{2}	hecto	h
10	10^{1}	deca	da
0.1	10^{-1}	deci	d
0.01	10^{-2}	centi	c
0.001	10^{-3}	milli	m
0.000 001	10^{-6}	micro	µ

Source: 2006 IPCC Guidelines, Volume 1: General Guidance and Reporting, Annex 8A.1: Prefixes, units and abbreviations, standard equivalents

12.5 Chemical formulae

Chemical formula	Gas
C	Carbon
CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
H_2	Hydrogen
H_2S	Hydrogen sulphide
N_2O	Nitrous oxide
NO_X	Nitrogen oxides
SO_x	Sulphur oxides
SO_2	Sulphur dioxide
NMVOC	Non-methane volatile organic compound
F-gases	

Source: 2006 IPCC Guidelines, Volume 1: General Guidance and Reporting, Annex 8A.1: Prefixes, units and abbreviations, standard equivalents