Republic of North Macedonia
MINISTRY OF ENVIRONMENT AND PHYSICAL PLANNING

NATIONAL GREENHOUSE GAS INVENTORY

2020–2022

ENERGY | INDUSTRIAL PROCESSES AND PRODUCT USE | AGRICULTURE | FORESTRY AND OTHER LAND USE | WASTE

This document was developed within the framework of the project “Development of the First Biennial Transparency Report of North Macedonia and the combined Second Biennial Transparency Report and Fifth National Communication on Climate Change under the UNFCCC (BTR1 and BTR2/NC5)”. The document was prepared with financial support from the Global Environment Facility (GEF) and implemented by the United Nations Development Programme (UNDP).

National Contact Person for the UNFCCC
Dr. Teodora Obradovic Grncarovska

Project Manager
Jozhe Jovanovski, M.Sc., B.Sc. Eng. for environmental protection

Chief Technical Advisor
prof. Dr. Konstantin Dimitrov

GREENHOUSE GAS INVENTORY DEVELOPMENT TEAM

MANU Team
Academician Ljupcho Kocarev
Dr. Aleksandar Dedinec, Senior Research Associate
Dr. Verica Taseska-Gjorgievska, Senior Research Associate
prof. Dr. Aleksandra Dedinec
M.Sc, Tatjana Dzambazova
M.Sc, Emilia Mihajloska
B.Sc. Eng. Dejan Dimitriev
B.Sc. Eng. Onur Amet

"Goce Delchev" University – Faculty of Natural and Technical Sciences
Prof. Dr. Dejan Mirakovski
Prof. Dr. Afrodita Zendelska
Prof. Dr. Sonja Lepitkova
Prof. Dr. Marija Hadzi-Nikolova
M.Sc. Ana Mihailovska

"Goce Delchev" University – Faculty of Agriculture
Prof. Dr. Ljupco Mihajlov
Prof. Dr. Dimitar Nakov

UKIM – Faculty of Forestry Sciences, Landscape Architecture and Eco-Engineering "Hans M."
Prof. Dr. Ljupco Nestorovski
prof. Dr. Nikola Nikolov

Preface

The national greenhouse gas inventory represents a fundamental tool for understanding, planning and monitoring climate policies in the country. It provides a comprehensive picture of the amount and types of greenhouse gases emitted or removed within the country, the sources of these emissions, how they have changed over time, and which sectors and factors are driving these trends. This information is used for the development of climate change mitigation measures, for planning energy and industrial transitions, for improving the management of agriculture, forests and waste, and for fulfilling international obligations, including those under the Paris Agreement. The greenhouse gas inventory of the Republic of North Macedonia covers emissions and removals for the period 1990–2022.

During the preparation of this report, additional effort was made to present the results and the methodology in a way that is understandable not only to experts directly involved in the inventory preparation process and to reviewers within the UNFCCC review process, but also to the wider public. The objective was for the report to serve as a useful source of information for all interested readers, researchers, students, policy makers, institutional representatives, as well as citizens who wish to better understand how greenhouse gas emissions in the country are estimated and monitored. In this way, an effort was made to overcome the perception that the inventory represents solely a technical document for international reporting, and instead to present it as a broader source of knowledge and information for understanding climate challenges and the opportunities for addressing them.

Acknowledgements

We express our sincere gratitude to all institutions and individuals who, in any way, contributed to the preparation, improvement and finalization of the National Greenhouse Gas Inventory. Your dedication, expertise and timely support were of key importance for the successful fulfilment of this national obligation. Special appreciation is extended to all participants of the two workshops organized in support of the inventory preparation process, as well as to the institutions and experts with whom meetings, discussions and consultations were held in order to improve the quality of the data and the applied methodologies.

Representatives from all key sectors actively participated in the workshops: approximately 12 governmental ministries and agencies, 8 academic and research institutions, 8 international organizations, 6 energy companies and public utility enterprises, 6 non-governmental and civil society organizations, 5 private companies and consulting firms, as well as representatives from local self-government units and other specialized institutions. This broad participation enabled strong cross-sectoral cooperation and technical dialogue in support of the activities related to the greenhouse gas inventory.

Every effort invested, every exchange of information and every professional discussion contributed to ensuring a higher level of quality, transparency and sustainability of the greenhouse gas reporting system. We sincerely thank all contributors for their cooperation, commitment and support in the preparation of a document of particular importance for the country.

Content

List of images

List of tables

Abbreviations and acronyms

AFOLU	Agriculture, Forestry and Other Land Use
AR5	Fifth Assessment Report (IPCC)
BUR	Biennial Update Report
BUR1	First Biennial Update Report
BUR2	Second Biennial Update Report
BUR3	Third Biennial Update Report
BTR	Biennial Transparency Report
CC	Climate Change
CHPs	Combined Heat and Power Plants
CLC	CORINE Land Cover
CMC	Center for Management of Crises
CRF	Common Reporting Format
CS	Country Specific
CTA	Chief Technical Advisor
DF	Default Factor
DOC	Degradable Organic Carbon
EC	European Commission
EEA	European Environment Agency
EFDB	Emission Factor Database
EMEP	European Monitoring and Evaluation Programme
EO	Earth Observation
Eurostat	Statistical Office of the European Union
FAOStat	Food and Agriculture Organization of the United Nations Statistical Databases
FFU	Firefighting Union
F-gas	Fluorinated gas
FOD	First Order Decay
FOLU	Forest and Other Land Use
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gas
GSP	Global Support Programme
GWP	Global Warming Potential
IDT	Inventory Development Team
IE	Included elsewhere
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
IST	Imperial Smelt Technology
LPG	Liquefied Petroleum Gas
LU	Land Use
LUCF	Land-Use Change and Forestry
LULUCF	Land Use, Land-Use Change and Forestry
MAFWE	Ministry of Agriculture, Forestry and Water Economy
MAKSTAT	Database of the State Statistical Office of the Republic of North Macedonia
MANU	Macedonian Academy of Sciences and Arts
MCC	Macedonian Chambers of Commerce

MKD	Macedonian Denar
MMR	Monitoring Mechanism Regulation
MMU	Minimum Mapping Unit
MNAV	Macedonian Navigation Agency
MOEPP	Ministry of Environment and Physical Planning
MRV	Measurement, Reporting and Verification
NA	Not Applicable
NACE	Nomenclature of Economic Activities
NC	National Communication
NC1	First National Communication
NC2	Second National Communication
NC3	Third National Communication
NC4	Fourth National Communication
NCV	Net calorific value
NE	Not estimated
NIR	National Inventory Report
NO	Not Occurring
ODS	Ozone-Depleting Substances
OECD	Organization for Economic Cooperation and Development
PV	Photovoltaic
QA	Quality Assurance
QAT	Quality Assurance Team
QC	Quality Control
RCESD	Research Center for Energy and Sustainable Development
RS	Remote Sensing
SAR	Second Assessment Report
SSO	State Statistical Office
SWDS	Solid Waste Disposal Sites
T1	Tier 1
T2	Tier 2
TWG	Technical Working Group
UN	United Nations
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
USA	United States of America
USD	United States Dollar
MMM	Ministry of Economy

Chemical symbols

$CaCO_3$	Limestone
$CaMgCO_3$	Dolomite
CH_4	Methane
$CO(NH_2)_2$	Urea
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2-eq	Carbon dioxide equivalents
HCO3-	Bicarbonate
HFCs	Hydrofluorocarbons
N	Nitrogen
N_2O	Nitric oxide
Na_2CO_3	Sodium carbonate
NH_3	Ammonia
NH4+2	Ammonium
NMVOC	Non-methane volatile organic compounds
NO3-	Nirat
NOx	Nitrogen oxides
OH-	Hydroxyl ion
PFCs	Perfluorocarbons
SF_6	Sulfurhexafluoride
SO_2	Sulfur dioxide
SOx	Sulfur oxides

Units and metric symbols

Unit	Name	Unit for	Metric symbols	Prefix	Factor
g	gram	table	P	heel	1015
W	watt	power	T	forces	1012
J	joule	energy	G	giga	109
m	meter	length	M	mega	106
What?	Watt-hour	energy	k	kilo	103
toe	tons of oil equivalents	energy	h	hecto	102
			yes	that	101
			d	children	10-1
1g			c	cents	10-2
1kg	= 1 000 g		m	dear	10-3
1t	= 1 000 kg	= 1 Mg	μ	micro	10-6
1kt	= 1 000 tons	= 1 Gg	n	nano	10-9
1Mt	= 1 000 000 tons	= 1 Tg	p	pico	10-12

Executive summary

The national greenhouse gas inventory represents the foundation of climate policy in every country and a key instrument for fulfilling obligations under the Paris Agreement. It provides a comprehensive overview of the amount of greenhouse gases emitted or removed in North Macedonia, the sectors from which these emissions originate, how they have changed over time, the main sources and trends, and the role of land and forests in balancing greenhouse gas emissions and removals. The inventory is not merely a statistical compilation; it also helps explain the key drivers of change, including transformations in the energy system, developments in industry, changes in agriculture, and the influence of forestry on the national greenhouse gas balance. In addition, it serves as an important basis for decision-making, for the development of mitigation measures related to climate change, and for defining the national contributions towards achieving the country's greenhouse gas reduction targets. This document covers the greenhouse gas emissions and removals of North Macedonia for the period **1990–2022**, representing the longest time series prepared so far.

With the submission of this inventory, North Macedonia fulfils its obligation for transparent reporting, while the preparation process involved all relevant institutions, scientific organizations, public enterprises and experts at the national level. The preparation process included the Ministry of Environment and Physical Planning as the coordinating institution, technical teams from the Macedonian Academy of Sciences and Arts and Goce Delchev University, the State Statistical Office, the Ministry of Agriculture, Forestry and Water Economy, and numerous other institutions. Although the new climate action legislation has not yet been formally adopted, the established practice and the long-standing experience of the involved expert teams enabled the process to proceed without major obstacles and ensured the availability of the necessary data and expertise. This cooperation is particularly important because the quality of the inventory depends on the availability and accuracy of data related to energy, industry, agriculture, forestry, waste and emission precursors.

This inventory was prepared in accordance with the 2006 IPCC Guidelines for National Greenhouse Gas Inventories and their 2019 Refinement, using the latest versions of the official IPCC Inventory Software. Since the 2025 software version contained certain technical inconsistencies, the calculations were also performed in parallel using the previous 2020 software version. This dual approach enabled additional verification of the results and the identification of errors that were subsequently corrected. In order to ensure full consistency, the entire time series from 1990 to 2022 was recalculated using updated activity data, improved emission factors, and the global warming potential values for a 100-year time horizon from the IPCC Fifth Assessment Report (AR5 GWP). Nevertheless, the results presented in this inventory were generated using the IPCC Inventory Software version 2.98 (June 2025), with the exception of the reference approach in the Energy sector, where the reported results were generated using the IPCC Inventory Software version 2020.

The inventory covers the five main sectors: Energy; Industrial Processes and Product Use (IPPU); Agriculture; Forestry and Other Land Use (AFOLU); and Waste. In addition, the emission precursors CO, NOx, NMVOC, SO_2 and NH_3 are also estimated. Although these are not direct greenhouse gases, they have indirect effects on the atmosphere and are included in accordance with the reporting requirements of the IPCC.

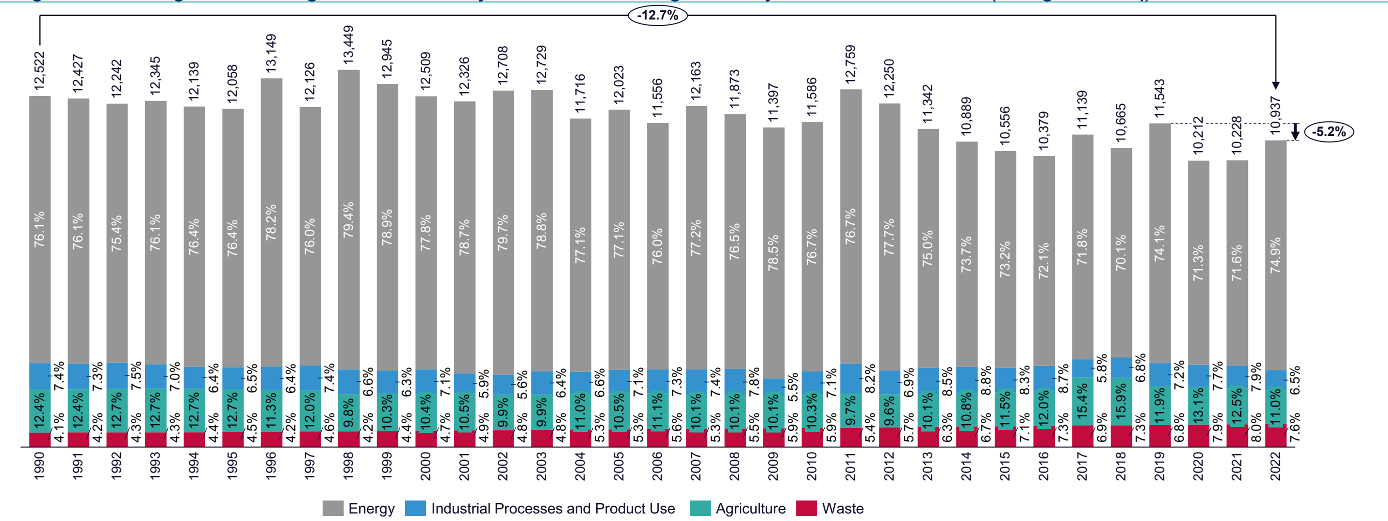
1.1 Overview of National Greenhouse Gas Emissions and Removals (1990–2022)

The trend of total greenhouse gas emissions (excluding the Forestry and Other Land Use sector) indicates that the country started in 1990 with approximately 12,500 Gg CO_2-eq, while in 2022 they amount to around 10,900 Gg CO_2-eq (Figure 1). This represents a moderate reduction of about 13%, although the decline does not occur in a linear manner. The time series shows increases during years of economic expansion, as well as declines associated with industrial restructuring, reductions in coal use, improvements resulting from the increasing share of natural gas and renewable energy sources, but also an increase in electricity imports. It should be noted that the level of greenhouse gas emissions is not highest in 1990, but rather in 1998, when greenhouse gas emissions reached a maximum of 13,449 Gg CO_2-eq, while in the last 15 years the maximum occurred in 2011, when emissions amounted to 12,759 Gg CO_2-eq (Figure 1), a level that is also higher than the level in 1990 (12,522 Gg CO_2-eq).

At the same time, total emissions (when the Forestry and Other Land Use sector is included) show even larger variations. In certain years, forestry acts as a strong sink, reducing the national balance by more than 3,000 Gg CO_2-eq (Figure 2), as observed in 2022, while in other years the same sector may become a source of emissions, particularly when large forest fires occur. For this reason, the national carbon balance as a whole is highly sensitive to variations in the forestry sector, which confirms its structural importance in climate policy.

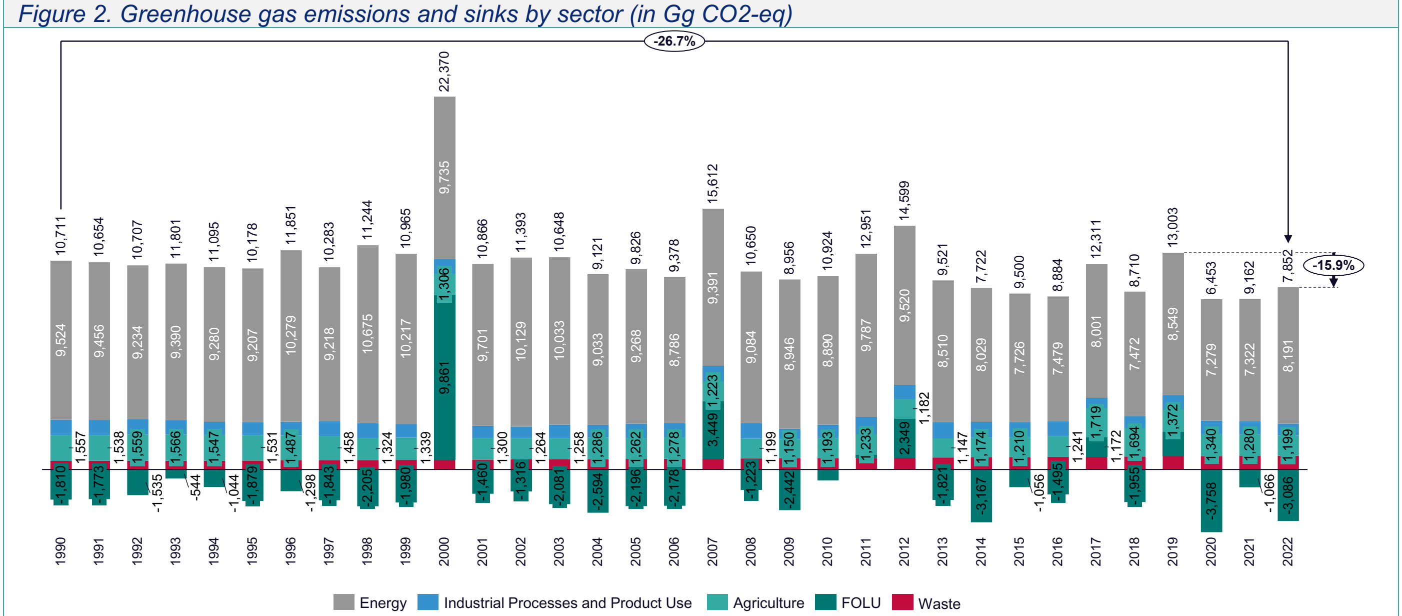
The sectoral distribution of emissions shows that the Energy sector dominates throughout the entire time series, with its share rarely falling below 70% of the national total (Figure 1). This means that trends in electricity generation, fuel consumption, the structure of the vehicle fleet and the efficiency of district heating systems practically define the country's climate profile. Agriculture, on the other hand, has a relatively stable level of emissions, but its internal structure changes significantly: the reduction in cattle numbers decreases emissions from enteric fermentation, while the increased use of mineral fertilizers, as well as changes in manure management and mechanization, create new sources of N_2O emissions. Industrial Processes and Product Use (IPPU) have a moderate share, most often between 7% and 8%. In the Waste sector, however, a stable and continuous increase in methane emissions is observed, which is particularly pronounced after 2000 due to the increased quantity of municipal waste and the insufficient implementation of mechanical-biological treatment systems. This makes the waste sector one of the few sectors with a long and consistent growth in emissions, which in the future will require targeted measures, such as improving landfill standards, landfill gas capture, and the introduction of regional waste management centres.

Figure 1. Total greenhouse gas emissions by sectors excluding Forestry and other land use (in Gg CO2-eq)



Source: IPCC software, team analysis

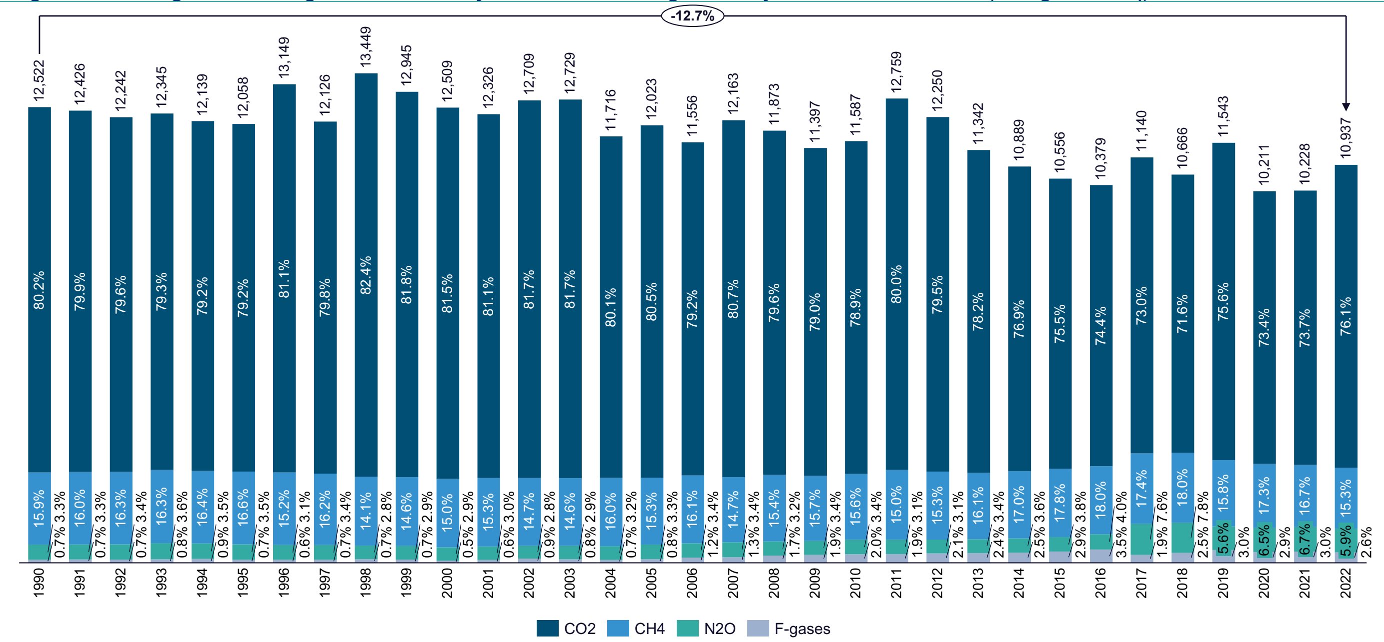
Figure 2. Greenhouse gas emissions and sinks by sector (in Gg CO2-eq)



Source: IPCC software, team analysis

When emissions are analysed individually by gas, the dominance of CO_2 is clearly visible, accounting for around 75–80% in each year of the time series (Figure 3). This is not surprising considering the country's dependence on fossil fuels, particularly coal. CH_4 remains the second most significant gas, although its structure changes over time: in 1990, the majority of emissions originated from agriculture, while in 2022 the waste sector becomes the dominant source. In this way, CH_4 emissions become an indicator not only of agricultural practices, but also of the degree of urbanisation and the efficiency of waste management systems. Fluorinated gases, although representing a small share, are increasing at the fastest rate, reflecting the growing use of air-conditioning and refrigeration systems in households, commerce and industry.

Figure 3. Total greenhouse gas emissions by sectors excluding Forestry and other land use (in Gg CO2-eq)

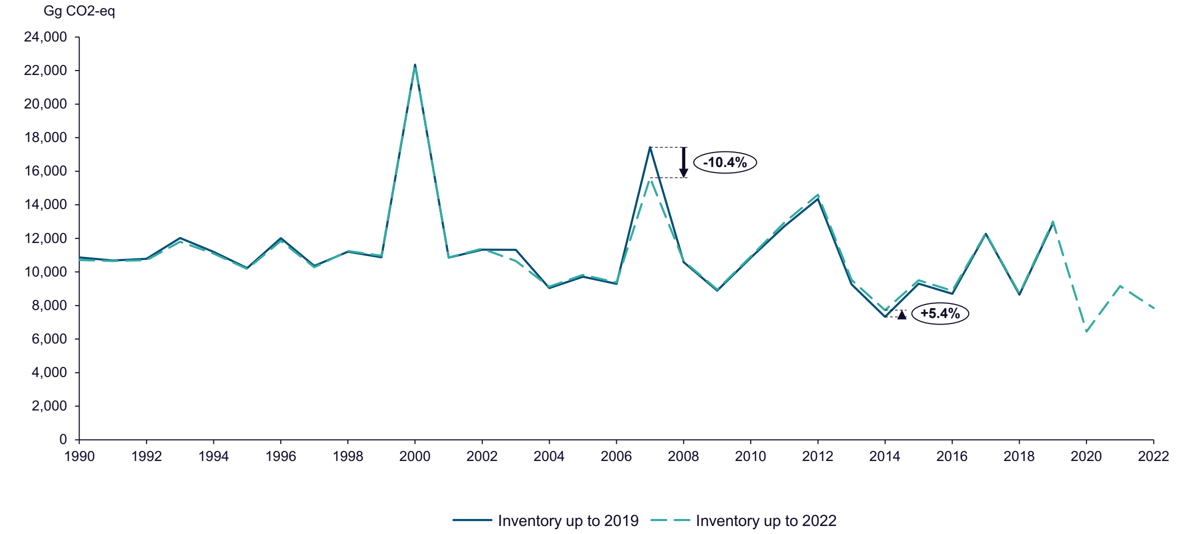


Source: IPCC software, team analysis

When the entire time series is considered, three distinct periods can be identified: 1990–2001, which is characterised by a decline in industrial activity and reduced electricity generation, leading to a decrease in emissions; 2002–2011, which brings stabilisation and moderate growth associated with economic recovery; and 2012–2022, when the country gradually reduces its carbon intensity, while at the same time the use of transport fuels increases, stabilising the overall trend and creating a slow trajectory of emission reductions.

The comparison between the previous greenhouse gas inventory (with a time series up to 2019) and the new inventory (with a time series up to 2022) shows that the overall trend of national emissions remains consistent, while the differences observed in certain individual years are the result of recalculations, methodological improvements, and the use of updated activity data. For total emissions including the Forestry and Other Land Use sector, larger variations are observed in certain years, with the most significant difference occurring around 2007 (a decrease of approximately 10.4%), while in the period around 2014–2015 a moderate increase of about 5.4% is observed (Figure 4). When only emissions excluding the Forestry and Other Land Use sector are analysed, the differences between the two inventories are relatively small and in most years remain within a range of a few percent (for example around 2.2% and 3.5% in certain years), indicating a high level of consistency of the time series. These changes mainly result from improvements in data quality and methodology in key sectors, whereby the new inventory provides a more complete and more accurate emissions time series for the period 1990–2022.

Figure 4. Comparison of greenhouse gas emissions and sinks in the greenhouse gas inventory by 2019 with the greenhouse gas inventory by 2022



Source: Team Analysis

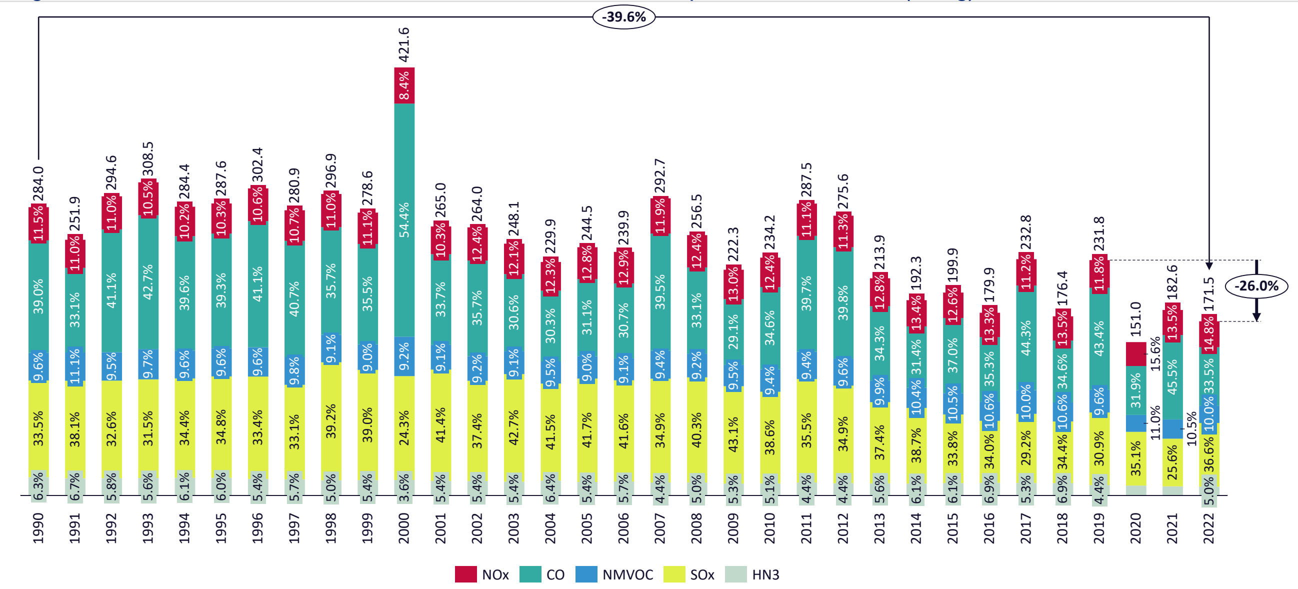
1.2 Precursors and indirect emissions

Precursors and indirect greenhouse gases represent a group of substances which, although they are not direct greenhouse gases, have a significant indirect influence on climate change through their participation in atmospheric chemical processes. The most important among them are carbon monoxide (CO), nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOC), sulfur oxides (SO_2), and ammonia (NH_3). These gases contribute to the formation of tropospheric ozone and aerosols, which can have both warming and cooling effects on the atmosphere. Although they are not reported as direct greenhouse gases in national inventories, their monitoring is important for a better understanding of the relationship between air pollution and climate change, as well as for the development of more effective air quality policies.

In North Macedonia, the assessment of these emissions has been gradually developed in accordance with international guidelines. The first systematic assessments were prepared within the framework of BUR2 (Biennial Update Report 2) for the period 1990–2014, while BUR3 included additional data for 2015 and 2016 and introduced a revision of part of the historical data through the application of the EMEP/EEA methodology. In the most recent update, the inventory has been expanded with estimates for the period 2020–2022, and an additional revision of data for the period 1990–2019 has been carried out in order to ensure time-series consistency and alignment with contemporary international reporting standards.

The analysis shows that the energy sector is the dominant source of precursor emissions, particularly for NO_x, CO and SO_2, although in recent decades its share has gradually declined. In 1990, more than 95% of NO_x and CO emissions and over 99% of SO_2 emissions originated from the energy sector, reflecting the structure of the energy system at that time, which relied heavily on coal and heavy fuel oil, as well as an older vehicle fleet. By 2022, the structure of emissions becomes somewhat more diversified, with an increasing share of other sectors, particularly in the case of CO emissions. Overall, during the period 1990–2022, a reduction of approximately 40% in total precursor and indirect emissions can be observed, representing a positive trend and indicating a gradual improvement in air quality and a reduction in the use of high-sulfur fuels (Figure 5). However, the trend is not entirely linear, as in certain years temporary increases in emissions are observed, most often associated with large forest fires and variations in activity levels in specific sectors.

Figure 5. Emissions of NOx, CO, NMVOC, SO2 and NH3 in the period 1990 – 2022 (in Gg)



Source: Developed Excel model by the team and team analysis

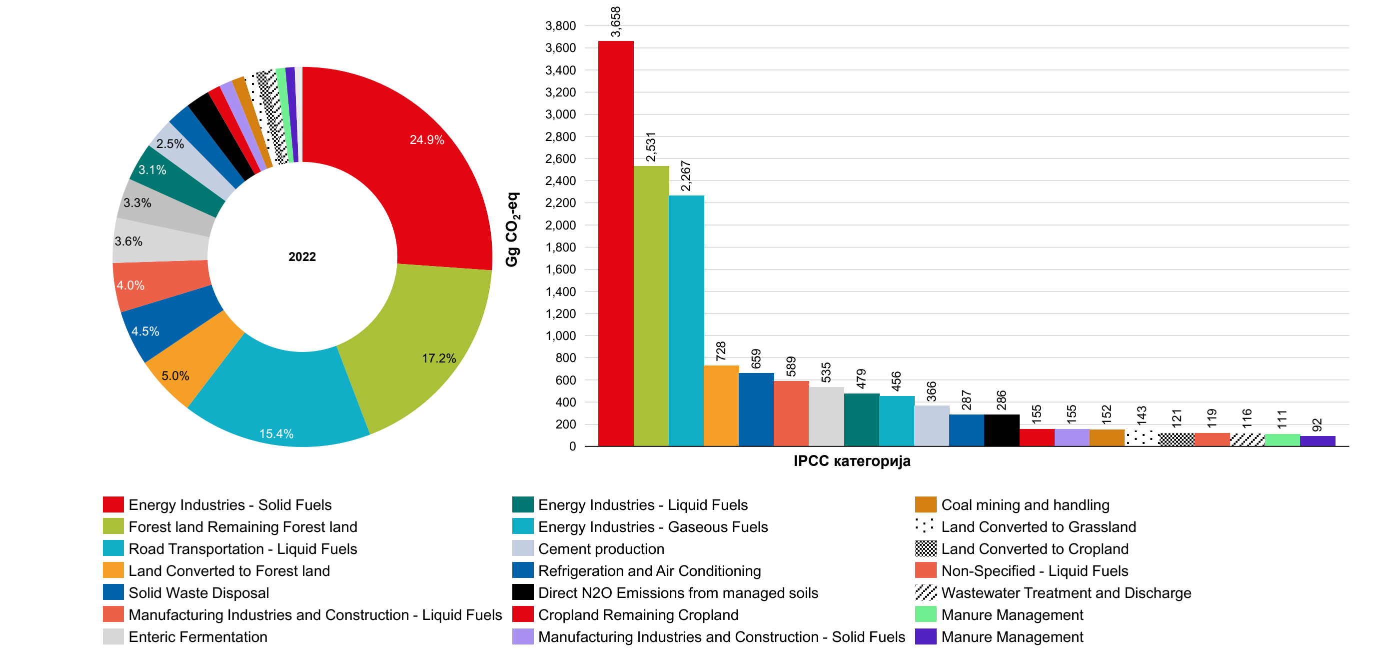
1.3 Key Category Analysis

The key category analysis represents one of the most important methodological elements of the national inventory, as it provides a focus on the sectors and subcategories that have the greatest influence on total emissions, removals, and the national emissions trend. The IPCC methodology requires countries to conduct the identification of key categories as a mandatory task in every cycle of preparing national greenhouse gas inventories, applying two approaches: level assessment and trend assessment. In the Macedonian inventory, this analysis has been conducted in detail and is based on calculations performed using the IPCC Inventory Software. The level assessment shows that in most years five to seven categories account for more than 85% of total emissions excluding forestry. At the top of this list are fuel combustion in energy industries (mainly coal-fired thermal power plants), transport, manufacturing industries and construction (industrial combustion), enteric fermentation, and solid waste disposal. These categories are considered "structural categories", as they not only contribute the largest share of emissions but are also among the most difficult to decarbonize.

The analysis reveals that coal combustion in large thermal power plants almost without exception has the largest impact, accounting for about 25% of emissions (Figure 6). The second most significant category on the list is "Forest land remaining forest land", with 17.2%. The fact that forestry appears so high on the list of key categories indicates that forest management, fire prevention, restoration of degraded areas, and biomass monitoring are crucial elements of climate policy. This is followed by the category "Road transport – liquid fuels" with 15.4%, which is one of the most dynamic and fastest-growing sources of emissions. The increase in the vehicle fleet, urbanization, growth in mobility, and the continued dependence on diesel and gasoline are the main drivers of this high share. As a result, transport becomes one of the most difficult categories to manage, as emission reduction measures require large investments, changes in behavioural patterns, and long-term technological transformations.

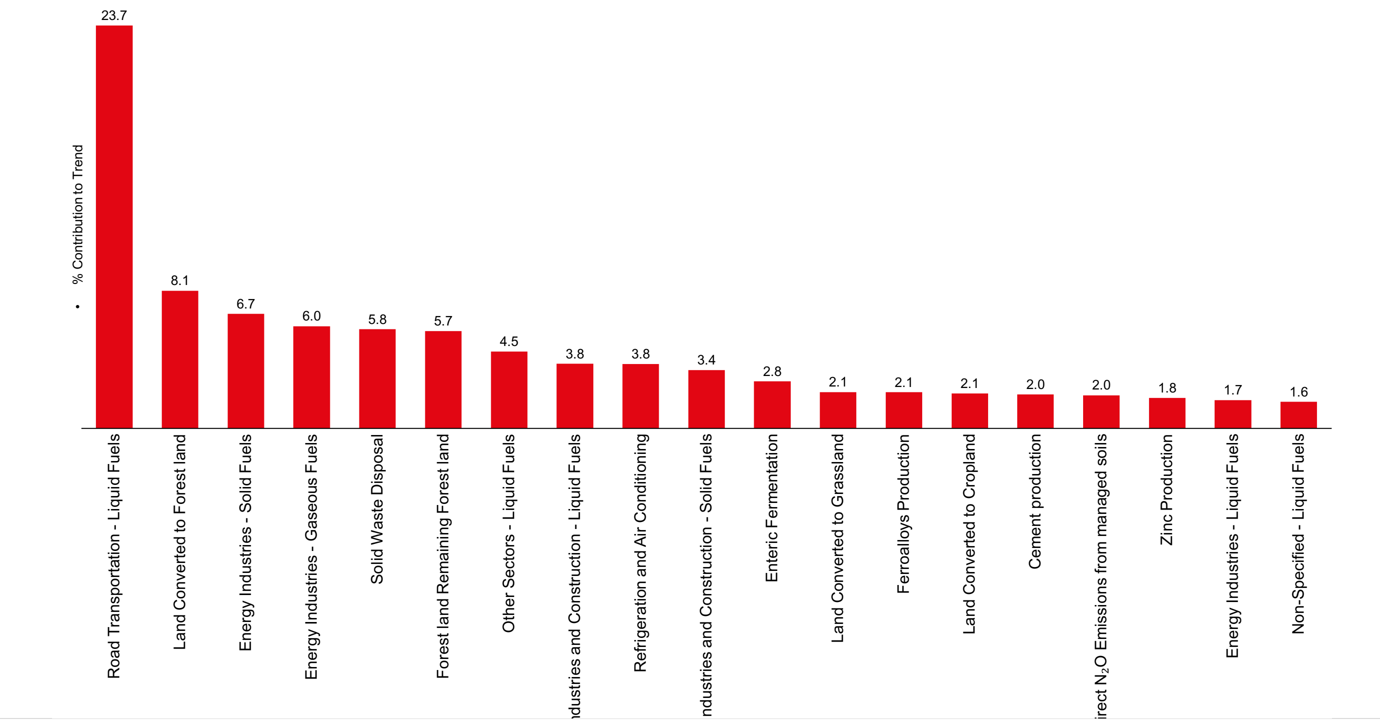
The role of transport is also confirmed by the trend analysis, where transport ranks first with approximately 24% (Figure 7), because it shows the largest change in emissions between 1990 and 2022. The growth of transport emissions occurs in parallel with economic expansion, higher levels of mobility, and urban development. This trend is particularly important because it demonstrates that, unlike the energy sector, where trends fluctuate over time, transport is a sector with a consistent growth in emissions, and therefore its importance in future climate policies will continue to increase.

Figure 6. Assessment of the level of contribution of key categories and their share in emissions in 2022



Source: IPCC software, team analysis

Figure 7. Contribution of key categories to emissions trend (1990, 2022) in percent



Source: IPCC software, team analysis

1.4 Methodological Improvements and Recalculations

Methodological improvements and recalculations were necessary in order to ensure consistency and a high level of reliability for the entire time series from 1990 to 2022. The new versions of the IPCC Inventory Software released in 2025 contained certain inconsistencies; therefore, the team used the older versions in parallel in order to prevent technical errors and harmonise the calculations. The transition to AR5 GWP values required a complete recalculation of the time series. During this process, previously identified gaps were also corrected, such as insufficiently reported removals from perennial crops and additions to the parameters for direct and indirect N_2O emissions. The updated datasets also include revised demographic series from the State Statistical Office, which significantly affects the Waste sector.

The revision process also included more extensive corrections in the Waste sector, particularly through the integration of new data on wastewater, landfills and wastewater treatment plants. The 2021 population census enabled more precise calculations, as previous years had been based on approximate estimates from the State Statistical Office, which have now been corrected by the institution for the entire time series 2003–2021. In the LULUCF sector, new geospatial datasets such as CLC+Backbone were applied, enabling clearer land categorisation, correction of previously misclassified areas and improved estimation of carbon sinks. The QA/QC process was significantly strengthened through parallel checks, comparative analyses and workshops with institutions, during which additional inconsistencies were identified, particularly those related to the IPCC software. This systematic verification contributed to greater accuracy, transparency and intersectoral consistency in the new time series.

Methodological improvements represent a strategic prerequisite for a sustainable national inventory. They ensure greater confidence in the trends, more harmonised calculations and increased trust in the policy analyses derived from them.

1.5 Main Findings and Their Importance for Climate Change Mitigation Policies

The main findings from the greenhouse gas inventory for the period 1990–2022 indicate that the energy sector remains the dominant source of emissions and a key factor in the national climate profile. The transport sector is gradually becoming the second most dynamic sector, with a consistent increase in emissions related to mobility and urbanisation. Forestry plays a critical dual role, as in some years it acts as a significant carbon sink, while in other years it becomes a source of emissions, depending on natural conditions and management practices. The agriculture and waste sectors contribute relatively stable, although not negligible, shares of emissions, and their trends are sensitive to demographic and structural changes. These patterns provide a clear indication of where the most significant interventions for emission reductions are required.

From a policy perspective, the most important implication is that the inventory indicates a clear prioritisation of mitigation measures in the energy sector, particularly in the segment of coal-based electricity generation, which most strongly defines the national carbon balance. The growth of greenhouse gas emissions in the transport sector points to the need for a strategy that includes electrification, improved infrastructure and sustainable mobility policies. Forestry, on the other hand, must be treated as a strategic resource, with systemic policies for protection, afforestation and fire prevention, since its sink capacity has a substantial impact on net emissions. The waste sector demonstrates that the regionalisation of waste management is not only an environmental measure but also a climate obligation. The agriculture sector requires targeted policies for improved use of mineral fertilisers and improved soil management practices, since N_2O is a gas with a high GWP and a significant influence on emission trends. Methodological improvements and recalculations, as part of the QA/QC system, increase the credibility of the inventory and enable state institutions to design policies based on robust and verified data. The national inventory thus becomes not only a statistical document, but also a policy instrument for the strategic planning of decarbonisation.

1 Introduction and Context of the Inventory

As a Party to the United Nations Framework Convention on Climate Change (UNFCCC), Macedonia has the obligation to regularly prepare a National Greenhouse Gas Inventory. This inventory represents a detailed record of how many greenhouse gases are emitted into the atmosphere from different sources (such as power plants, industrial facilities, cars, heavy-duty vehicles, and livestock) and how many are absorbed by sinks (such as forests and other natural ecosystems). This process is not only a formal reporting requirement; it also represents the basis for planning climate policies, monitoring national emission trends, assessing the effects of mitigation measures, and fulfilling international obligations. For this reason, the inventory constitutes an integral component of the National Communications, the Biennial Update Reports (BUR) and, in accordance with the new requirements of the Paris Agreement, the Biennial Transparency Report (BTR)..

1.1 History of Greenhouse Gas Inventories in Macedonia

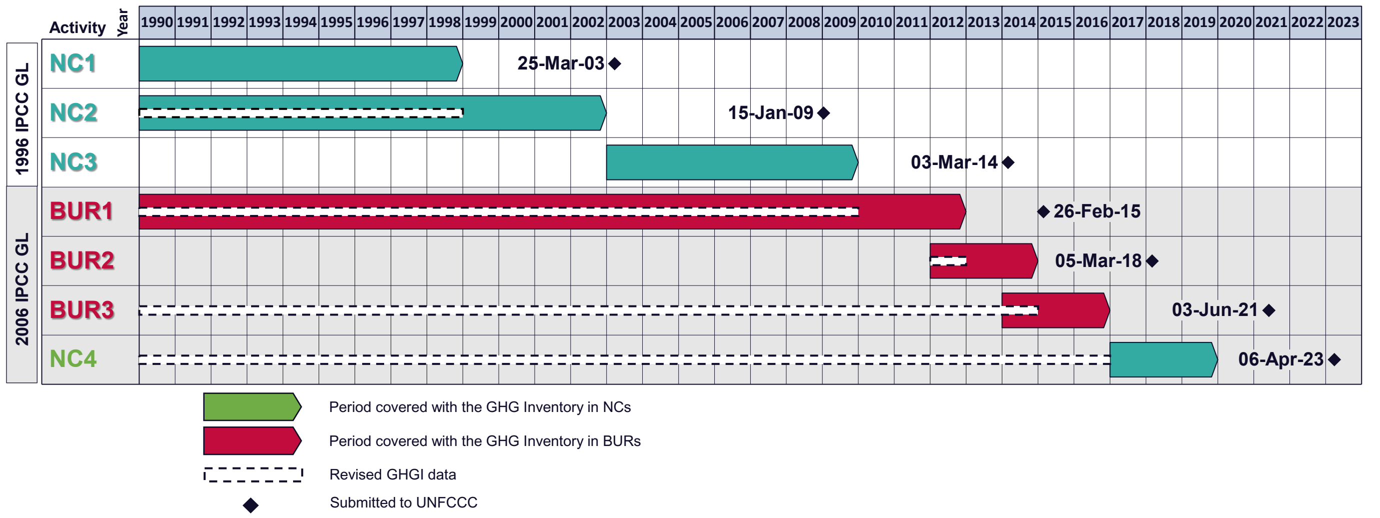
Since the Paris Agreement, that is from 2015 onwards, Macedonia has submitted three Biennial Update Reports (BUR1, BUR2 and BUR3) and one National Communication (Fourth National Communication), which also serves as the basis for the preparation of the First Biennial Transparency Report (BTR1). The transition from BUR to BTR is the result of the new Enhanced Transparency Framework established under the Paris Agreement (Article 13). The BTR introduces a stricter, more harmonised and more binding methodology for all countries, with the aim of improving data comparability, enabling more effective tracking of progress toward climate targets, and increasing confidence within the international community. For this reason, the preparation of the national greenhouse gas inventory cannot be regarded merely as a national obligation, but rather as a key element of the global transparency system.

Looking back historically, Macedonia prepared its First National Greenhouse Gas Inventory within the First National Communication (NC1), which covered the period 1990–1998. In the Second National Communication (NC2), this inventory was revised using improved data and expanded to cover the period 1999–2002 (Figure 8). In NC3, emissions were reported for the period 2003–2009. In these national communications, the inventory was developed in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories and the IPCC Good Practice Guidance from 2000.

With BUR1, the application of the 2006 IPCC Guidelines and the use of the IPCC Inventory Software began. Within that process, the time series was extended to include 2010–2012, and the data for the period 1990–2009 were revised in accordance with improved methodologies. The same approach was applied in BUR2 and BUR3, where the time series was further extended with greenhouse gas emissions for 2013 and 2014 (BUR2) and 2015 and 2016 (BUR3). In BUR3, certain data were additionally revised due to identified inconsistencies, in order to ensure the consistency of the entire time series.

Within the Fourth National Communication (NC4), the inventory was further extended to include 2017, 2018 and 2019. Once again, the 2006 IPCC Guidelines and the latest available version of the IPCC Inventory Software (version 2.691, available since 23 January 2020) were applied. Due to changes in the methodology for land use and land-use change, as well as the availability of new information sources, a recalculation of the entire time series reported in BUR3 was carried out.

Figure 8. The development of greenhouse gas inventories as part of reporting documents to the UNCCD



Source: Team Analysis
Note:NC = National Plan, BUR = Biennial Report; GHGI = Greenhouse Gas Emissions Inventory

1.2 Brief Overview of the Preparation and Content of the Greenhouse Gas Inventory

This National Greenhouse Gas Inventory covers the time series for the period 2020–2022 and represents the first complete calculation prepared in the context of BTR1. At the same time, a comprehensive revision of the entire historical series from 1990 to 2019 was carried out. The need for revision arises from the transition from the IPCC Inventory Software version released in 2020 to the latest version developed in 2025, which includes updated methodologies, additional improvements, and corrected technical inconsistencies. In order to ensure consistency and comparability across the entire time series, all years were recalculated using updated activity data and emission factors, as well as the application of AR5 Global Warming Potential (GWP) values. This approach guarantees that the methodology is harmonised across all years and that the inventory fully meets the requirements of the Enhanced Transparency Framework under the Paris Agreement.

The greenhouse gas inventory covers five main sectors: Energy; Industrial Processes and Product Use (IPPU); Agriculture; Forestry and Other Land Use (FOLU); and Waste. Each of these sectors consists of categories and subcategories. The reported emissions include the following greenhouse gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), perfluorocarbons (PFCs), and hydrofluorocarbons (HFCs). The inventory also covers precursors and indirect emissions of carbon monoxide (CO), nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOC), sulfur dioxide (SO_2), and ammonia (NH_3). Emissions of sulfur hexafluoride (SF_6) have not been estimated for Macedonia due to the lack of activity data.

The structure of this National Greenhouse Gas Inventory is largely aligned with the outline for the National Inventory Document (NID) defined within the Enhanced Transparency Framework of the Paris Agreement, as established by Decision 5/CMA.3. The inventory contains all the main elements required under this structure, including an overview of national emissions and removals, detailed sectoral chapters, key category analysis, uncertainty analysis, quality assurance and quality control activities (QA/QC), explanations of recalculations, and the identification of areas for further improvements. However, in certain sections the structure of the information differs from the format proposed in the outline, particularly with regard to certain elements that, according to the recommended structure, should be integrated within each sectoral or subcategory chapter. These differences primarily relate to the presentation of the uncertainty analysis, QA/QC procedures, recalculations, and planned improvements, which, so as to maintain comparability with the previous inventory covering the period up to 2019, have been retained as separate chapters.

In this sense, the present inventory can be considered a transitional document in the process of aligning with the reporting structure defined under the Enhanced Transparency Framework. All information required by the guidelines is included in the report; however, in some cases it is organised in separate chapters. In the next inventory preparation cycle, it is planned to achieve full alignment of the document structure with the outline established by Decision 5/CMA.3, which will involve integrating information on uncertainty, QA/QC activities, recalculations, and planned improvements directly within the sectoral and subcategory chapters.

This National Greenhouse Gas Inventory is structured into 12 chapters, in order to provide a comprehensive, transparent, and methodologically consistent presentation of all aspects of the inventory process. Chapter 1 serves as the introduction, describing the institutional framework, the approach to inventory development, and a brief overview of the input data and applied methodologies. Chapter 2 focuses on the trend of total national greenhouse gas emissions and removals, providing an overview of the long-term dynamics of the inventory. The detailed sectoral presentation of emissions and removals for the sectors Energy, Industrial Processes and Product Use, Agriculture, Forestry and Other Land Use, and Waste is provided in Chapters 3 to 7, where the data sources, methodologies, emission factors, and key drivers influencing changes in the time series are explained for each sector. Chapter 9 contains detailed data on precursors and indirect emissions (CO, NOₓ, NMVOC, SO_2 and NH_3), in accordance with IPCC requirements.

Chapter 8 presents the key category analysis, both in terms of their absolute contribution to total emissions and their influence on emission trends. This analysis provides the basis for identifying priority areas for future improvements. Chapter 10 contains the uncertainty analysis, while Chapter 11 describes the Quality Assurance and Quality Control (QA/QC) procedures. Macedonia's approach is based on a combination of national practices and international best standards, whereby the QA/QC plan initially developed in BUR1 was further expanded and adapted in BUR2 and BUR3, and is fully applied in this inventory preparation cycle. This chapter covers verification procedures, validation processes, documentation, and archiving, in accordance with IPCC requirements and the national institutional framework.

The final chapter, Chapter 12, summarises the recalculations, their implications for emission levels and trends, and the methodological improvements implemented during this inventory cycle. Areas for further capacity strengthening are also identified, particularly with regard to activity data collection, increasing the level of disaggregation, and the application of higher-tier methodologies. These recommendations form the basis for the Improvement Plan, which constitutes an integral part of the continuous process of strengthening the national inventory system.

1.3 Institutional Structure for the Preparation of the National Greenhouse Gas Inventory

The process of preparing the National Greenhouse Gas Inventory (Figure 9) involves the following key entities:

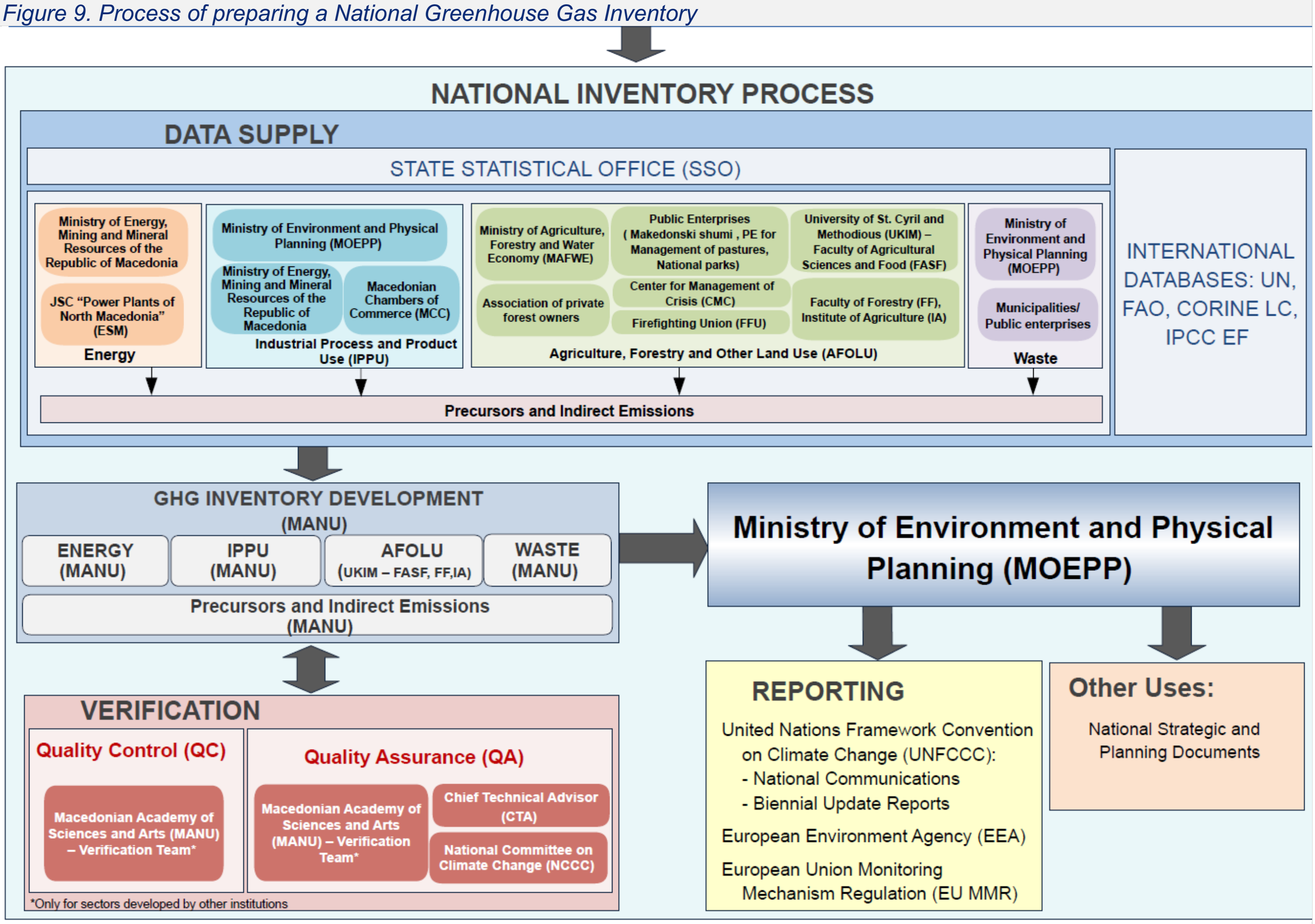
- **Ministry of Environment and Physical Planning**, responsible for overseeing the inventory development process and for reporting greenhouse gas emissions to the UNFCCC, as well as for other international emissions reporting obligations;
- **Greenhouse Gas Inventory Development Team**, consisting of a team from the Macedonian Academy of Sciences and Arts (MANU) and a sectoral team for Agriculture, Forestry and Other Land Use (AFOLU) composed of experts from the "Goce Delčev" University in Štip;
- **Verification Team,** which includes experts responsible for Quality Control (QC) as well as experts responsible for Quality Assurance (QA) of the inventory. This assurance is also provided through a multi-level structure coordinated by a Chief Technical Advisor (CTA).

Although the process of preparing the new climate legislation began several years ago, the Law on Climate Action and the accompanying by-laws (for example, the Rulebook on the form and content of the National Greenhouse Gas Inventory and the methodology for its preparation) have not yet been officially adopted. These legal acts are intended to establish a formalised, legally binding and inter-institutional coordination mechanism for regular, standardised and coherent reporting of greenhouse gas emissions. Although draft documents have been prepared, the absence of adopted legislation means that the national system continues to operate primarily on the basis of existing administrative practices, without clearly defined obligations for the institutions that hold the required data. As a result, the process still largely relies on voluntary cooperation, fragmented data sources and ad hoc agreements, which complicates the timeliness, standardisation and automation of reporting in accordance with the requirements of the IPCC and the Paris Agreement.

Under such circumstances, an important advantage is the fact that the inventory team consists of experts who have been working in this field for many years and possess in-depth knowledge of the methodology, the system and sector-specific characteristics. This long-standing experience enables the team to respond to complex methodological challenges, maintain time-series consistency, and establish stable working practices. Equally important is the long-term and direct cooperation with institutions such as the State Statistical Office, the Ministry of Environment and Physical Planning, the Ministry of Agriculture, Forestry and Water Economy, energy companies, public utilities and other institutions, which ensures access to key data, timely discussions, exchange of information and more efficient resolution of data gaps or inconsistencies. A positive step forward is also the involvement of new experts in the team, which increases the critical mass of expertise, expands capacities and ensures the long-term sustainability of the inventory process.

The preparation of the National Greenhouse Gas Inventory is implemented as a project supported by the Global Environment Facility (GEF) and the United Nations Development Programme (UNDP) (Figure 9). The estimated emissions reported in the inventory are publicly available on the national climate change platform (www.klimatskipromeni.mk) as well as on the UNFCCC website. In this way, the process also contributes to transparency in climate data reporting, as required under Article 13 of the Paris Agreement.

Figure 9. Process of preparing a National Greenhouse Gas Inventory



Source: Team Analysis

1.4 Brief Description of Input Data and Methodologies

Most of the sectoral activity data (input data) used for the preparation of the national inventory were obtained from official national sources, such as statistical yearbooks, energy balances, sectoral reports, and the MAKSTAT database of the State Statistical Office (SSO). Additional information was obtained from various strategies and reports prepared by relevant national institutions, including the Ministry of Environment and Physical Planning (MoEPP) and the Ministry of Agriculture, Forestry and Water Economy (MAFWE), as well as from international databases, such as population and gross domestic product (GDP) projections from the United Nations (UN) and FAOSTAT.

Within the preparation of this national greenhouse gas inventory, the calculations were performed in parallel using two versions of the official IPCC Inventory Software. The reason for this approach is that in the most recent software versions developed in 2025 (including versions 2.95, 2.96 and 2.98) several technical issues and inconsistencies were identified during the calculations, particularly in the reference approach for the energy sector, as well as in parts of the waste sector calculations. These shortcomings were carefully documented and communicated to the team responsible for maintaining the IPCC software. As a result of this communication, some of the identified issues were corrected, and the IPCC released two updated versions of the software incorporating part of the comments and recommendations submitted by the national team. Nevertheless, in order to ensure maximum reliability, verifiability, and methodological consistency of the time series, the national team also carried out the calculations using the previous version of the IPCC software (the 2020 version used for NC4). The comparison of results provided an additional quality control mechanism, and any discrepancies were analysed in detail to prevent potential errors in the final report. This approach is consistent with the quality improvement principles required under the Enhanced Transparency Framework of the Paris Agreement.

In accordance with the IPCC Guidelines, the estimated greenhouse gas emissions and removals are divided into the following five sectors: Energy; Industrial Processes and Product Use (IPPU); Agriculture; Forestry and Other Land Use (FOLU); and Waste. Each sector consists of individual categories and subcategories, and therefore the national inventory has been developed at the subcategory level. The inventory covers the greenhouse gases CO_2, CH_4, N_2O, PFCs and HFCs, as well as precursors and indirect emissions of CO, NOx, NMVOC, SO_2 and NH_3. Emissions of SF_6 have not been estimated for Macedonia due to the lack of available activity data. **Therefore, Macedonia uses the flexibility provisions for developing countries, reporting the three mandatory greenhouse gases (CO_2, CH_4 and N_2O) and two additional greenhouse gases (PFCs and HFCs).**

According to the IPCC Guidelines, emission estimation methods are divided into three tiers. Tier 1 is the so-called "default method", which is the simplest and is typically applied when country-specific emission factors are not available. Tier 2 uses the same methodological structure as Tier 1 but incorporates country-specific emission factors and parameter data, or at least data specific to a particular region of the country. Tier 3 refers to country-specific methodologies, such as models, detailed inventories or other advanced analytical approaches.

In the preparation of the Macedonian national greenhouse gas inventory, Tier 2 methods were applied for CO_2 emission factors for lignite, heavy fuel oil and natural gas in activities related to fuel combustion in the Energy sector. Tier 2 was also applied in the Industrial Processes and Product Use sector for emission factors related to cement production in the Mineral Industry and iron, steel and ferroalloy production in the Metal Industry. Furthermore, Tier 2 was applied in the Agriculture sector, specifically in the Livestock subcategory, for estimating emissions associated with dairy cattle and pig production. The Waste sector is another sector in which Tier 2 methods were applied, approaching Tier 3, through the application of the IPCC First Order Decay (FOD) method, using country-specific activity data on solid waste disposal and historical GDP and population data. For the remaining sectors, the default Tier 1 method was applied. The methods used in the preparation of this national greenhouse gas inventory within the BTR1 framework are summarised in Annex I.

In order to facilitate aggregated reporting of greenhouse gas values expressed as carbon dioxide equivalents (CO_2-eq), the Global Warming Potential (GWP) factors from the IPCC Fifth Assessment Report (AR5), based on a 100-year time horizon, were applied (Table 1).

Table 1. Values of global warming potential (GWP) factors used in the preparation of the greenhouse gas inventory (for a period of 100 years)

Gas	CO2 equivalent		Gas	CO2 equivalent
CO2	1		**HFC-23**	12400
CH4	28		**HFC-32**	677
N2O	265		**HFC-125**	3170
			HFC-134a	1300
			HFC-152a	138
			HFC-143a	4800
CF4	6630		**HFC-227ea**	3350
C2F6	11100		**HFC-236fa**	8060

Source: IPCC Fifth Assessment Report (AR5), 2014

The estimates of precursors and indirect emissions (including indirect emissions of NH_3) are based on the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2023). The tables used for emission factors are referenced in the sectoral subchapters in Chapter II. Estimates for all sectors are calculated using the Tier 1 methodology (Method 1), except for the category Biological Treatment of Waste – Composting within the Waste sector, for which Tier 2 emission factors are applied. Higher-tier methodologies require detailed fuel characteristics combined with on-site measurements or other detailed parameters, which were not available during the preparation of this inventory.

1.5 Transparency

In accordance with the principle of transparency, two thematic workshops were organised during the preparation of the inventory. During these workshops, the methodologies, preliminary results, data sources, and sectoral trends were presented. These workshops ensured the participation of institutions and stakeholders, enabling joint verification and discussion, and contributed to strengthening inter-institutional cooperation.

In addition, all input data used for the calculations in the sectors Energy, Industrial Processes and Product Use, and Waste, such as energy balances, industrial production data, and waste statistics, were made available for review by institutional representatives and experts participating in the workshops. In this way, all stakeholders were given the opportunity to actively participate in the verification of the data, which represents an important element in ensuring transparency, traceability, and confidence in the national inventory.

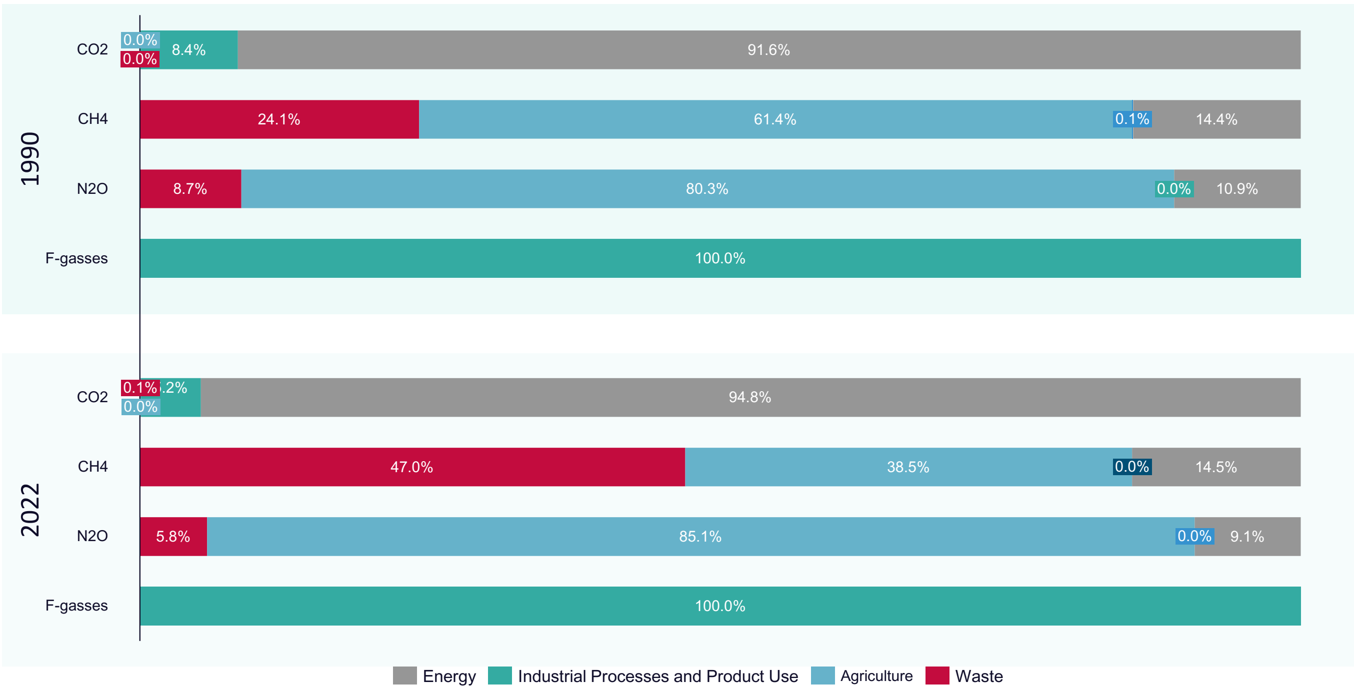
2 Greenhouse Gas Emissions and Removals Inventory

This chapter represents the central part of the national inventory, as it brings together all CO_2, CH_4, N_2O and fluorinated gas emissions from the different sectors. The analysis makes it possible to observe the overall emissions trend and to identify changes in the structure of emissions over time.

In 1990, the energy sector was the dominant source of CO_2 emissions, accounting for 91.6% of total emissions of this gas, while industrial processes contributed 8.4% (Figure 10). This clearly shows that carbon dioxide emissions were almost entirely related to the combustion of fossil fuels for electricity and heat generation. For CH_4 (methane), the main sources were agriculture (61.4%) and waste (24.1%), indicating the significant role of landfills and enteric fermentation in the emission profile at that time. Nitrous oxide (N_2O) originated almost entirely from agriculture (80.3%), while a smaller share (10.9%) was associated with the energy sector.

By 2022, the structure shows a more pronounced concentration of emissions in certain sectors. CO_2 emissions from the energy sector further increased to 94.8%, confirming the country's continued dependence on fossil fuels. In the case of methane (CH_4), a significant structural change is observed: waste becomes the dominant source with 47%, while the share of agriculture decreases to 38.5%, reflecting urbanisation and the increasing quantities of waste generated. For N_2O, agriculture remains the dominant source with 85.1%, while the energy sector accounts for approximately 9%.

Figure 10. Total greenhouse gas emissions by sector and by gas (in %)



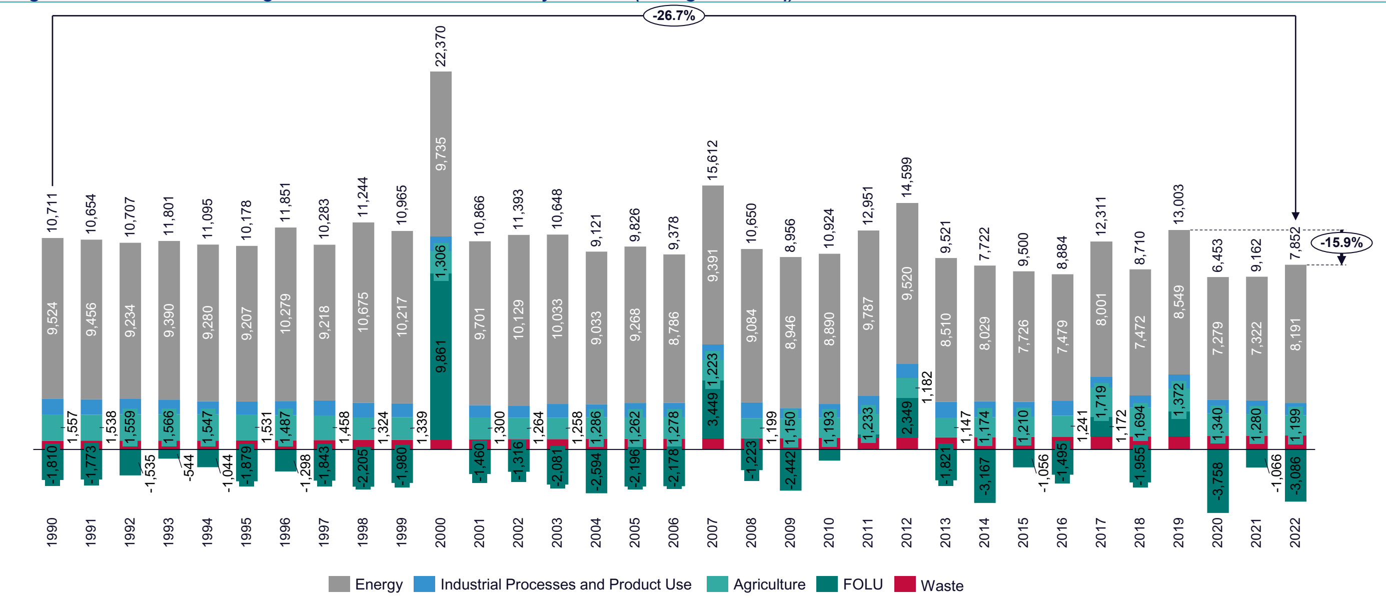
Source: IPCC software, team analysis

Total greenhouse gas emissions in Macedonia for the period 1990–2022 have decreased by approximately 33%, while in the period 2019–2022 they have decreased by around 16% (Table 2 and Figure 11). The Energy sector makes the largest contribution, accounting for more than two-thirds of total emissions and remaining the main source of emissions despite the gradual decline observed particularly after 2011. This reduction is the result of decreased electricity generation from coal, improved energy efficiency, and a higher share of natural gas and renewable energy sources, although at the same time energy consumption in the transport sector has increased. At the same time, the Forestry and Other Land Use sector shows the largest variations: in certain years it contributes as a significant carbon sink (up to –3,800 Gg CO_2-eq in 2022), while in other years it becomes a source of greenhouse gas emissions, particularly during years with large forest fires. This is precisely what makes forestry a key, but also a potentially volatile element in the national carbon balance.

Table 2. Greenhouse gas emissions and sinks by sector (in CO2-eq)

Sector	1990	2000	2005	2014	2015	2016	2017	2018	2019	2020	2021	2022
Energy	9523.8	9735.4	9267.6	8028.7	7725.6	7479.3	8001.1	7471.8	8548.7	7279.0	7321.8	8191.3
IPPU	924.5	883.2	857.1	955.3	875.1	900.3	649.0	724.6	832.9	790.7	808.1	715.9
Agriculture	1556.7	1306.2	1261.5	1174.4	1210.3	1241.2	1719.5	1694.0	1371.9	1339.6	1279.6	1199.3
Forestry	-1810.4	9861.0	-2196.2	-3166.7	-1056.5	-1494.9	1172.1	-1955.3	1460.0	-3758.4	-1066.1	-3085.8
Waste	516.6	584.3	636.3	730.6	745.2	757.8	769.8	775.0	789.2	802.3	819.0	831.0
Total	10711.2	22370.0	9826.4	7722.3	9499.7	8883.6	12311.5	8710.1	13002.7	6970.0	9662.8	7135.8
Total excluding forestry	12521.6	12509.0	12022.6	10889.0	10556.2	10378.5	11139.4	10665.3	11542.7	10211.6	10228.5	10937.5

Figure 11. Greenhouse gas emissions and sinks by sector (in Gg CO2-eq)

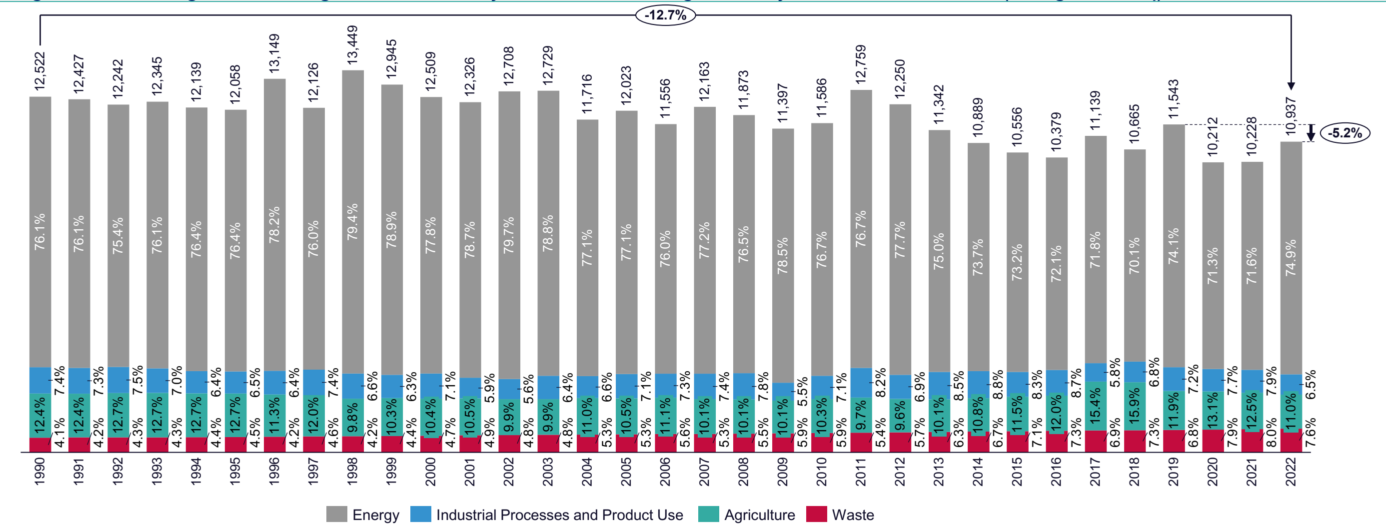


Source: IPCC software, team analysis

The results for total greenhouse gas emissions in Macedonia, excluding the Forestry and Other Land Use sector, provide a clearer picture of the emission sources within the economy. Total emissions in 2022 amount to approximately 10,900 Gg CO_2-eq, representing a decrease of about 13% compared to 1990 (Figure 12), with the most pronounced decline occurring after 2011. The Energy sector makes the largest contribution, accounting for more than 75% of total emissions, although in absolute terms emissions from this sector have declined over time. The Industrial Processes and Product Use sector contributes around 7–9%, showing a slight increase during the last decade, mainly driven by cement production and metallurgical activities. Agriculture maintains a relatively stable share (approximately 10–12%), with a very slight decrease primarily due to the reduction in livestock numbers. In contrast, the Waste sector shows a continuous increase, with emissions rising by more than 60% compared to 1990, which is associated with urbanization, increased municipal waste generation, and the limited implementation of waste separation and treatment systems. As emissions from this sector increase, its share in total emissions rises from 4% in 1990 to around 8% in the period 2020–2022.

These results indicate that without forestry acting as a carbon sink, the trend in total emissions becomes significantly more stable and more accurately reflects the structure of the national economy. The observed reduction in emissions is primarily the result of structural changes in the energy sector, while other sectors either remain relatively stable or grow at a slower pace. This clearly confirms that long-term decarbonization policies should remain strongly focused on the transformation of the energy system, accompanied by parallel measures for improved waste management and sustainable agricultural practices.

Figure 12. Total greenhouse gas emissions by sectors excluding Forestry and other land use (in Gg CO2-eq)

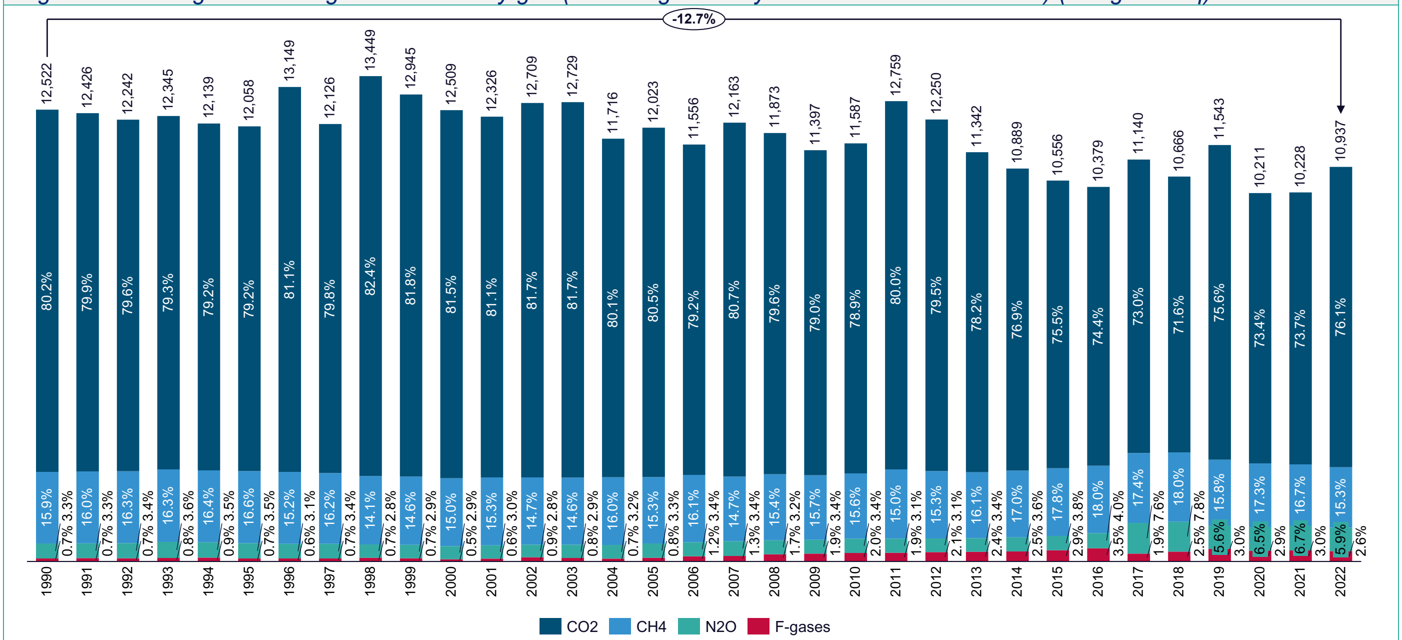


Source: IPCC software, team analysis

Total greenhouse gas emissions by gas (excluding sinks from the Forestry and Other Land Use sector) for the period 1990–2022 show a clear dominance of carbon dioxide (CO_2), which accounts for more than 75–80% of total emissions and represents the primary indicator of Macedonia's climate dynamics (Figure 13 and Table 3). Although total CO_2 emissions have decreased by approximately 17% compared to 1990, their overall level remains relatively high, mainly due to electricity generation from coal and the intensive use of petroleum products in the transport sector. Methane (CH_4) is the second most significant gas, contributing about 15% of total emissions, with a reduction similar to that observed for CO_2 emissions—around 15% in 2022 compared to 1990. The main sources are landfills and agriculture, particularly enteric fermentation and manure management.

On the other hand, fluorinated gases (F-gases), although accounting for a very small share (<1%), show the largest relative increase, with emissions rising more than 3.5 times by 2022, reaching a 2.6% share compared to 1990 (Figure 14). This increase is primarily driven by the expansion of refrigeration and air-conditioning systems and the growing use of HFC gases.

Figure 13. Total greenhouse gas emissions by gas (excluding Forestry and other land use sector) (in Gg co2-eq)



Source: IPCC software, team analysis

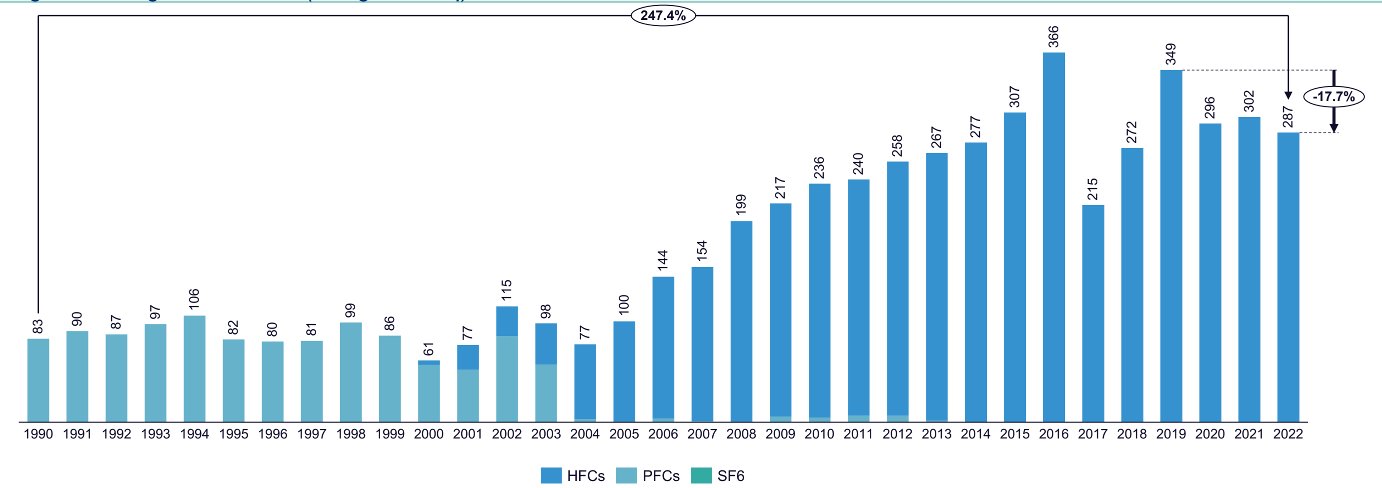
Table 3. Greenhouse gas emissions, by gas (in CO2-eq)

Gas	1990	2000	2005	2014	2015	2016	2017	2018	2019	2020	2021	2022
CO2	10038.7	10200.7	9682.9	8368.4	7972.7	7724.5	8133.9	7641.7	8722.2	7491.5	7538.9	8325.3
CH4	1985.1	1882.2	1841.8	1849.8	1879.0	1870.1	1938.9	1922.9	1823.0	1764.0	1705.8	1676.1
N2O	415.5	364.9	398.0	394.1	397.8	417.6	851.7	829.2	648.7	659.9	681.1	649.0
HFCs	0.0	4.5	99.5	277.0	306.7	366.2	215.2	271.8	348.7	296.0	302.4	286.9
PFCs	82.6	56.6	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SF6	NO											
Total	12521.9	12509.0	12022.6	10889.3	10556.2	10378.5	11139.6	10665.6	11542.7	10211.3	10228.2	10937.2

Despite the relatively small share of fluorinated gases (F-gases) in total emissions, this inventory reports only the emissions of HFC and PFC gases (Figure 14). SF_6 emissions have not been estimated for Macedonia due to the lack of activity data. Therefore, Macedonia applies the flexibility provisions available to developing countries, reporting the three mandatory greenhouse gases (CO_2, CH_4, N_2O) together with two additional gases (PFCs and HFCs).

HFC emissions begin to appear in the inventory in 2000 and reach 366 Gg CO_2-eq in 2016, after which a decline is observed. By 2022, emissions had decreased by approximately 18% compared to the 2019 level.

Figure 14. F-gas emissions (in Gg CO2-eq)



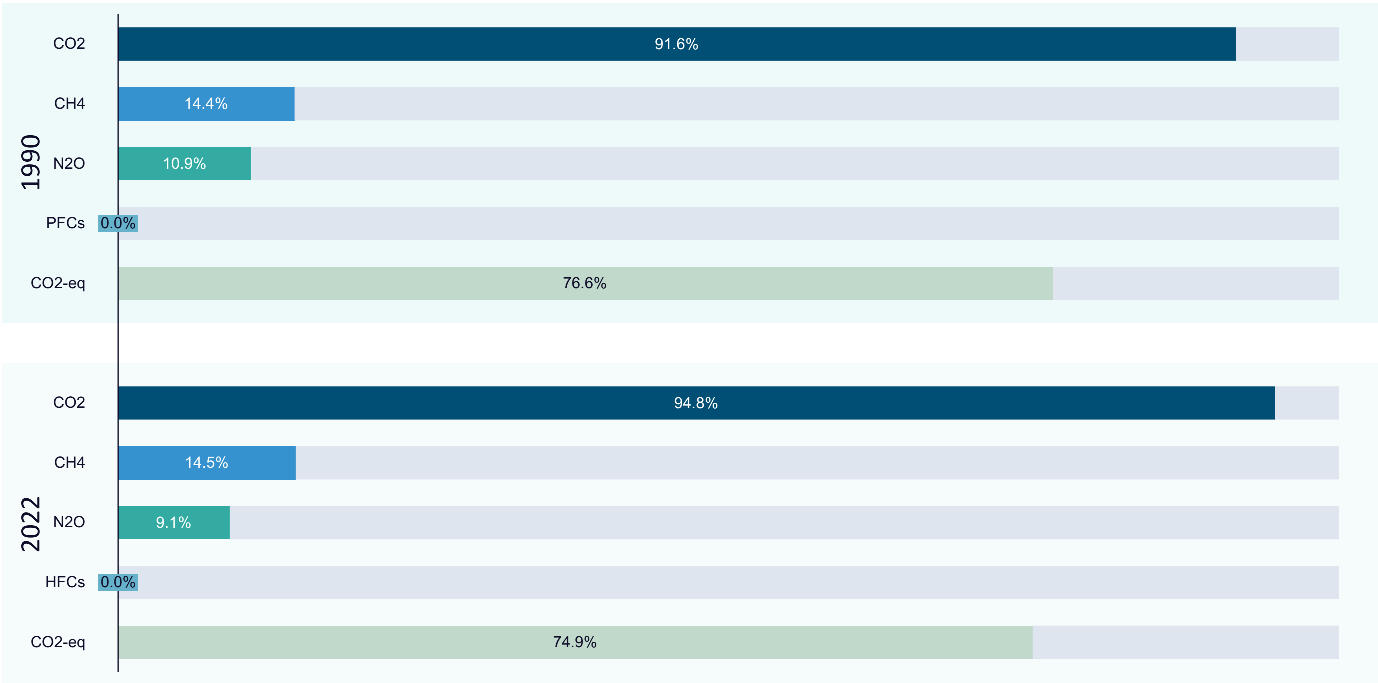
Source: IPCC software, team analysis

3 Energy

3.1 Summary overview

The results of greenhouse gas emissions show that the energy sector continuously dominates total national emissions: in 1990 its share was 76.6%, and in 2022 74.9% (Figure 15), which indicates that, despite structural changes and increased energy efficiency, the sector still has a decisive impact on greenhouse gas emissions. The main contribution comes from CO_2, whose share in total CO2 emissions at the national level grows from 91.6% in 1990 to 94.8% in 2022. At the same time, the share of methane (CH_4) is almost at an identical level, while nitrous oxide (N_2O) records a moderate decline from 10.9% to 9.1%. This only confirms that the Energy sector in Macedonia is in a specific, subordinate role, because on the one hand it is the foundation of the functioning of the state, providing electricity and heat, fuels for transport and energy for industrial processes, and on the other hand it is the largest source of greenhouse gases, which makes it a key target group for reducing emissions. Therefore, this sector must simultaneously ensure security of supply, economic sustainability and competitiveness, but also gradually reduce its carbon dependence, leading the decarbonization process at the national level.

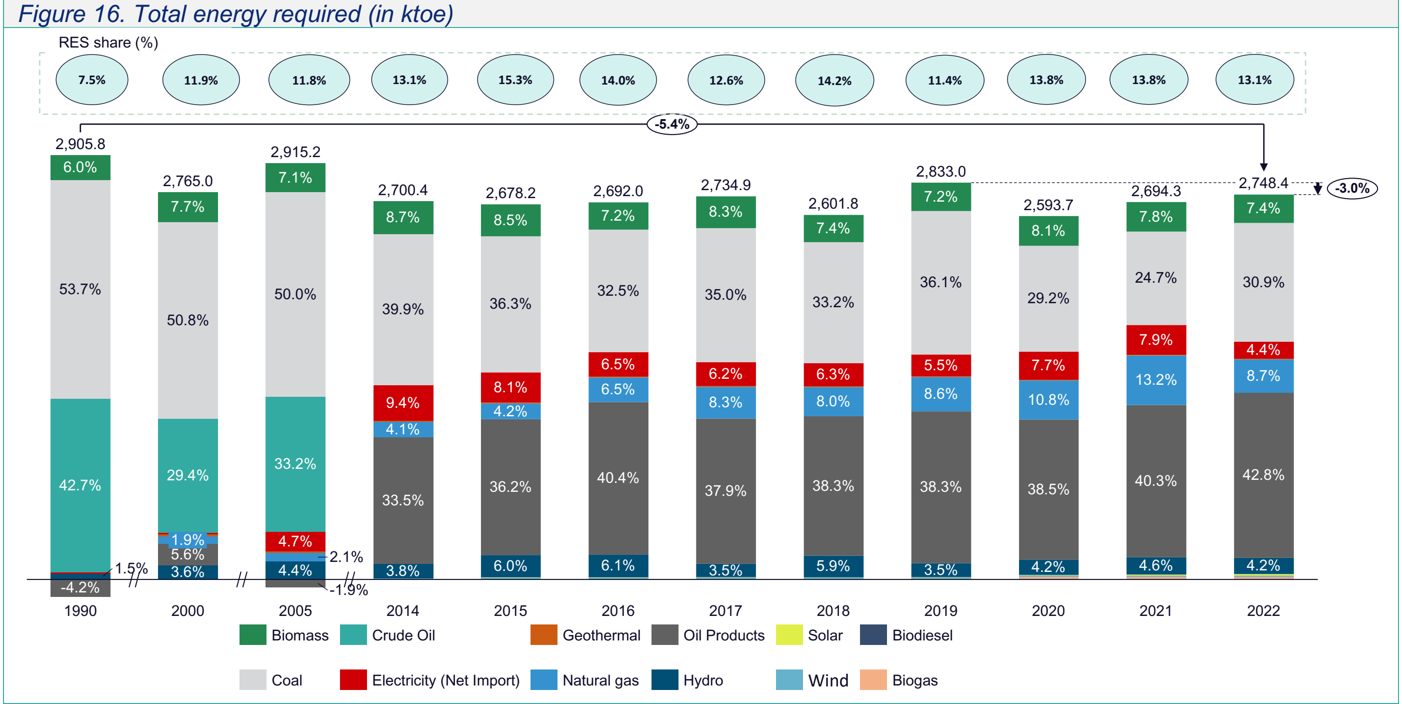
Figure 15. Greenhouse gas emissions in the energy sector, 1990 and 2022 (in Gg CO2-eq)



Source: IPCC software, team analysis

Macedonia's energy sector has traditionally been based on fossil fuels, but in the last decade there has been a gradual diversification of sources. In 1990, fossil fuels accounted for over 95% of total primary energy consumption, while in 2022 their share is expected to decrease to around 84% (Figure 16). Total primary energy in the period 1990-2022 decreased by 5.4%, while 2022 compared to 2019 shows a decrease of 3%. Although the decrease is relatively modest, it indicates a gradual transition to cleaner energy sources and the increasing role of renewable energy sources (RES), whose share increased from around 7.5% in 1990 to around 13% after 2022. At the same time, electricity imports, which in 1990 were almost negligible (0.2%), today represent a significant part of the energy balance, reaching around 5–6% in total consumption. This trend reflects Macedonia's dependence on external sources of electricity in years with lower domestic production, especially in seasons when hydropower potential is limited due to reduced rainfall and snowfall.

Figure 16. Total energy required (in ktoe)

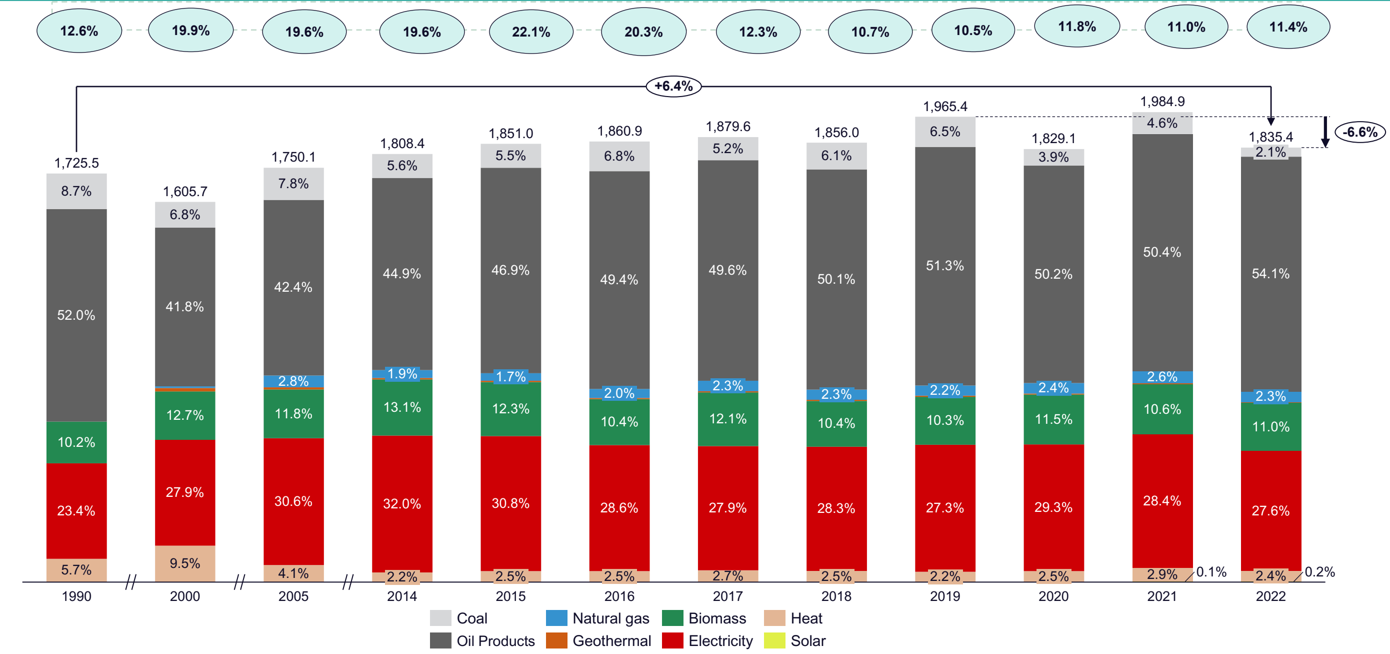


Source: IPCC software, team analysis

On the other hand, when analyzing final energy consumption, i.e. the energy used by households, transport, industry and the commercial and public sectors, a different dynamic is observed. In 2021, a maximum of almost 2,000 ktoe was reached, which is about 15% more compared to 1990, but in 2022 there is a decrease of over 7.5% compared to 2021. Oil products are the most common energy sources with about 50% share in the entire period, followed by electricity (28%), biomass (about 11%) and thermal energy and natural gas (about 2% each). These values indicate a stable but slowly evolving structure of final consumption, where although in certain years there is an increase in consumption, the increasing penetration of energy efficiency measures, including the introduction of new technologies, contribute to a gradual improvement in the overall energy efficiency of the energy system.

The fact that primary energy consumption is decreasing and final energy consumption is increasing indicates that the energy system is becoming more efficient, i.e. less energy is lost in the processes of production, transformation and transmission. This also means that the country today consumes less primary energy to provide the same or even greater volume of final energy, which means that technologies for the production of electrical and heat have improved, losses in the system have been reduced, and consumers are using more efficient devices. The increased share of renewable sources and natural gas also contributes to this.

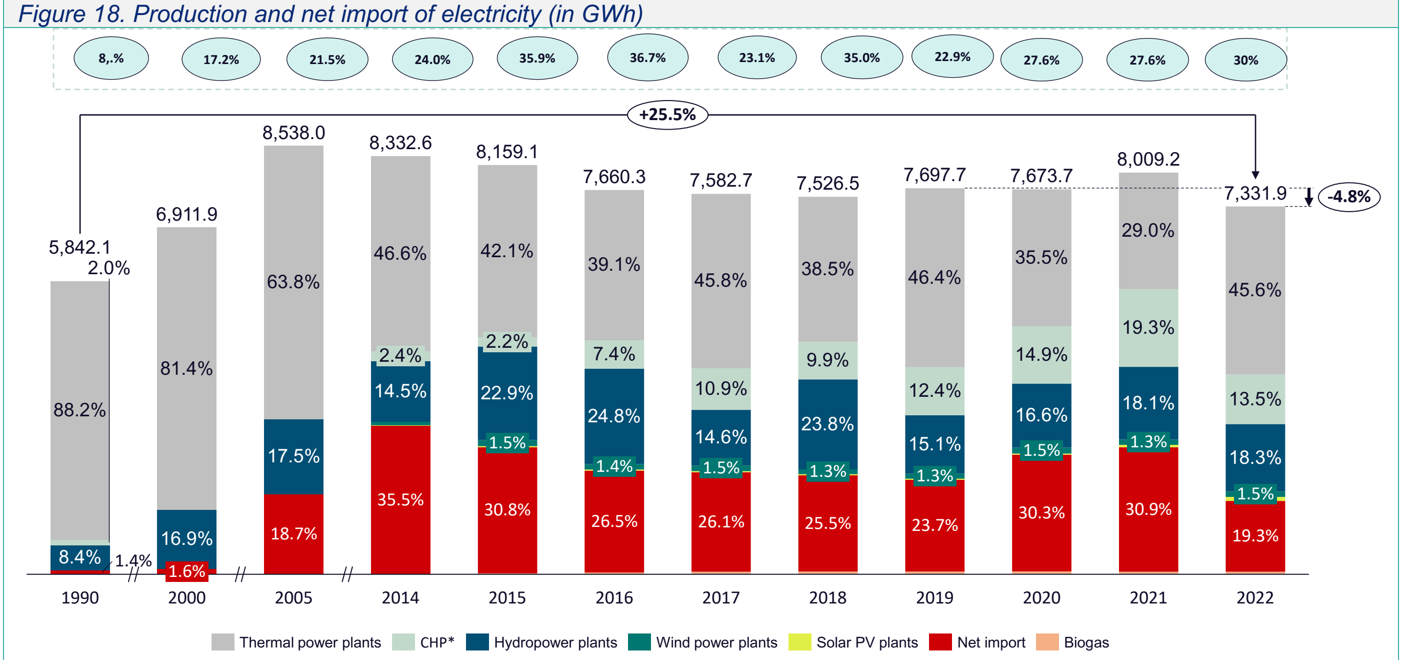
Figure 17. Final energy consumption (in ktoe)



Source: IPCC software, team analysis

Electricity, together with biomass, are very important energy sources for Macedonia, especially as domestic resources. Electricity production remains the most critical part of the energy system. In 1990, thermal power plants accounted for 88% of the total electricity demand, and in 2021 their share is reduced to 30% (Figure 18). At the same time, hydroelectric power plants and TETO increase their share to around 18% and 19% respectively. New technologies such as solar and wind power plants show significant growth, but their share remains small during the analysed period.

Figure 18. Production and net import of electricity (in GWh)

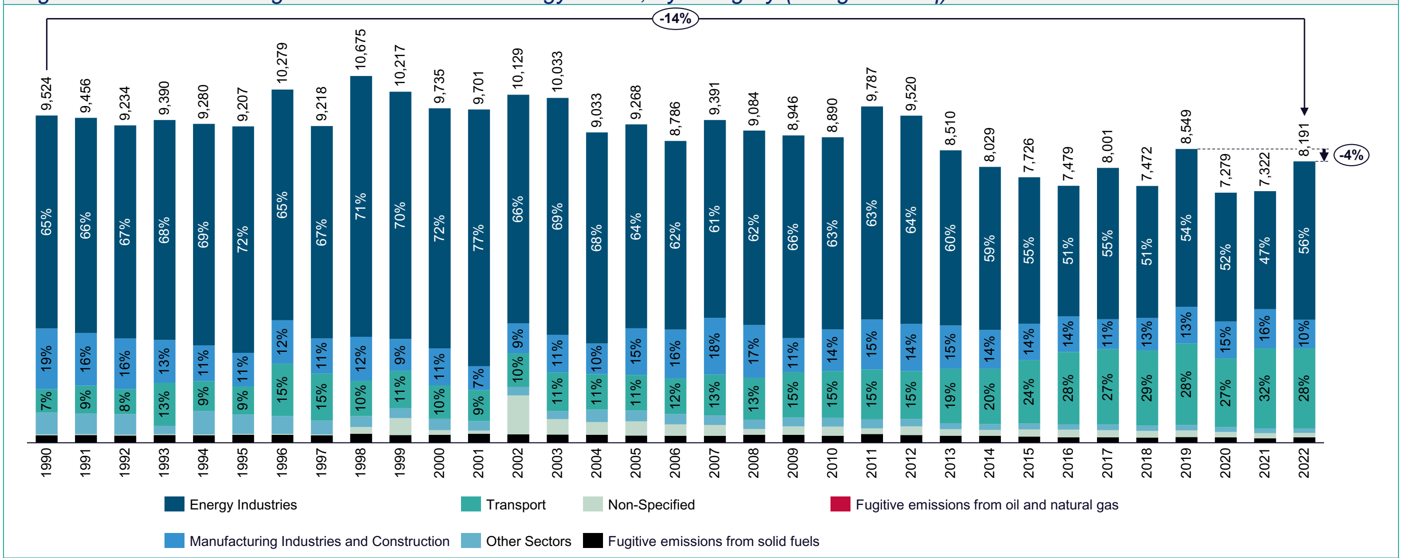


Source: IPCC software, team analysis
Note: In 1990 the value is for CHP (combined power plants) for own needs within industrial plants.

Total emissions from the Energy sector in the period 1990–2022 change from year to year, but with a constant dominance of the Energy Industries category, whose share most often ranges between 47% and 77% of total emissions. The initial years are characterized by high values, above 9000 Gg CO_2-eq, with a peak in 1998, when emissions exceed 10,600 Gg CO_2-eq (Figure 19). After 2011, as a result of reduced lignite production, higher electricity imports and structural changes in the energy system, a gradual decline in emissions began from around 9,800 Gg CO_2-eq to around 8,200 Gg CO_2-eq in 2022. The comparison of 2022 with 1990 shows that emissions have decreased by 14%, while the comparison of 2022 with 2019 shows a decrease of only 4%. However, it should be noted that during the entire period from 1990-2022, total emissions in the sector did not decrease proportionally to the trend of decreasing electricity production from coal-fired thermal power plants (Figure 18), because part of that production has been replaced by electricity production from natural gas-fired thermal power plants, which, although has a lower emission factor compared to lignite, still generates significant CO_2 emissions.

It should also be emphasized that one of the key reasons why total greenhouse gas emissions from the Energy sector are not decreasing significantly, despite the reduction in coal-fired electricity production and its partial replacement with natural gas, is precisely the continuous growth of emissions from the Transport sector. This sector has recorded a long-term and stable increase in the consumption of liquid fuels, which results in increased CO_2 emissions and in some way neutralizes the effect achieved by reducing coal consumption. Hence, transport is a structural factor that limits the net effect of the transition in the electricity subsector. Expressed in numbers, Transport is the only sector with continuous growth, from 679 Gg CO_2-eq in 1990 to 2,328 Gg CO_2-eq in 2022, which reflects primarily increased motorization but also the increase in the transport of passengers and goods. In contrast, emissions from Manufacturing Industries and Construction are halved (from 1,771 Gg in 1990 to 832 Gg in 2022).

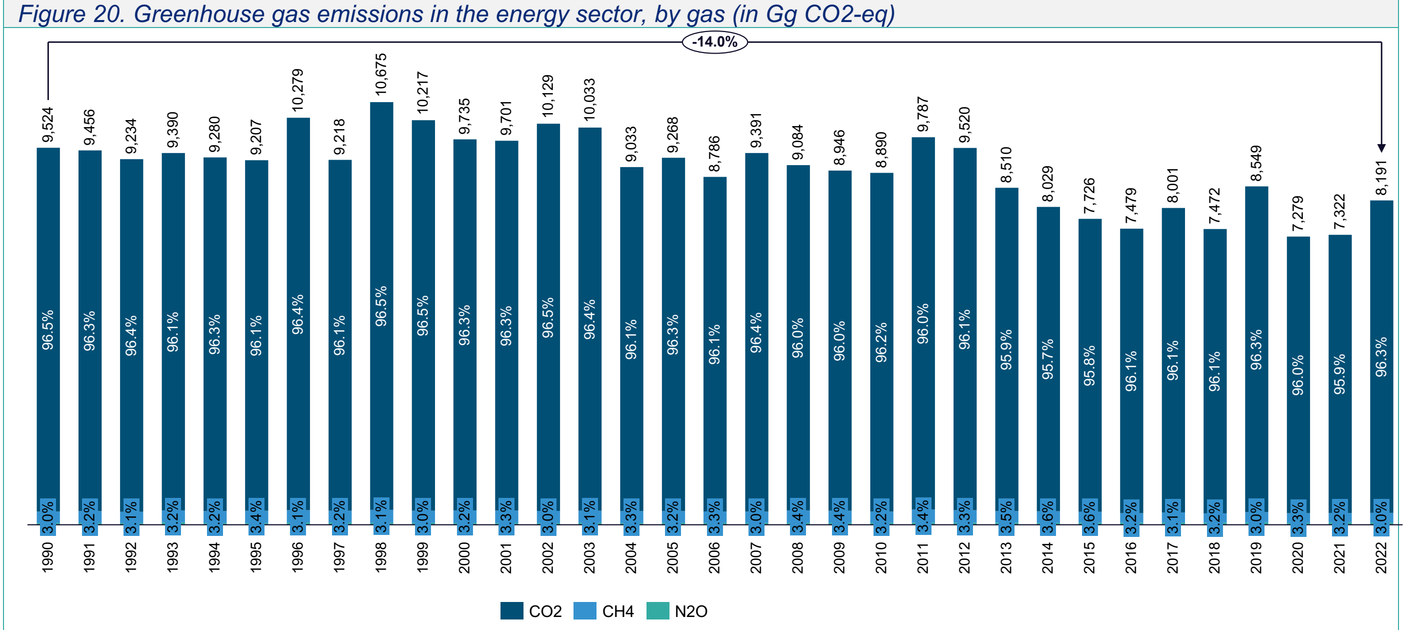
Figure 19. Greenhouse gas emissions in the energy sector, by category (in Gg CO2-eq)



Source: IPCC software, team analysis

Total greenhouse gas emissions in the Energy sector by gas (in Gg CO2-eq) in the reporting years are given together in Figure 20. Almost all greenhouse gas emissions from the Energy sector in 2022 are actually CO₂ emissions (96.4%), with CH4 and N2O emissions accounting for only 3% and 0.7%, respectively.

Figure 20. Greenhouse gas emissions in the energy sector, by gas (in Gg CO2-eq)



Source: IPCC software, team analysis

3.2 Combustion of fuels for energy needs

The category Combustion of fuels for energy needs covers all emissions that occur when a certain fuel is burned to obtain energy, whether it is for electricity production, operation of industrial plants, driving vehicles or heating households. This category includes four groups of activities:

1. Energy industries
2. Manufacturing industries and construction
3. Transportation
4. Other sectors, which include households and agriculture.
5. Unspecified, which is used only when an activity cannot be classified in the previous groups.

3.2.1 Energy industries

The category "Energy Industries" in the national inventory covers activities related to the conversion of primary energy sources (coal, fuel oil, natural gas) into electricity and/or heat, before they reach the consumers themselves. This means that this category does not include emissions from energy use in households or industry, but only emissions that occur in plants where energy is produced or converted from one form to another. According to the 2006 IPCC Guidelines, the category includes three clearly defined subcategories:

1. Electricity production – thermal power plants that produce electricity from lignite, natural gas or fuel oil.
2. Combined heat and power (CHP) plants – plants that simultaneously produce both heat and electricity in one process and which can also use coal, natural gas or other energy sources as input.
3. District heating plants – plants that produce only thermal energy (steam or hot water) and deliver it through a central heating system to households, public buildings or industrial consumers. In Macedonia, district heating plants used to use fuel oil in the past, but today they use natural gas.

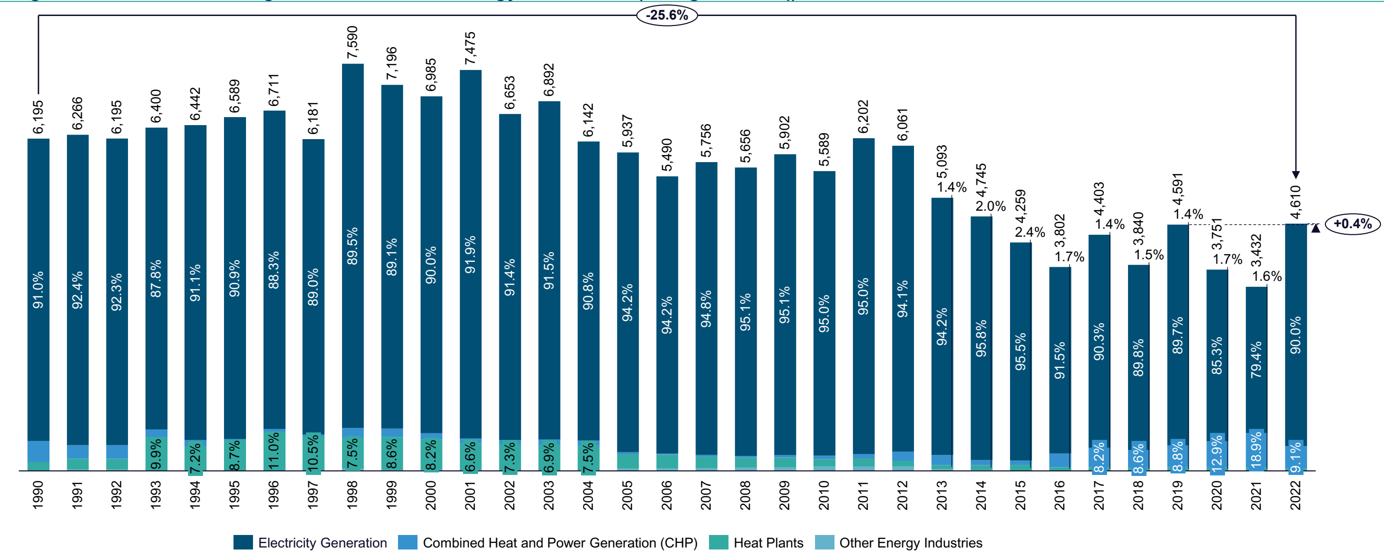
Additionally, under the subcategory “Other energy industries”, greenhouse gas emissions arising from fuels consumed within the energy sector itself are reported. This includes fuels used for internal technological processes in energy enterprises, such as pumps, compressors, heating systems and other equipment that enable the operation of production plants. In other words, emissions arising not from the production of electricity or heat for consumers, but from the energy consumed by the energy plants themselves for their own operations, are included here.

The long-term dynamics of emissions from the "Energy Industries" category in the period 1990–2022 clearly shows a downward trend of about 25.6% over three decades (Figure 21). The reduction is the result of multi-year changes in the energy system, the most significant of which are the gradual reduction of electricity production from lignite, the transition from fuel oil to natural gas in heating plants and cogeneration plants, as well as broader structural changes in the energy sector. In some years, the decline in emissions has been further amplified by higher electricity imports, which reduces the need for domestic production and thus the combustion of fuels.

The largest decrease occurs in 2020 and 2021, during the Covid-19 and energy crisis period when domestic production was significantly reduced. In 2020, consumption decreased, while in 2021 imports reached record levels, which directly resulted in lower emissions within this category. In 2022, the trend changes: emissions grow again and approach the 2019 level, with a minimal increase of 0.4%. This growth is related to the increased domestic electricity production, the reactivation of the fuel oil thermal power plant, after a break of about 15 years, and the reduced import of electricity compared to previous years.

Despite the reduction in emissions and large fluctuations, the dominance of electricity generation remains constant throughout the period, with a constant share between 80%-95%. This indicates that the structure of electricity generation itself is the most critical and determining factor for the level of emissions in the Energy Industries sector.

Figure 21. Greenhouse gas emissions in energy industries (in Gg CO2-eq)



Source: IPCC software, team analysis

3.2.2 Manufacturing industries and construction

The category "Manufacturing Industries and Construction" represents a significant part of the Energy sector and in 2022 accounted for 10.2% of total greenhouse gas emissions in the energy sector. This category includes emissions resulting from the combustion of fuels directly in industrial and construction processes, i.e. from the energy that factories and industrial facilities use for their operation.

Within the activities of companies in the industry, various fuels are used, including coke, lignite, hard coal, sub-bituminous and bituminous coal, fuel oil, heating oil, liquefied petroleum gas, natural gas, as well as various types of biomass (firewood, wood waste, pellets, briquettes). In some industries, petroleum coke is also used, and part of the emissions also originate from the use of diesel in internal transport or technological processes. The category includes the following subcategories:

- Iron and steel
- Nonferrous metallurgy
- Chemical industry
- Pulp, paper and printing
- Food industry, beverages and tobacco
- Non-metallic minerals
- Machines
- Mining of ores (excluding fuels) and stone
- Textile industry and leather industry
- Unspecified industry

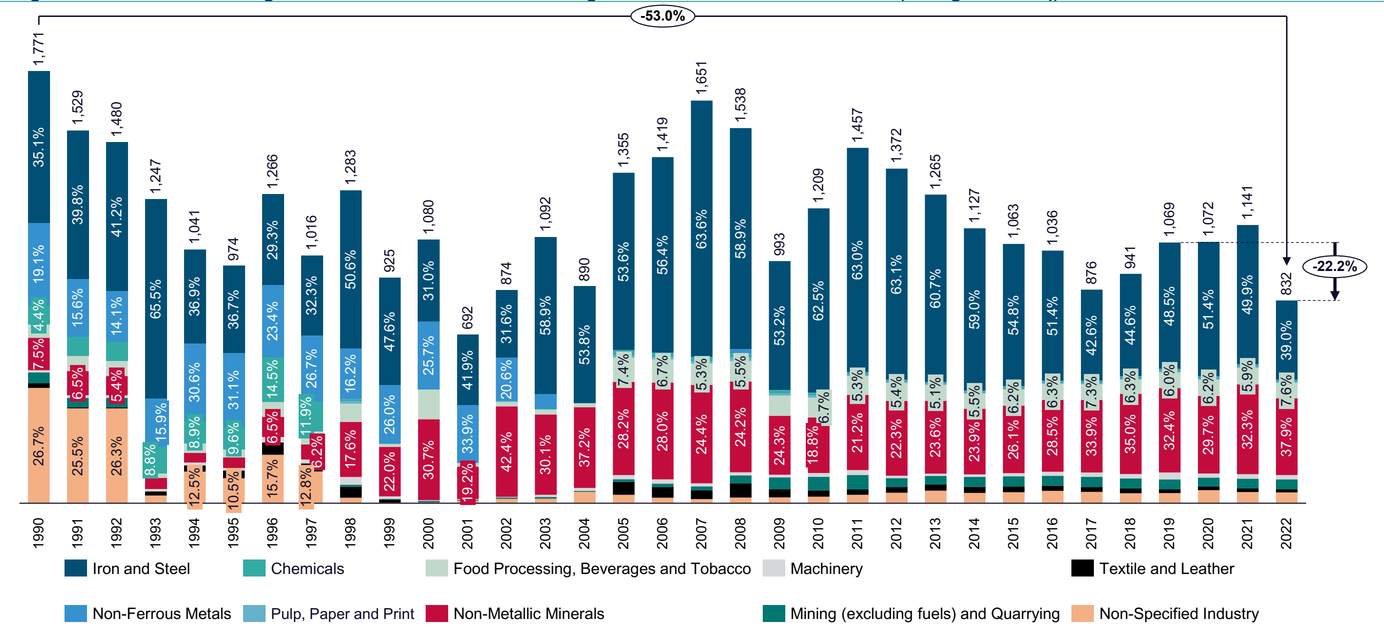
Although both the Manufacturing Industries and Construction subcategory and the IPPC sector refer to industry, the Manufacturing Industries and Construction category only covers emissions resulting from the combustion of fuels (such as coal, fuel oil, diesel, gas) used by industrial facilities for energy, heating, machinery operation or industrial processes. In contrast, the IPPC sector covers emissions resulting from the chemical or physical processes themselves, regardless of whether fuel is burned, such as in the production of cement, lime, steel, glass or from the use of chemicals and fluorinated gases. In other words, Manufacturing Industries and Construction covers energy emissions in industry, while the IPPC covers process emissions, so although they originate from the same factories, they are different in nature and must be reported separately.

Emissions from the category "Manufacturing Industries and Construction" show a significant decrease in the period 1990–2022, with total emissions decreasing by about 53% (Figure 22). This long-term decline has two reasons, on the one hand it reflects the modernization of industrial processes, the reduction of energy intensity and the gradual change of the fuel mix, but on the other hand it also reflects the closure of certain large industrial capacities. In the 1990s, the use of solid fossil fuels (lignite, coal, coke) dominated, which contributed to the largest share of emissions. Over time, their role has significantly decreased, while natural gas has become an increasingly common energy source in several industrial subcategories, contributing to lower specific emissions. At the same time, the use of fuel oil and other petroleum derivatives has decreased.

Looking at the industrial branches, the largest contribution to total emissions is made by the "Iron and Steel" branch, which in the early 1990s recorded over 600 Gg CO_2-eq (35% participation),reaches a maximum in 2007 of 1000Gg CO_2-eq, to drastically reduce emissions to around 330 Gg CO in 2022_2-eq, which is again due to the energy crisis which also results in reduced production.Similar,but still more pronounced trend on reduction everything notes in the colored one metallurgy,where the emissions from above300 Ggin1990-the everything withlead to only 2–5 Gg after 2005 due to drastically reduced activity and closure of facilities. The chemical industry, which previously recorded emissions exceeding 100 Gg CO_2-eq, also declined to minimal levels after 2000, indicating structural changes and the closure or transformation of industrial facilities. Other industrial branches show more systematic stability. Non-metallic minerals, which include cement, lime and glass production, are one of the most stable but also the most emission-intensive categories, with levels of 200 to 400 kt per year, reflecting continued activity in the construction sector.

These results show that the industrial sector in Macedonia has undergone a strong structural transformation: with the reduction of heavy industry, the disappearance of certain branches, the modernization of equipment and the shift to less emission-intensive fuels. At the same time, the dominance of the “Iron and Steel” and “Non-metallic Minerals” branches only shows us that the industries with the highest material and energy intensity remain key sources of emissions, and their technological transition is the one that will be most significant for the future reduction of emissions in this category.

Figure 22. Greenhouse gas emissions in manufacturing industries and construction (in Gg CO2-eq)



Source: IPCC software, team analysis
Note: In 1990, the Unspecified Industry category included more industrial branches compared to other years.

3.2.3 Transportation

The “Transport” category in the national greenhouse gas inventory includes all emissions resulting from the combustion of fuels in vehicles, aircraft, which do not leave the borders of Macedonia, as well as mobile machinery used for the transport of people and goods. The IPCC treats this category as part of the Energy sector and defines it as the energy consumed for the physical movement of passengers and goods, regardless of whether it is private, public, commercial or industrial transport. This category includes emissions resulting from the use of various types of fuels such as diesel, motor gasoline, liquefied petroleum gas, motor gasoline used in aviation and natural gas. The combustion of these fuels generates greenhouse gas emissions as well as other gases, with CO_2 being the most significant due to its direct dependence on the amount of fuel consumed.

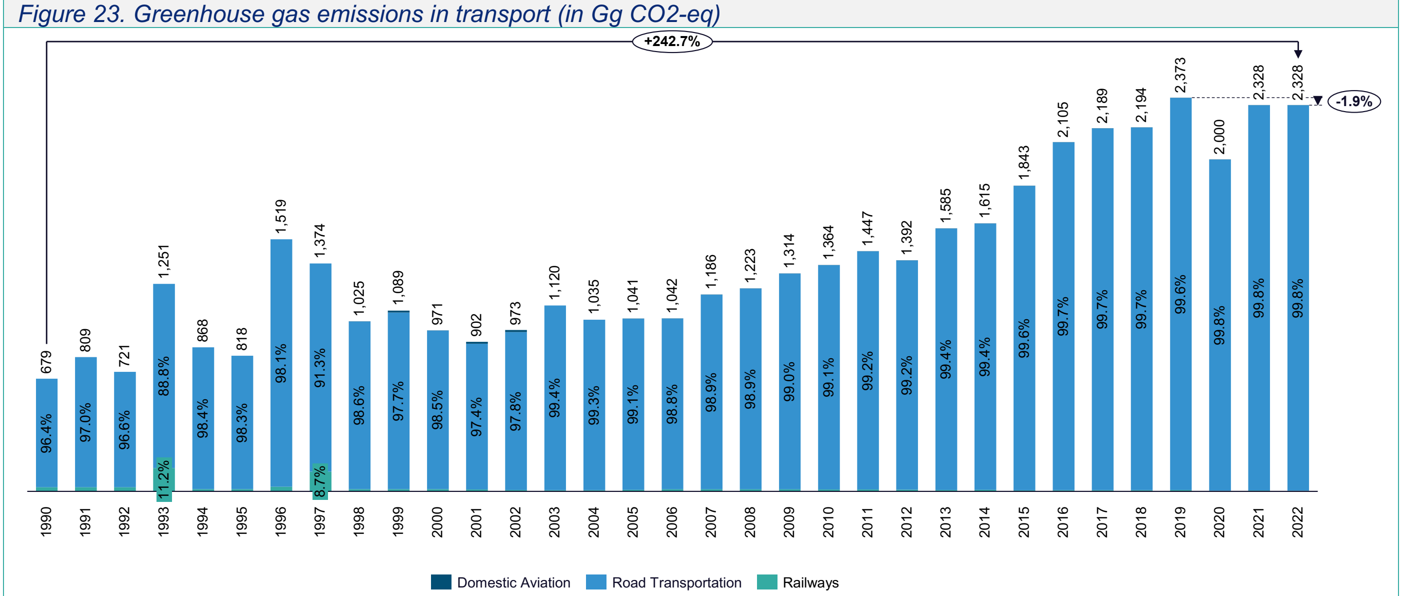
According to the IPCC classification, transport is divided into several subcategories depending on the type of means of transport and the mode of transport:

1. Road transportation – includes vehicles powered by diesel, gasoline, LPG, natural gas (passenger cars, trucks, buses, vans).
2. Railways – emissions originate from the use of diesel locomotives, while if there is an electrified railway, its emissions are reported in the energy industries, i.e. in the electricity generation sector, and not in the transport sector.
3. Domestic aviation – emissions originate from the combustion of motor gasoline in aircraft operating within the borders of Macedonia (domestic flights). The consumption from the combustion of kerosene used for aircraft in international transport is not included in the transport section.

The results for the Transport category show that emissions have increased significantly in the period 1990–2022. In relation to the total level, the trend indicates an increase of approximately 3.5 times (Figure 23), which makes this category one of the most dynamic and contributes to the increase in emissions in the Energy sector. The growth has been most pronounced since the mid-2000s, when a continuous increase in the number of vehicles, the intensity of road traffic and fuel consumption began and lasted until 2019. In recent years (2020–2022) emissions have stabilized and recorded a small decrease of 1.9%, which is partly a result of COVID-19-related restrictions, and partly of structural changes in fuel use and improved fleet efficiency. However, the long-term picture remains clear: transport is one of the main causes of emissions growth in the last three decades.

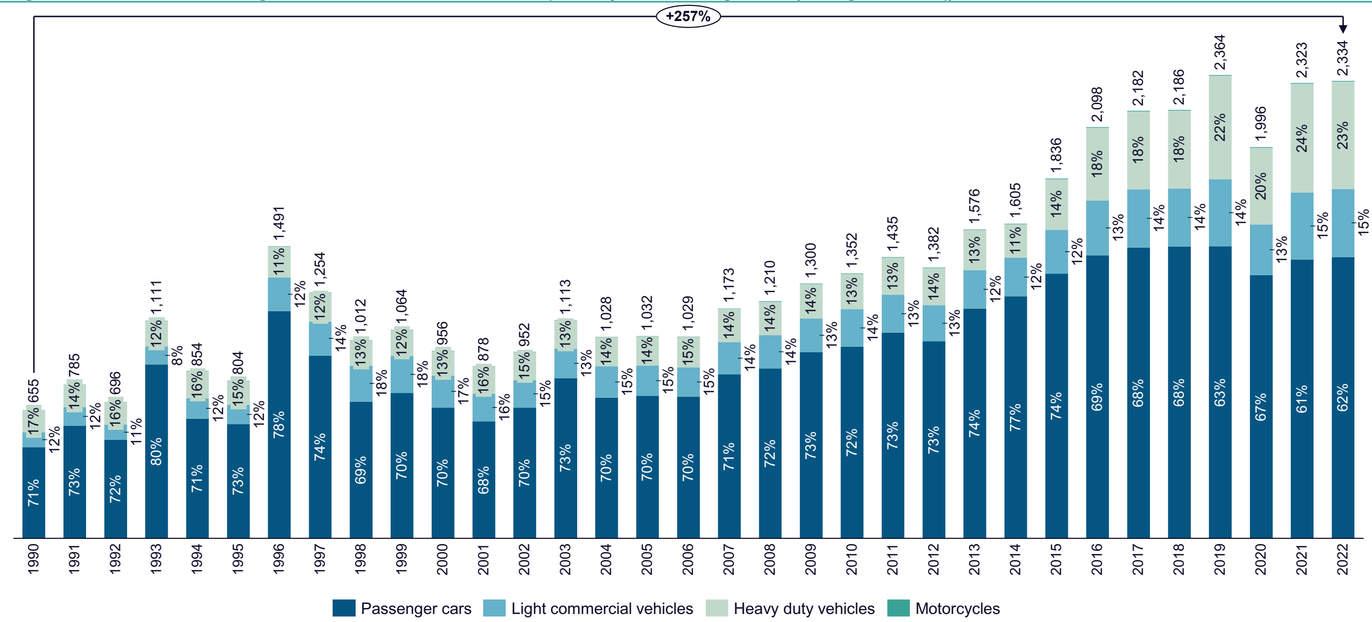
Road transport is dominant at 99% and is the most critical source of emissions. Passenger cars account for 60–80% of total transport emissions in all years, making them the largest single contributor (Figure 24). Light goods vehicles (vans, delivery vans) contribute an additional 15%, while heavy goods vehicles (lorries) add another 10–20%, with their growth most pronounced in recent years due to increased freight transport. The results indicate that road transport is a key target category for decarbonisation measures, including electrification, fleet modernisation, improved public transport and other programmes for more sustainable passenger and freight transport.

Figure 23. Greenhouse gas emissions in transport (in Gg CO2-eq)



Source: IPCC software, team analysis

Figure 24. Greenhouse gas emissions in road transport by sub-categories (in Gg CO2-eq)



Source: IPCC software, team analysis

Improvements in greenhouse gas emissions calculations for the Road Transport category

In previous inventories, emissions from Road Transport were calculated at an aggregate level based on road transport fuel consumption reported in annual energy balances due to a lack of data on fuel consumption by vehicle type. In this inventory, greenhouse gas emissions from Road Transport were calculated at a disaggregated level, by subcategories available in the IPCC software, which include: passenger cars (with and without 3-way catalysts), light commercial vehicles (with and without 3-way catalysts), heavy commercial vehicles and buses and motorcycles, evaporative emissions from vehicles and emissions associated with the use of catalysts in road vehicles, i.e. urea-based catalysts.1.

A key element in this inventory is that COPERT is applied as the basic methodology for the entire period 1990–2022. From the COPERT model, based on data on the structure of the vehicle fleet, average kilometers, fuel consumption (l/100km) and the distribution of fuel consumption by IPCC subcategories, a recalculation has been performed for all years, back from 1990 to 2019. In this way, a consistent, methodologically aligned and detailed disaggregated time series has been provided, in accordance with international best practices and IPCC guidelines, and the results are shown inFigure 24

3.2.4 Other sectors

The "Other sectors" category in the national greenhouse gas inventory includes all emissions resulting from fuel combustion by consumers, namely in:

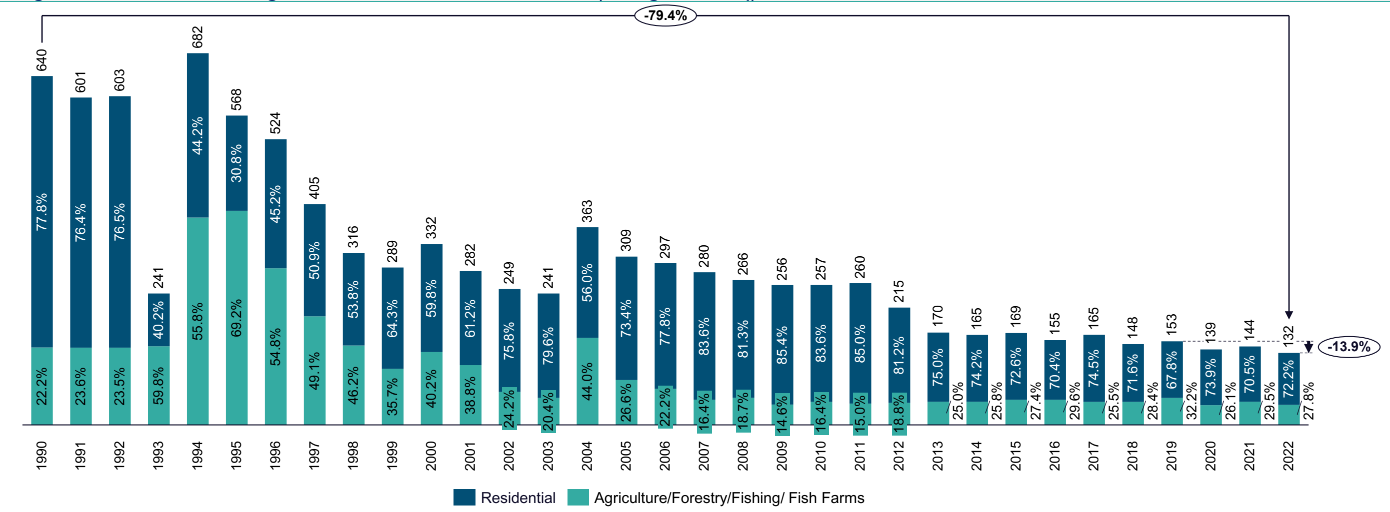
1. Households - emissions resulting from the use of energy for heating, cooking and other household activities.
2. Agriculture/forestry/fishery - includes the combustion of fuels in agricultural machinery, tractors, dryers, small-scale rural power plants, agricultural and fisheries equipment, and forestry-related activities.

The most commonly used fuels are: liquefied petroleum gas, motor gasoline, fuel oil, firewood, wood waste, briquettes and pellets, transport diesel and heating oil and natural gas. This category accounts for 1.6% of total emissions in the Energy sector in 2022 and covers greenhouse gas emissions. The results from “Other sectors” in the period 1990–2022 clearly indicate a significant reduction of 79.4% in greenhouse gas emissions. In the early 1990s, emissions reach very high levels, with households dominating with a share of 78–77%, and the remaining subcategories participating with 20–25% (Figure 25This high initial intensity largely stems from the massive use of petroleum derivatives and coal at a time when energy efficiency was low and central heating systems underdeveloped.

Since the mid-1990s, a rapid decline in emissions has begun, and the reasons are: higher heating efficiency, a gradual transition to electric heating, improved equipment quality and changing consumer behavior. In recent years (2020–2022) emissions have decreased by 13.9% compared to 2019. The share of households remains the largest at around 72%.

[1]*Note from the 2006 IPCC Guidelines: Urea consumption for catalytic converters in vehicles is directly related to fuel consumption and vehicle technology.*

Figure 25. Greenhouse gas emissions in other sectors (in Gg CO2-eq)



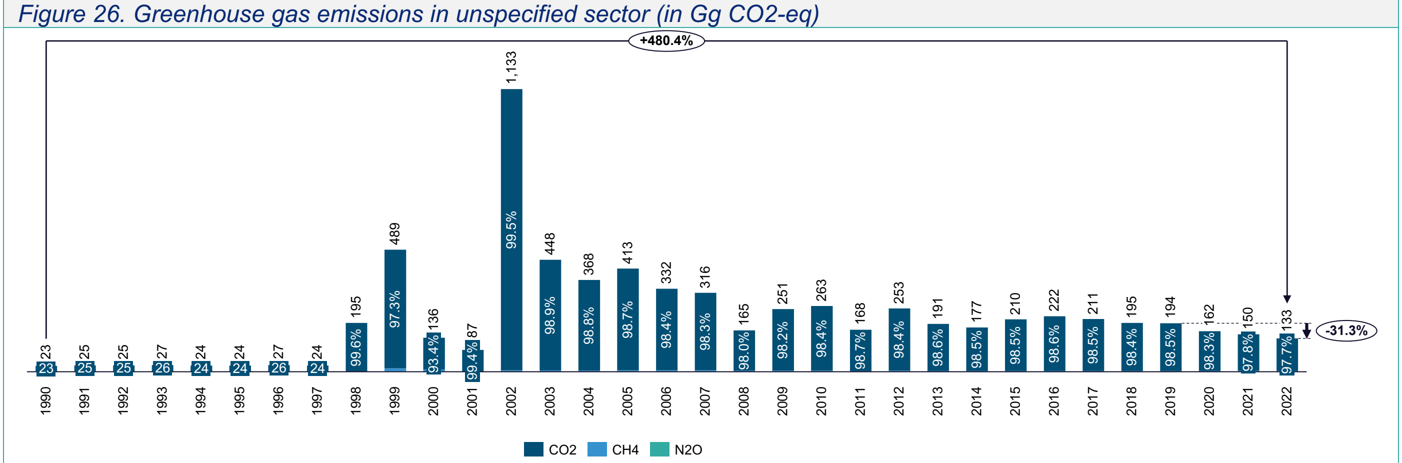
Source: IPCC software, team analysis

3.2.5 Unspecified

The last category of activities that burn fuel is the "Unspecified" category, which in 2022 accounted for 1.6% of total emissions from the Energy sector. Although technically labeled as "unspecified", the emissions actually arise from activities that by their nature belong to the commercial and public sectors (administrative buildings, private service facilities, public institutions and other commercial users). The following fuels are used in this category: lignite, liquefied petroleum gas, fuel oil, natural gas, biomass, transport diesel and heating oil (extra light). Greenhouse gas emissions from this category areFigure 26.

The majority of emissions (more than 97% in all years) are CO2, with CH4 and N2O having a minimal share (<3%). In 2022, emissions have decreased significantly and amount to 133 Gg CO2-eq, which is 31.4% less than in 2019. From 1990 to 2002, emissions increased, especially after 1997 with a peak in 2002 (1,133 Gg CO2-eq). After 2002, there was a sharp decrease and stabilization, so that from 2003 to 2019 the values ranged between 448 Gg CO2-eq and 150 Gg CO2-eq. From 2020 to 2022, there was a downward trend of 31%, with the lowest value in 2022.

Figure 26. Greenhouse gas emissions in unspecified sector (in Gg CO2-eq)



Source: IPCC software, team analysis

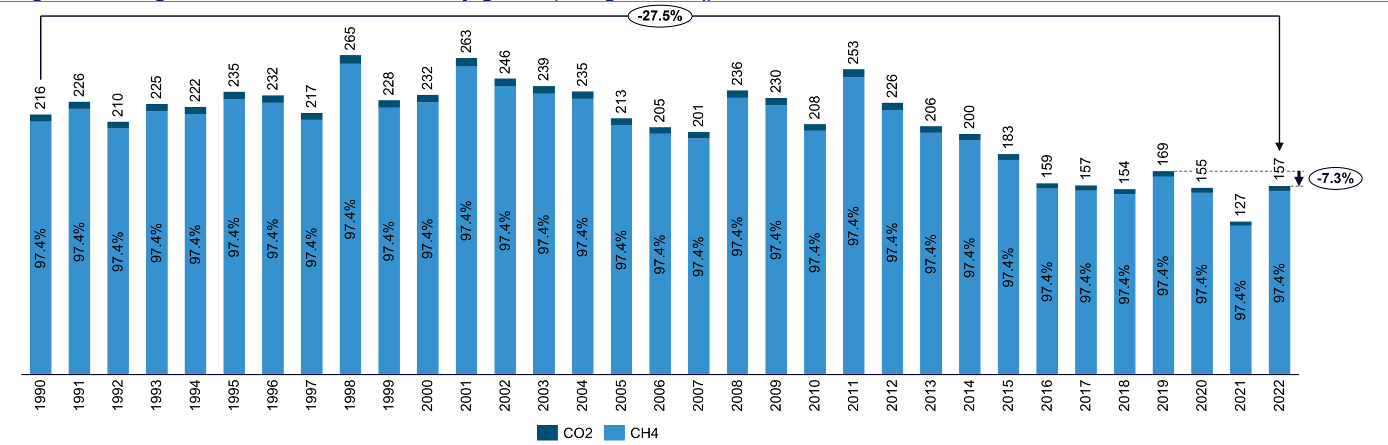
3.3 Fugitive emissions from fuels

Fugitive emissions are greenhouse gas emissions that do not occur during fuel combustion, but are released unplanned or uncontrolled during various activities related to the production, transport or storage of energy sources. Most of the fugitive emissions in Macedonia originate from coal mining, especially from surface mines. When removing coal layers, CH is naturally trapped in the ore layers.₄ who everything releases when the coalcomes into contact with the air. In addition, emissions occur during the very process of handling, transporting and storing the mined coal. In addition, fugitive emissions are also created in the refining processes of petroleum derivatives, as well as in the transmission and distribution of natural gas, where small leaks through pipelines, valves and compressor stations can release significant quantities of methane. This type of emissions is typical for all energy systems in the world, since complete elimination of micropressures, leaks and outgassing is technically impossible, but can be minimized with modern technologies.

In Macedonia, fugitive emissions contribute 1.9% to total emissions from the Energy sector in 2022. Almost all emissions come from solid fuels (from coal mining) or 157 Gg CO2-eq in 2022, and fugitive emissions from oil and natural gas are below 0.1 Gg CO2-eq (Figure 27).

In the period 1990-2022, emissions decreased by around –27.5%, and in 2022 the decrease is around –7.3% compared to 2019 (Figure 27). The structure of fugitive emissions is dominated by methane, whose share is constantly around 97.4%, what indicates that the activities related with excavation on coal, handling with superficial mines and transport on natural gas they remain the main ones sources. Almost all emissions come from solid fuels (from coal mining) or 157 Gg CO_2-eq in 2022, and fugitive emissions from oil and natural gas are below 0.1 Gg CO_2-eq. The decrease in emissions in recent years is primarily due to a decline in coal production.

Figure 27. Fugitive emissions from fuels, by gases (in Gg CO2-eq)



Source: IPCC software, team analysis

3.4 CO_2 transport and storage

The category "Transport and storage of CO_2" according to the IPCC guidelines from 2006 covers all potential emissions arising from the transport, injection, storage and management of carbon dioxide within the framework of carbon capture and storage (CCS) technologies. In Macedonia, there are no active systems for capture, transport or storage of CO_2, nor industrial facilities or infrastructure that would produce emissions falling under the category Transport and storage of CO_2.

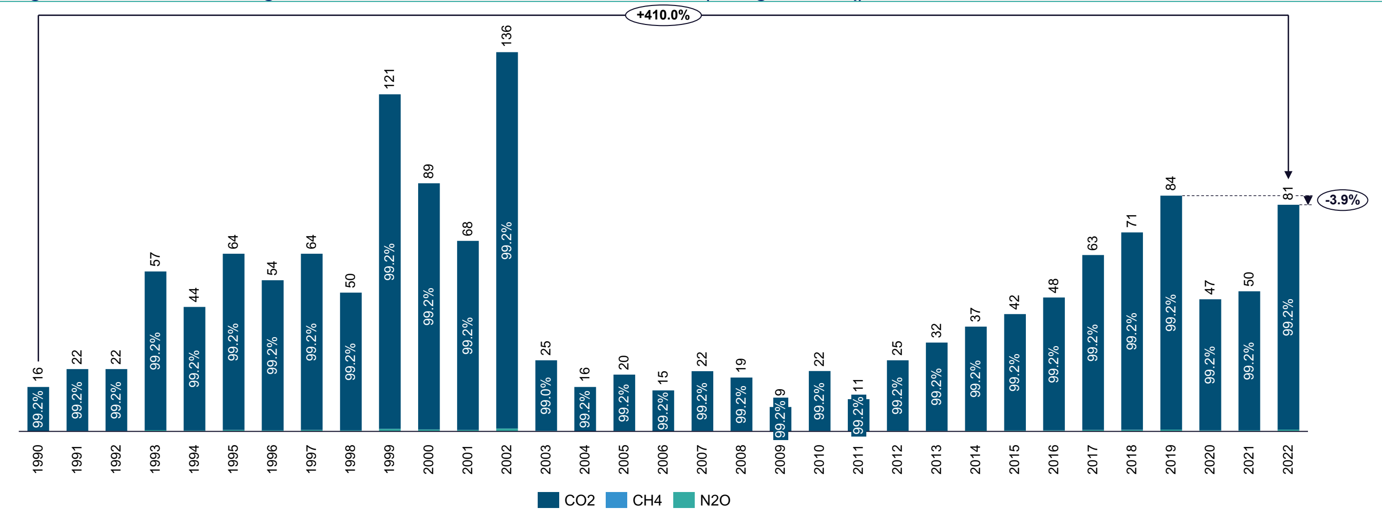
3.5 Other energy-related issues

3.5.1 Memo and informational items

According to the 2006 IPCC Guidelines, 'memo items' or informational items are emission categories that are not included in the national emission totals, but are reported separately to ensure completeness, transparency, and international comparability. They are presented separately because the emissions are not considered "national" in terms of territorial responsibility or because the IPCC prescribes a different way of calculating them. Memo items in the Energy sector include International Aviation and CO_2 from combustion on biomass. Emissions from biomass combustion are not reported in total greenhouse gas emissions because they are considered part of the biological carbon cycle, i.e. CO_2 what everything releases at combustion everything assumes that previously was absorbed from the tree.

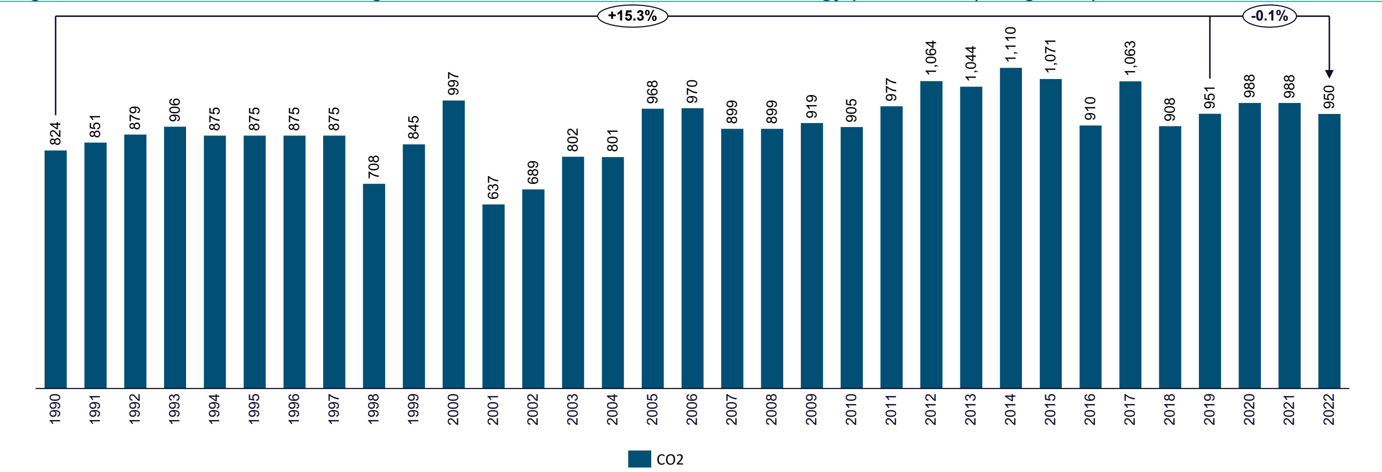
The contribution of International Aviation is almost insignificant. Kerosene is used as fuel. Greenhouse gas emissions increased significantly in the period 2012-2019, but in 2020 and 2021 there was a significant decrease due to limited travel during the Covid pandemic, and in 2022 emissions are slightly lower than the level in 2019 (3.9%), reaching 81 Gg CO2-eq (Figure 28). CO2 emissions resulting from biomass combustion increased by 15.3% in the period 1990 - 2019, however, after 2017 there has been some stagnation in these emissions and in 2022 they amount to 950 Gg CO2-eq (Figure 29).

Figure 28. Greenhouse gas emissions from international aviation (in Gg CO2-eq) – memo items



Source: IPCC software, team analysis

Figure 29. CO2 emissions resulting from the combustion of biomass for energy production (in Gg CO2) – information items



Source: IPCC software, team analysis

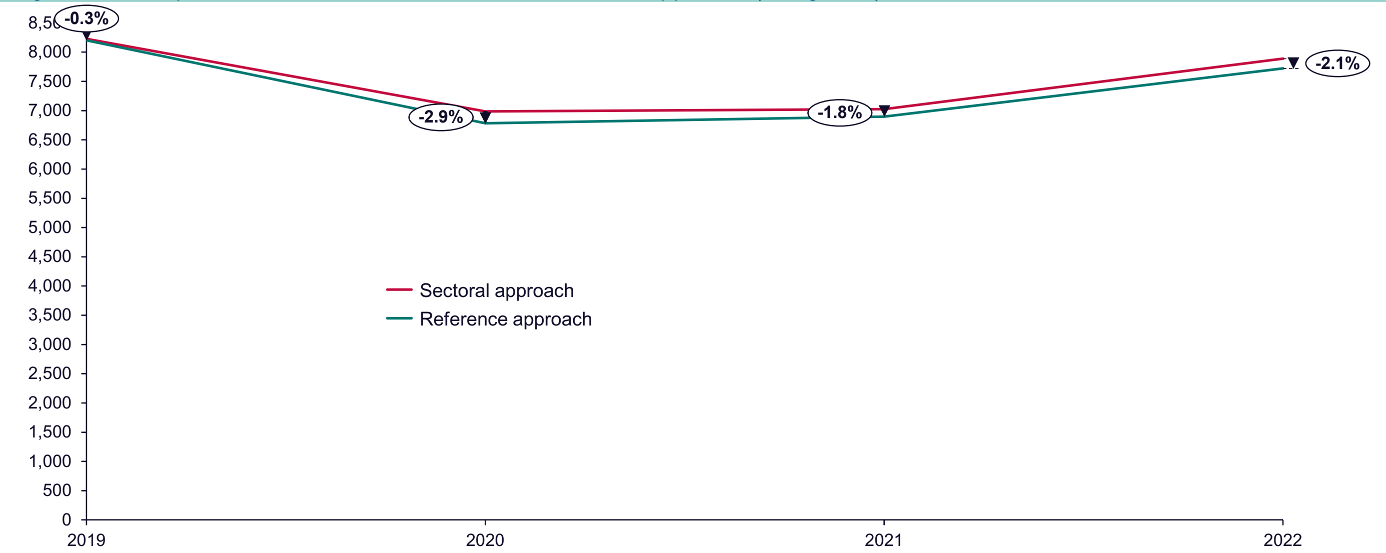
3.5.2 Reference approach and comparison with sectoral approach

In the energy sector, greenhouse gas emissions are basically calculated using two different approaches: reference and sectoral. The sectoral approach, which is the one presented in the previous chapter, is a “bottom-up” method and focuses on where exactly energy is used, whether in power plants, cars, industrial facilities, households and other subsectors. In other words, this is actually final energy consumption and energy consumption in the transformation part (conversion from one type of energy to another). Specific data on energy consumption and emission factors are used for each subsector, which allows for a more detailed analysis and better planning of measures to reduce emissions.

The reference approach is a top-down method, based on the total fuel supply in the country, how much is produced, imported, exported and stored, or in other words, based on primary energy consumption. This approach provides an important check on whether the overall emissions estimates are complete. Comparing the results of the two approaches helps to detect possible inconsistencies in the data and improve the quality of the inventory.

Figure 30 shows a comparison of greenhouse gas emissions calculated using the sectoral and reference approaches in the period 2019–2022. It can be concluded that both methods give almost identical results, indicating a stable and consistent data system. The largest difference in emissions is observed in 2020 (-2.9%), while in 2021 and 2022 the differences are much closer (1.8% and 2.1%). Small percentage differences may be the result of aggregated emission factors, aggregated conversion factors, etc. However, this serves as an indicator for checking the consistency between fuel supply and consumption data.

Figure 30. Comparison of sectoral and reference emissions approach (in Gg CO2) – informative items



Source: IPCC software, team analysis

3.6 Methodology and emission factors

The choice of the tier of method for each calculation of greenhouse gas emissions from the Energy sector is determined depending on the availability of appropriate national data.

The following methods were used in this inventory report:

- Method 1 (Tier 1): using data on the amount of fuel burned in the category that is the source of emissions; default (baseline) emission factor.
- Method 2 (Tier 2): using data on the amount of fuel burned in the emission source category; country-specific emission factor for the source category and the fuel used, for CO2 emissions only.

CO_2 emissions from the combustion of lignite, fuel oil and natural gas have been calculated using the Tier 2 method. A country-specific emission factor has also been calculated for fuel oil, using the same carbon content and NCV data as in the previous biennial reports. In previous inventories, the national emission factor for natural gas was updated for the years 2017, 2018 and 2019 using data on the composition specification of natural gas provided by the MoEPP (based on reports from the measuring station at the entry point of the natural gas pipeline in the country). Due to a lack of updated data, the same natural gas emission factor as in 2019 was used for 2020, 2021 and 2022.

The State Statistical Office publishes annual Energy Balances containing data on fuel consumption, both in natural units and in kilotons of oil equivalent (ktoe). These data are used to calculate net-the calorific values of each fuel for a given year. It should be noted that variations in the net calorific values of a particular fuel from one sector to another have been taken into account.

The energy balances (with data from 2005 onwards) used for previous inventories provide a more distributed set of data. Namely, similar fuels that in older editions of the Energy Balances were given together, in newer ones they are given separately. This indicates a more thorough approach by the State Statistical Office, but also indicates the fact that the importance of certain fuels is already large enough to be reported separately.

The concept of more detailed data has also been applied to biomass in the Energy Balances published from 2005 onwards, biomass is divided into the following three categories:

- Biomass (Firewood)
- Wood waste, briquettes and pellets
- Fruit tree or other type of plant debris

In order to take advantage of this distributed data, in previous national greenhouse gas inventories, there were three entries for Wood/Wood waste in the IPCC software, one for Biomass (or firewood) entered in 1000m3, the second for Wood waste, briquettes and pellets entered in Gg and the third for Wood from fruit plantations or other plant residues also entered in 1000m3, but with a different conversion factor (NCV) from biomass. However, in newer versions of the IPCC software, the possibility of defining fuels according to the needs of the user has been introduced. Thus, in this inventory, instead of three entries with the same name Wood/Wood waste, the three categories of biomass have been defined individually in accordance with the Energy Balances from the State Statistics Service. The same has been done for diesel fuels, which in the Energy Balances (from 2005 onwards) are divided into two categories, Diesel for transport and Heating oil (Extra light fuel).

In terms of fugitive emissions from fuels, specifically surface mines, the average CO2 emission factor (0.44m3 tonne-1) from the 2019 Improvements to the 2006 IPCC Guidelines has been taken into account, while the CH4 factor remains the same as in previous reports.

The emission factors used to calculate greenhouse gas emissions are given in Table 4.

Table 4. Emission factors used in the Energy sector

Emission factor	NC4	Comment
Energy industries	NW,	NZ for lignite and fuel oil same as the Inventory inNIR-BUR1,NIR-BUR2, andNIR BUR3 Natural Gas SZ updated in 2017, 2018 and 2019
Manufacturing industries and construction **Other sectors** **Unspecified**	NW, SF	NZ for lignite and fuel oil same as the Inventory inNIR-BUR1,NIR-BUR2, andNIR-BUR3 Natural Gas SZ updated in 2017, 2018 and 2019 SF - from the 2006 IPCC Guidelines
Transportation	SF	SF - from the 2006 IPCC Guidelines
Fugitive emissions from fuels	SF	SF - from the 2019 Improvements to the 2006 IPCC Guidelines

3.6.1 Data sources

The main data sources for the Energy sector are the Energy Balances from the State Statistical Office as the most appropriate institution for collecting accurate data and the Energy Balances and Statistics from the International Energy Agency (IEA), as a second data source. As a data source for the type of vehicles, the National Road Transport Emissions Inventory based on data from the COPERT database (Table 5).

Table 5. Data sources for the energy sector

	Document	Data source
Department of Energy	• National Road Traffic Emissions Inventory – COPERT Database 2014-2022 • MAXStat database 2005-2022* • Energy balance, Revised data 2005-2016 • Energy balance, final data, 1998 • Energy balance, final data, 1999 • Energy balance, final data, 2000 • Energy balance, final data, 2001 • Energy balance, final data, 2002 • • IEA Energy Balances and Statistics (1990-1997; 2003, 2004)	Ministry of Environment and Public Works State Statistical Office IEA

4 Industrial processes and product use

4.1 Summary overview

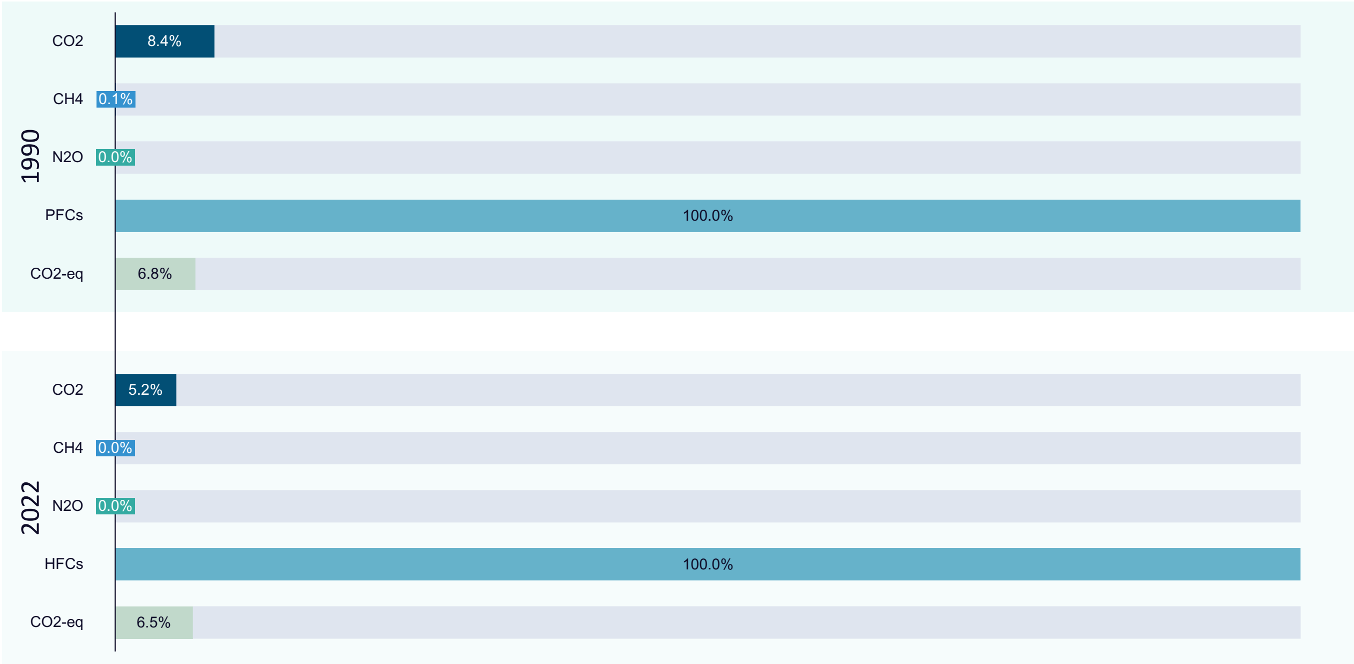
This sector covers all greenhouse gas emissions that do not arise from the combustion of fuels, but from the industrial processes themselves and reactions that occur during the production and processing of various materials. This means that this sector includes emissions that occur when raw materials, such as limestone, metals, or chemical compounds, are transformed into finished products through physical or chemical changes. For example, in the production of cement, limestone (calcium carbonate) decomposes and releases carbon dioxide (CO_2) without burning fuel. In addition, this sector also includes emissions that occur due to the use of certain gases in products and technologies, such as fluorinated gases used in refrigerators, air conditioners, foams, aerosols and industrial applications. This also includes emissions that originate from the non-energy use of fossil fuels, when they are used as raw materials for chemical or other processes, and not for energy production.

The IPPC sector covers several industrial branches: the mineral industry, the chemical industry, the metal industry, the use of solvents and other chemical products, the electronics industry, and the use of products that serve as substitutes for ozone depleting substances. It is important to distinguish between emissions originating from industrial processes, which are reported in the IPPC sector, and emissions from the combustion of fuels in industry, which are reported in the Energy sector. In other words, the IPPC measures the impact of the production processes themselves, not the energy consumption required to carry them out.

In 1990, the share of the IPPC sector in total greenhouse gas emissions in Macedonia was around 6.8%, while in 2022 it is 6.5%, which indicates a constant level of participation over a longer period of time (Figure 31). In 1990, in the total national greenhouse gas emissions, this sector was dominated by PFCs emissions, which accounted for 100% of their category, and CO_2 emissions with a share of 8.4%. By 2022, the share of CO_2 decreases to 5.2%, while fluorinated gases change in composition and PFCs are replaced by HFCs, which become the main source of emissions within this sector.

The development of industry in Macedonia in the last three decades has been closely linked to the process of economic transition, from a centrally planned economy to a market-oriented system. In the 1990s, a significant decrease in industrial production was observed (Figure 32), as a result of privatization, restructuring, but also the closure of some of the existing industrial capacities, which also led to a decline in emissions in the IPPC sector.

Figure 31. Share of the IPPC sector in total greenhouse gas emissions in 1990-2022 (%)



Note:

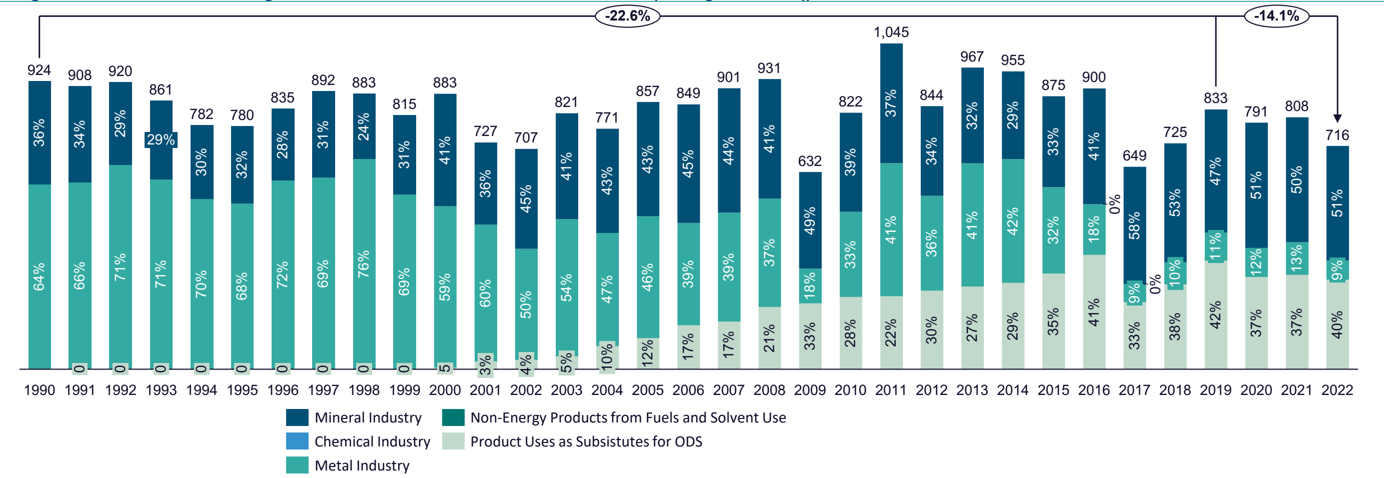
The gradual increase in industrial activity in the Republic of North Macedonia is directly related to the increased inflow of foreign direct investment, especially after 2005. The entry of companies from the automotive industry and the production of electronic components has significantly changed the structure of the national industry. Thus, the share of traditional sectors such as metallurgy and the mining industry, which dominated industrial production and greenhouse gas emissions in the 1990s, has gradually declined, while the share of new, technology-oriented industries has increased. However, despite these structural transformations, certain heavy industry capacities have remained active, and their production has in most cases remained at a stable or higher level compared to previous years (Figure 32),therefore, they continue to represent a significant source of emissions in the IPPC sector. During the analyzed period, a gradual decline in emissions from the metal industry was observed, which, due to restructuring and reduced production, reduced its share from 64% in 1990 to 9% in 2022 (Figure 33). At the same time, the mineral industry is increasing its share and becoming the dominant source of emissions, with around 50% of the sector's total emissions, while the category Product Uses as Substitutes for Ozone Depleting Substances is growing and reaching 40% in 2022.

Figure 32. Production of cement, iron and steel and ferroalloys 1990-2022 (in kt)

Source: SSO, team analysis

What should be emphasized is that in the years after 2020, the industrial sector in the Republic of North Macedonia faced a double challenge, the consequences of the Covid-19 pandemic and the subsequent energy crisis. These events temporarily reduced industrial activity, which contributed toBy 2022, total emissions from the IPPC sector will be at a level of 716 Gg CO_2-eq, which represents a reduction of 22.6% compared to 1990 and 14.1% compared to 2019 (Figure 33Emissions from other categories, such as the chemical industry, the electronics industry and manufacturing, and the use of other products, do not occur in the country.

Figure 33. Greenhouse gas emissions from the IPPC sector (in Gg CO2-eq)



Source: IPCC software, team analysis

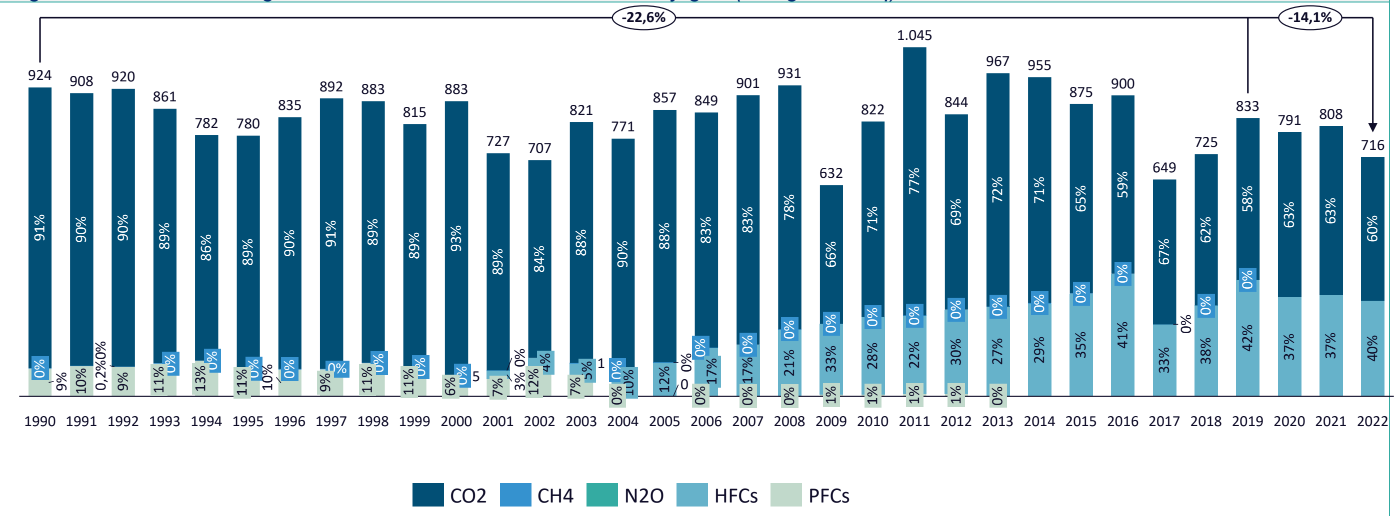
Table 6. Greenhouse gas emissions from the IPPC sector, by category (in Gg CO2-eq)

Categories	1990	1995	2000	2005	2010	2015	2019	2020	2021	2022
Industrial processes and product use	924.47	779.75	883.15	857.10	822.42	875.07	832.87	790.68	808.10	715.89
2.A -Mineral industry	331.92	248.28	360.43	366.62	317.90	291.20	395.17	401.77	400.70	366.78
2.A.1 Cement production	292.57	234.04	347.36	353.88	316.61	285.42	376.89	400.78	399.71	365.79
2.A.2 Production of lime	33.72	10.40	11.17	11.13	0.00	4.72	17.25	NO	NO	NO
2.A.3 Glass production	0.33	0.09	0.05	0.01	0.02	0.01	0.07	0.04	0.07	0.09
2.A.4 Other processes using carbonates (t)	5.30	3.76	1.85	1.60	1.28	1.05	0.96	0.94	0.93	0.90
2.A.4.a Ceramics*	2.62	0.34	0.41	0.30	0.11	0.01	0.01	0.00	0.01	0.01
2.A.4.b Other uses of bicarbonate of soda (t)	2.68	3.41	1.45	1.30	1.16	1.04	0.96	0.94	0.92	0.90
2.C Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2 C Metal Industry	592.54	531.48	518.22	390.95	272.88	277.18	88.95	92.96	104.95	62.25
2.C.1 Iron and steel production	24.75	2.89	15.15	58.23	26.49	11.04	21.71	16.32	28.44	22.37
2.C.2 Production of ferroalloys	268.13	263.65	199.03	332.38	241.25	264.76	61.54	71.27	71.14	33.77
2.C.3 Aluminum production	91.35	90.65	62.65	0.33	5.14	0.00	0.00	0.00	0.00	0.00
2.C.5 Lead production	22.09	18.11	22.97	0.00	0.00	1.38	5.70	5.38	5.38	6.11
2.C.6 Zinc production	186.23	156.18	218.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.D Non-Energy Products from Fuels and Solvent Use	NO	NO	NO	NO	0.00	0.00	0.00	0.00	0.00	0.00
2.D. Other	NO	NO	NO	NO	0.00	0.00	0.00	0.00	0.00	0.00
2.E Electronics industry	NO									
2.F. Product Uses as Substitutes for Ozone Depleting Substances	0.00	0.00	4.51	99.54	231.64	306.69	348.74	295.95	302.45	286.87
2.F.1 Refrigeration and air conditioning	0.00	0.00	4.51	99.54	231.64	306.69	348.74	295.95	302.45	286.87
2.F.1.a Refrigeration and stationary air conditioning devices	0.00	0.00	4.51	99.54	231.64	306.69	348.74	295.95	302.45	286.87
2.F.1.b Mobile air conditioning devices*	IE									
2.F.2 Foam blowing agents	NO, NO									
2.F.3 Fire protection										
2.F.4 Aerosols										
2.F.5 Other applications										
2.G Other production and use of products										
2.H. Other										

NO - Not occurring, NA – Not Applicable, NE – Not Estimated, IE – Included Elsewhere

During the period under review, the structure of emissions by gas type shows significant changes. In 2022, CO_2 has the largest share in total emissions from the IPPC sector, with around 60% (Figure 34). In 1990, CO_2 dominated with 91% of total emissions, while in 2019 its share decreased to 58%, which is another indicator of the gradual reduction of emissions from traditional industrial processes. The second most significant contributor is HFCs, which in 2022 contribute with 40% of total emissions, almost the same as in 2019 (42%). The increase in the share of these gases is the result of the greater use of HFCs in refrigeration, air conditioning systems and other products that replace ozone-depleting substances. Methane (CH_4) emissions are recorded until 2019, while PFCs until 2013. SF_6 emissions are not estimated due to lack of data.

Figure 34. Greenhouse gas emissions from the IPPC sector, by gas (in Gg CO2-eq)



Source: IPCC software, team analysis

4.2 Mineral industry

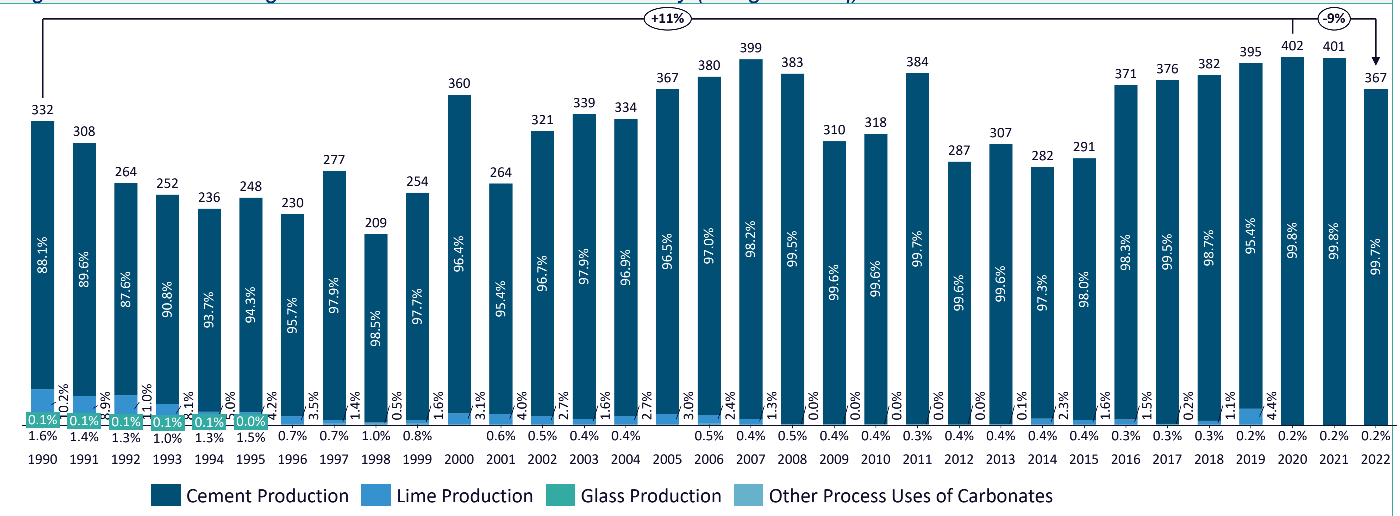
The mining industry is one of the most significant categories in the IPPC sector. Its share in total greenhouse gas emissions was 36% in 1990, 47% in 2019 and 51% in 2022, indicating continued growth.

This category in North Macedonia includes shows from the following subcategories:

- Cement production,
- Lime production,
- Glass production,
- Other process uses of carbonates.

In terms of the structure of emissions over the years, the largest source of emissions has continuously been cement production. In 1990, this subcategory accounted for about 88% of total emissions in the mineral industry, while lime production accounted for about 10%. In the period 2020-2022, over 99% of emissions in the mineral industry come from cement production, which confirms its dominant role. Following the trend of greenhouse gas emissions in the mineral industry, it is clearly seen that economic crises have significantly affected this industry and contributed to noticeable changes in the level of emissions. Emissions reached a maximum in 2007 of about 400 Gg CO2-eq, which is almost the same level as in 2020 and 2021. The global economic crisis in 2009, as well as the European one in 2012, contribute to a decrease in emissions from this sector to a level of about 290 Gg CO2-eq in 2012 (Figure 35). The latest crisis in 2022 contributes to a reduction in emissions of 367 Gg CO2-eq in 2022, which is 9% below the level of 2020, which is the year with maximum emissions. However, compared to 1990, total emissions from the mineral industry in 2022 are higher by about 11%.

Figure 35. Greenhouse gas emissions from the Mineral Industry (in Gg CO2-eq)



Source: IPCC software, team analysis

4.2.1 Cement production

There is only one cement production plant in Macedonia. Marl is used as the main mineral raw material and is obtained from the open pit mine, located within the factory. Marl, as a non-metallic mineral raw material, is a basic component in the production of clinker, i.e. cement. The amount of greenhouse gas emissions from cement production depends on the level of industrial activity and is generally variable throughout the considered time series.

As written in the previous chapter, the maximum emissions from cement production were achieved in 2020 and 2021, while in 2022, emissions from cement production decreased. In 2022, emissions from cement production were 25% higher compared to 1990, while compared to 2019, emissions decreased by 2.9%.

4.2.2 Production of lime

According to the SSO reports for the Industry sector, lime production in the country includes the production of quicklime, hydraulic lime and slaked lime, with variation in their production between years (not all types are produced in all years). In the period 2010–2012, no lime production was recorded, while from 2012 to 2019, only hydraulic lime production was recorded.

As with the other subcategories, the amount of greenhouse gas emissions from lime production depends on the level of industrial activity and generally emissions decrease over the period considered in the inventory, except in 2019 where an increase in emissions is observed from 4 Gg CO2-eq in 2018 to 17.2 Gg CO2-eq in 2019. According to the latest SSO reports on industrial production, no lime production was recorded in the country in the period 2020–2022, therefore no emissions from this subcategory appear.

4.2.3 Glass production

Continuous glass production has been registered in North Macedonia since 1990. According to the SSO reports on industrial production, glass production in the country includes the production of tempered safety glass and laminated insulating glass. In the period under review, production of both categories of glass was registered in all years. Since 2016, there has been an increase in glass production compared to the previous period, although glass production in recent years has been significantly lower than production in the 1990s, which is reflected in the total emissions from this category. Total emissions from this category from 0.33 Gg CO_2-eq in 1990 have decreased to 0.09 Gg CO_2-eq in 2022.

4.2.4 Other process uses of carbonates

Other process uses of carbonates in the mineral industry in the country include the production of ceramics and the use of sodium carbonate in the chemical industry. As activity data for the category of ceramics production, data from the State Statistical Office reports on various types of clay used in the industry for processing other non-metallic minerals, which are available only up to 1998, are used. To calculate the mass of consumed carbon, a standard carbonate content of 10% is used. According to statistical reports, it is evident that there was production of ceramic products in the country (such as bricks and roof tiles, refractory products, expanded clay products, wall and floor tiles, dining and decorative products, sanitary products, etc.) and after 1998, the data on ceramic products were multiplied by a factor of 1.2 in order to continue the trend line for the use of clay in the industry. The factor was calculated as the average of the ratio between the data on clay used in the processing industry and ceramic products produced in the period 1990 - 1998. According to the SSO reports, sodium carbonate is used in the basic chemical products industry and in the chemical products processing industry, but data are only available up to 1998. The trend of these data was used to extrapolate the series up to 2022.

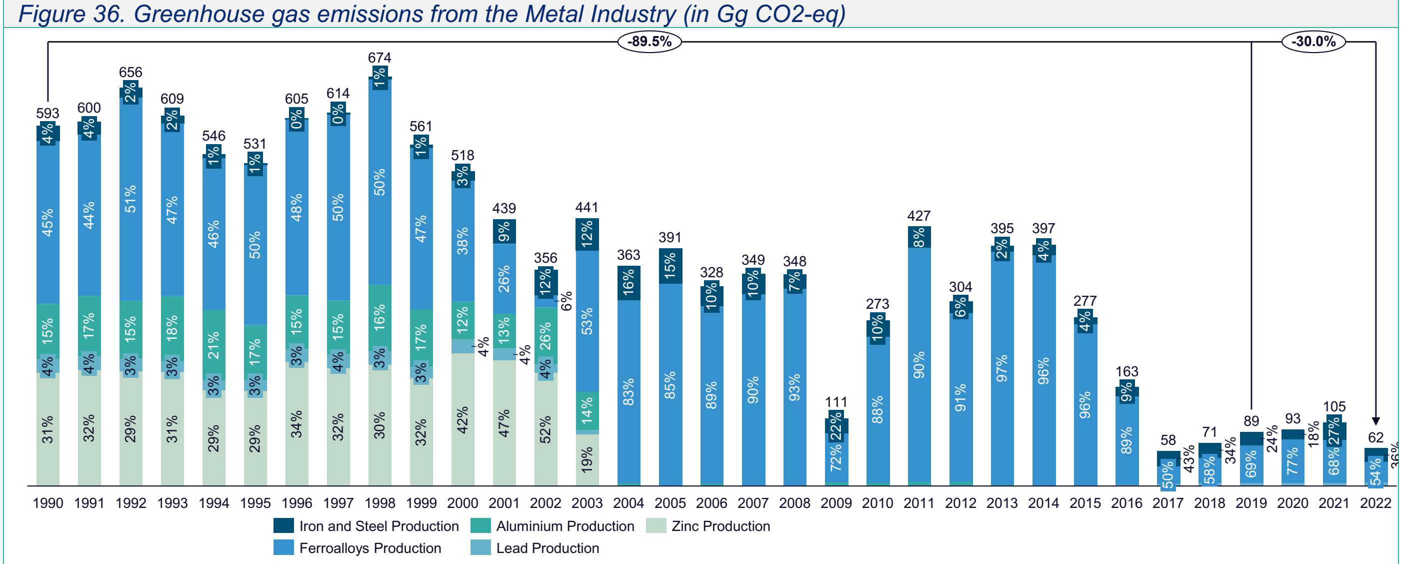
Therefore, the estimated emissions from the category of other process uses of carbonates follow the decreasing trend of the use of both ceramic products and sodium carbonate.

4.3 Metal industry

The metal industry has been a significant, but decreasing source of greenhouse gas emissions in the IPPC sector over time. In 2022, its contribution amounted to about 9% of the sector's total emissions, which is a drastic decrease compared to the 1990s, when this sector had a dominant role with a share of about 65%. Compared to 1990, emissions from the metal industry in 2022 decreased by about 89%, and compared to 2019 by about 30%, which clearly reflects the long-term downward trend. Overall, the trend of reducing emissions from the metal industry follows the economic activity in the country of gradually closing energy-intensive plants and shifting to smaller, more technologically modern production processes with lower emissions.

In this category, emissions from the following subcategories have been recorded in the country: production of iron and steel, ferroalloys, aluminium, lead and zinc. Most of the emissions in recent years come from the production of ferroalloys, which in 2022 accounts for about 54% of the total emissions of this sector, while the production of iron and steel has a share of 36%. The remaining subcategories, such as the production of aluminium, lead and zinc, have a marginal contribution or are not active at all. From 1990 to 2002, emissions from zinc production also had a significant share in the structure of emissions from the category, but after 2003 no production was registered, and therefore the emissions from this subcategory are zero.

Figure 36. Greenhouse gas emissions from the Metal Industry (in Gg CO2-eq)



Source: IPCC software, team analysis

4.3.1 Iron and steel production

Steel production in the Republic of North Macedonia is based on smelting using electricity, with scrap steel as the main raw material. Iron ore has not been used for a long time, so there are no emissions associated with ore processing. The production process takes place in two plants: the production of steel in plates takes place in a steel mill, while the production of hot-rolled plates takes place in a rolling mill. The production process in the steel mill involves the preparation and processing of scrap iron, which is melted in an electric furnace, producing liquid steel. This liquid steel is then further processed in another electric furnace, from which steel plates are obtained. The rolling process for thick plates involves heating the plates in the furnace and then hot rolling them in mills. In the plate production process, in addition to scrap iron, other materials that act as reductants, melting agents and electrodes in electric furnaces (anthracite, coke, limestone, dolomite, electrode mass) are also used as the main input raw materials.

Emissions from iron and steel production are calculated based on data from the State Statistical Office for the production of steel shot, steel castings and plates, which represent only the steel production process. For the purposes of this inventory, the methodological approach with a national emission factor for electric steel production (Electric Arc Furnace) is applied, in accordance with the publication "National emission factors for CO_2 and non-CO_2 emissions for key sectors according to the IPCC and CORINAIR methodologies".

Emissions from steel production consist almost entirely of CO_2 and in 2022 they amounted to 22 Gg CO_2-eq, which is about 10% less than in 1990, but 3% more than in 2019 (Table 6). Fluctuations in the emissions trend are due to the changing level of industrial activity, which is linked to market electricity prices, steel demand and economic cycles. The reduction in emissions in 2020, of around 25% compared to 2019, is a direct consequence of the decline in production during the Covid-19 pandemic and reduced demand on international markets.

What should be emphasized for this subcategory is that in the period 1990–2000, according to the SSO archival data, it is noted that part of the reported iron and steel production also originated from other technologies (including potentially processes using ores and reductants). The team preparing the national inventory assessed that these historical data are inconsistent, since during this period the methodology and classification of industrial products were changed several times, which makes direct comparison with more recent data difficult. Therefore, a single and conservative methodology based on electric steel production has been retained for the current inventory, while in the process of preparing the next inventory, consultations will be organized with the relevant institutions and industry representatives (SSO, production companies) in order to confirm the real technological process that was in use in the early years of the reporting period and to revise the historical data. The goal is to establish a consistent time series of data and emissions, in accordance with IPCC requirements, but also to see what technological improvements have been made and how they have contributed to reducing greenhouse gas emissions.

4.3.2 Production of ferroalloys

In the Republic of North Macedonia, the production of ferroalloys is mainly based on the use of electricity in submerged electric arc furnaces. Heating of the mixture is achieved by passing an electric current through graphite electrodes, which create an electric arc that allows the melting and reduction of metal oxides. The reduction of carbon in metal oxides occurs during the use/consumption of coke and graphite electrodes. This process results in CO2 and CH4 emissions.

According to the SSO data on industrial production, in North Macedonia in the last three years 2020 - 2022 there has been production of only ferronickel. In 2022, the amount of greenhouse gas emissions from the production of ferroalloys decreased by 87% compared to the level of emissions in 1990, and by 45% compared to the level of emissions in 2019.

Similarly to the iron and steel subcategory, within the meetings that the inventory preparation team held with relevant stakeholders, it was pointed out that the data on the quantity of nickel produced reported to the State Statistics Service are not fully consistent with the data submitted by the companies themselves.

Due to this inconsistency, the inventory team plans to examine this issue in more detail in the coming period, for the needs of the next inventory, through coordination and additional consultations between the SSO, the MEPP and the industry entities. The goal is to provide a consistent and verified time series of data on ferronickel production, which will be harmonized and confirmed by both parties, the companies and the SSO, in accordance with the IPCC requirements for time consistency and data transparency.

4.3.3 Aluminium production

The largest industrial plant that existed in the Republic of North Macedonia, which had a complete process for the production of aluminium alloys, profiles, pipes and structures, closed in 2003. As a result, aluminium production in the country was drastically reduced, and realized by several small production plants. Since 2014, there has been no evident aluminium production. Greenhouse gas emissions from this category have decreased significantly after 2003, reaching an average annual level of about 3.6 Gg CO2-eq in the period 2003-2013.

4.3.4 Lead production

Lead production in the Republic of North Macedonia took place until 2003, within the lead and zinc smelter that used the IST (Imperial Smelting Technology) process. After the cessation of production in 2003, emissions from this category were not recorded until 2015, when crude lead production was again recorded in the SSO reports. With the resumption of industrial activity in 2015, greenhouse gas emissions from this category reappeared, although at a low level of 1.4

Gg CO2-eq in 2015 and 2.3 Gg CO2-eq in 2016. In recent years, lead production in the country has increased, resulting in an increase in emissions of about three times compared to 2016, i.e. in 2022 they will reach 6.1 Gg CO2-eq.

4.3.5 Zinc production

Zinc production in North Macedonia was carried out until 2003 with a pyrometallurgical process using IST (Imperial Smelt Technology) technology, which allows for the simultaneous treatment of lead and zinc concentrates. The process results in the simultaneous production of lead and zinc and the release of non-energy CO2 emissions. Greenhouse gas emissions from this category occur until 2003.

4.4 Use of non-energy products from fuels and solvents

This category includes greenhouse gas emissions from 2006 onwards resulting from the use of urea in diesel engines using SCR technology. These emissions are reported in 2.D.4 Other emissions. Emissions from this category are small, so their contribution to total emissions from the IPPC sector is negligible.

4.5 Product uses as substitutes of ozone depleting substances

HFCs and to some extent PFCs are used as alternatives to ozone-depleting substances (ODS) that were banned for use by the Montreal Protocol. HFCs and PFCs are not controlled and banned by this protocol, as they do not contribute to the depletion of the stratospheric ozone layer. In Macedonia, these gases are used for refrigeration and air conditioning. Since 2000, hydrofluorocarbons and their mixtures have been regulated by the Ministry of Environment and Physical Planning. Data for the period 2000-2010 are based on issued permits for the import of these gases. For this report, the Ozone Unit of the MoEPP provided data on imports of HFCs and HFC mixtures for the period 2012-2022.

HFC emissions from this sector have decreased in the last three years compared to 2019. HFC emissions from this sector reached a value of 287 CO2-eq in 2022, i.e. they have decreased by 18% compared to 2019.

4.6 Methodology and emission factors

The calculation of the amount of greenhouse gas emissions from all categories in the IPCC sector was carried out in accordance with the 2006 IPCC Guidelines, applying Method 1 (Tier 1) and Method 2 (Tier 2), depending on the availability and quality of data. The calculations of greenhouse gas emissions were made, as in all other sectors, using the official IPCC Inventory Software (version from June 2025), which allows for structured data entry, application of standardized formulas and automatic checking of time consistency and logical compliance of the results.

Emission factors and other parameters as well as documentation and technical references were derived from the IPCC Emission Factor Database (EFDB), which contains standard data from the 2006 IPCC Guidelines as well as the 2019 enhancements. In the preparation of this inventory, emission factors were checked and compared with those used in previous Biennial Reports and National Communications, in order to confirm their consistency and ensure time consistency. The data source from which the emission factors used in this greenhouse gas inventory were taken is shown in Table 7. For certain industrial categories where sufficient national data and technological information exist, country-specific emission factors have been used, presented in the publication 'National emission factors for CO2 and non-CO2 emissions for key sectors according to the IPCC and CORINAIR methodologies'.[2]Such nationally specific factors apply to the following subcategories: cement production, iron and steel production and ferroalloy production.

Table 7. Emission factors used for the IPPC sector

Emission factor	BTR 1	Comment
Industrial processes and product use	**NW, SF**	
Mineral industry	**NW, SF**	
Cement production	NW	*National emission factors for CO2 and non-CO2 emissions for key sectors according to IPCC and CORINAIR methodologies*
Production of lime	SF	SF- from the 2006 IPCC Guidelines
Glass production	SF	SF - from the 2006 IPCC Guidelines
Other process uses of carbonates	SF	SF - from the 2006 IPCC Guidelines
Ceramics	SF	SF - from the 2006 IPCC Guidelines
Other uses of sodium carbonate	SF	SF - from the 2006 IPCC Guidelines
Metal industry	NW, SF	

[2]Available at:http://www.unfccc.org.mk/content/Documents/INVENTORY/EFs%20EN.pdf

Iron and steel production	NW	*National emission factors for CO2 and non-CO2 emissions for key sectors according to IPCC and CORINAIR methodologies*
Production of ferroalloys	NW, SF	*National emission factors for CO2 and non-CO2 emissions for key sectors according to IPCC and CORINAIR methodologies* SF - from the 2006 IPCC Guidelines
Aluminum production	SF	SF - from the 2006 IPCC Guidelines
Lead production	SF	SF - from the 2006 IPCC Guidelines
Zinc production	SF	SF - from the 2006 IPCC Guidelines
Using products as substitutes for ozone-depleting substances	SF	
Cooling and air conditioning	SF	SF - from the 2006 IPCC Guidelines
Refrigeration and stationary air conditioning devices	SF	SF - from the 2006 IPCC Guidelines
Note: SF= Standard Emission Factor, CZ= Country Specific Factor		

4.7 Data sources

Data for the preparation of the greenhouse gas inventory for the IPPC sector were generally collected from three sources: the State Statistical Office, the Ministry of Environment and Physical Planning, and directly from industrial plants (Table 8).

Table 8. Data sources for the Industrial Processes and Product Use sector

	Documents	Data source
Mineral industry		
Cement production	Cementarnica Usje – Titan AD Skopje (annual sustainability reports and annual social responsibility reports)[3])	Cementarnica Usje – Titan AD Skopje; SSO
Production of lime		State Statistical Office
Glass production	SSO, Publication Industrial Production (printed edition) 1989 – 1992, 1993 – 1998, 1996 – 2000 SSO, Publication Industry in the Republic of Macedonia[4], for the period 2002-2007. SSO, MaxStat database, Table: Industrial production in natural indicators, by years[5], 2007 – 2022	State Statistical Office
Other process uses of carbonates		State Statistical Office
Ceramics		State Statistical Office
Other uses of sodium carbonate		State Statistical Office
Other		State Statistical Office
Metal industry		
Iron and steel production	SSO, Publication Industrial Production (printed edition) 1989 – 1992, 1993 – 1998, 1996 – 2000 SSO, Publication Industry in the Republic of Macedonia[5], for the period 2002-2007. SSO, MaxStat database, Table: Industrial production in natural indicators, by years, 2007 – 2022 g6.	State Statistical Office
Production of ferroalloys		
Aluminum production		
Lead production		
Zinc production		
Using products as substitutes for ozone-depleting substances		
Cooling and air conditioning	HCFC Control - Report Ozone Unit – MEPP (data for the period 2012 – 2022)	Ministry of Environment and Public Works
Refrigeration and stationary air conditioning devices		

[3]Available at:https://www.usje.mk/mk/vesti/godishni-izveshtai/

[4]Available at:https://www.stat.gov.mk/PublikaciiPoOblast.aspx?id=8&rbrObl=19

[5]Available at:https://makstat.stat.gov.mk/PXWeb/pxweb/mk/MakStat/MakStat__Industrija__Bazna2021/525_Proizvodstvo_na_ind_proizv_po_godini.ml.px/?rxid=46ee0f64-2992-4b45-a2d9-cb4e5f7ec5ef

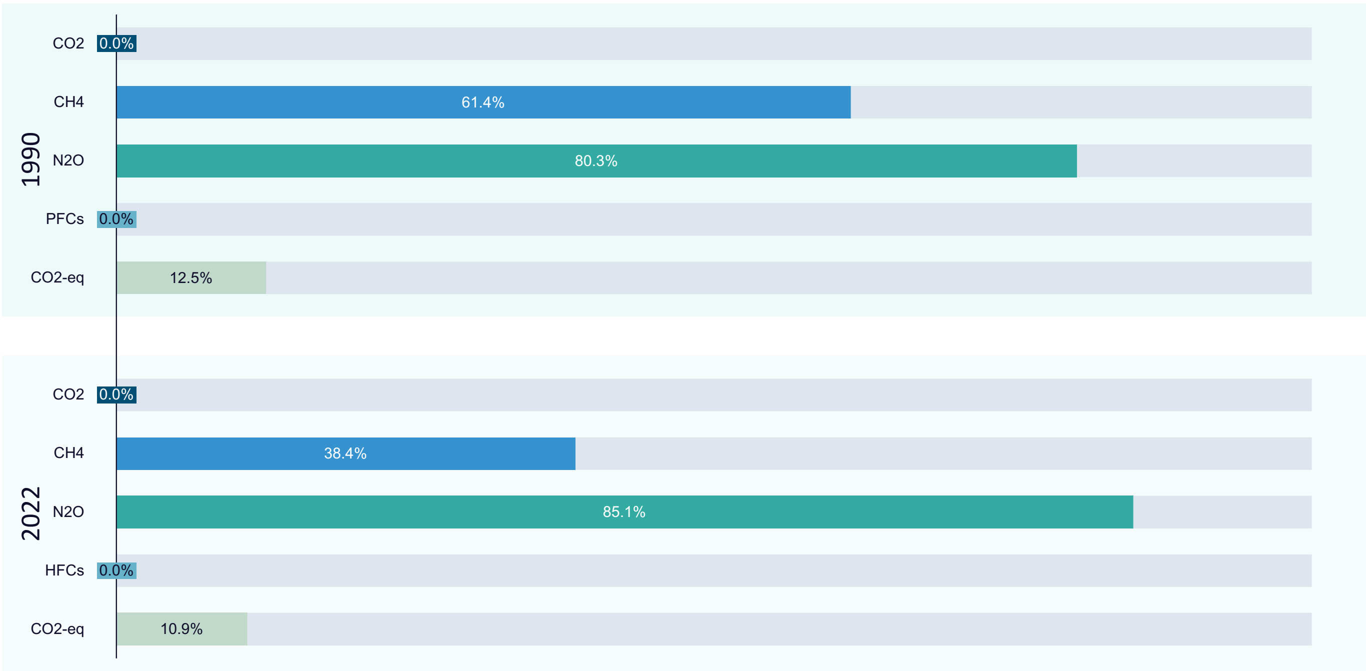
5 Agriculture

5.1 Summary overview

Agriculture is the third largest economic sector in the Republic of North Macedonia. The share of agriculture in total GDP has remained relatively stable in recent years, with a share of approximately 10–12%, and if the processing industry related to agricultural production is included, the total share reaches 16–18%. According to the latest structural survey in agriculture, the total number of agricultural holdings is 178,125, of which 99.8% are family farms, while only 280 are registered business entities, i.e. enterprises in agricultural activity. This structure shows that agriculture in the Republic of North Macedonia is predominantly small, fragmented and family-oriented, which has a direct impact on the productivity and efficiency of production.

The comparison of data for 1990 and 2022 shows a clear change in the structure of greenhouse gas emissions in the agriculture sector. In 1990, CH_4 and N_2O dominated the emissions structure with shares of 61.4% and 80.3%, respectively, indicating a strong presence of enteric fermentation and the use of nitrogen fertilizers as the main sources. By 2022, the share of methane decreases to 38.4%, while the share of N_2O increases to 85.1%, indicating that emissions from fertilizer-managed soils increasingly dominate the sector. This trend reflects the change in the structure of agriculture in the Republic of North Macedonia, with a decrease in livestock, but with a greater dependence on mineral fertilizers and intensive soil cultivation practices. At the same time, the total share of agriculture in national greenhouse gas emissions decreased from 12.5% in 1990 to 11% in 2022, indicating a gradual decrease in the role of agriculture in the country's total emissions.

Figure 37. Share of the Agriculture sector in total greenhouse gas emissions in 1990 and 2022 (%)



Source: IPCC software, team analysis

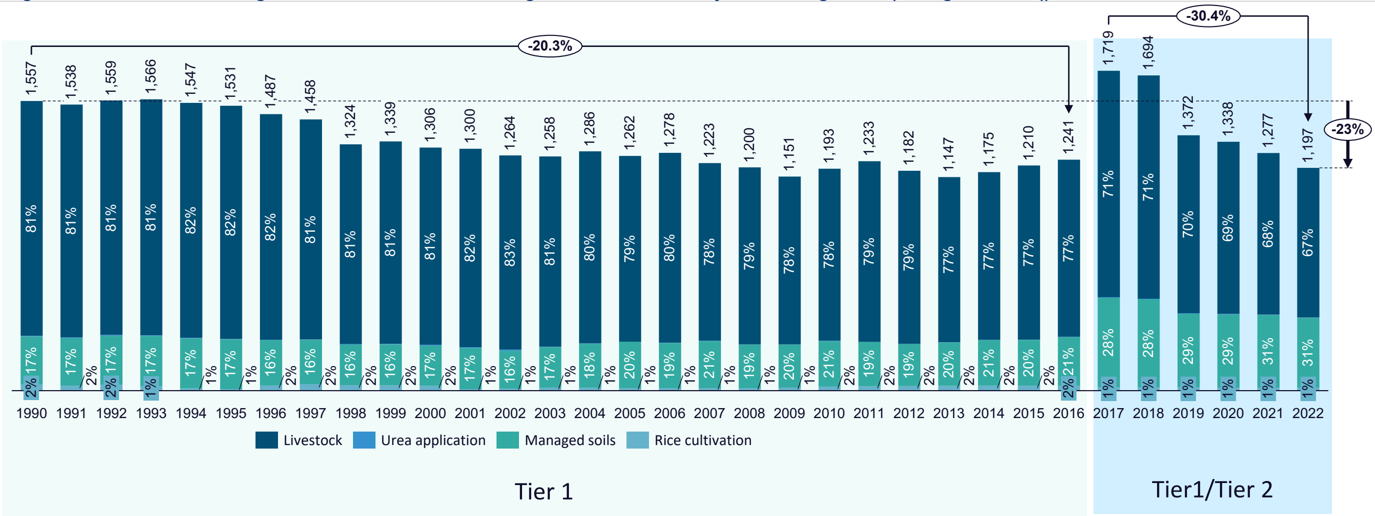
The agriculture sector, according to the IPCC methodology, can basically be divided into two main categories:

- Livestock farming, which includes emissions from enteric fermentation (the biological activities of domestic animals) and manure management, and
- Soils and other agricultural activities, which include emissions from fertilizer use and land cultivation.

Total greenhouse gas emissions from agriculture expressed as CO_2-eq have decreased from around 1557 Gg in 1990 to approximately 1,200 Gg in 2022, representing a total reduction of around 23% (Figure 38). The maximum emissions from the agriculture sector were achieved in 2017 of around 1,720 Gg CO_2-eq, which is primarily due to the use of a higher Tier 2 methodology for calculating emissions from enteric fermentation in dairy cows and manure management from farms. If we look only at the period when the Tier 2 methodology was implemented, it can be seen that emissions have decreased by around 30% (2022 compared to 2017).

Livestock farming has a dominant share in total emissions in the Agriculture sector throughout the period under consideration. The share of Livestock farming in the period 1990-2016 (when using the Tier 1 methodology) is around 77–83%, and in the period 2017-2022 it is within 67%-71% (when using the Tier 2 methodology) (Figure 38). Although in 2017 there was an increase in emissions, this should not be associated with an increase in the number of livestock, but exclusively with the application of the higher Tier 2 methodology. Basically, there was a decrease in emissions throughout the entire period, which is mainly due to the decline in the number of livestock in the country. What should be emphasized in this section is that in the next inventory, the team will make an effort to approximate the Tier 1 emission factors, so that they correspond to the emission factors obtained with the Tier 2 methodology in order to obtain a consistent series. Arable soils are the second subcategory with the largest share in emissions in the Agriculture sector, which in the last six years (2017-2022) has contributed about 30%.

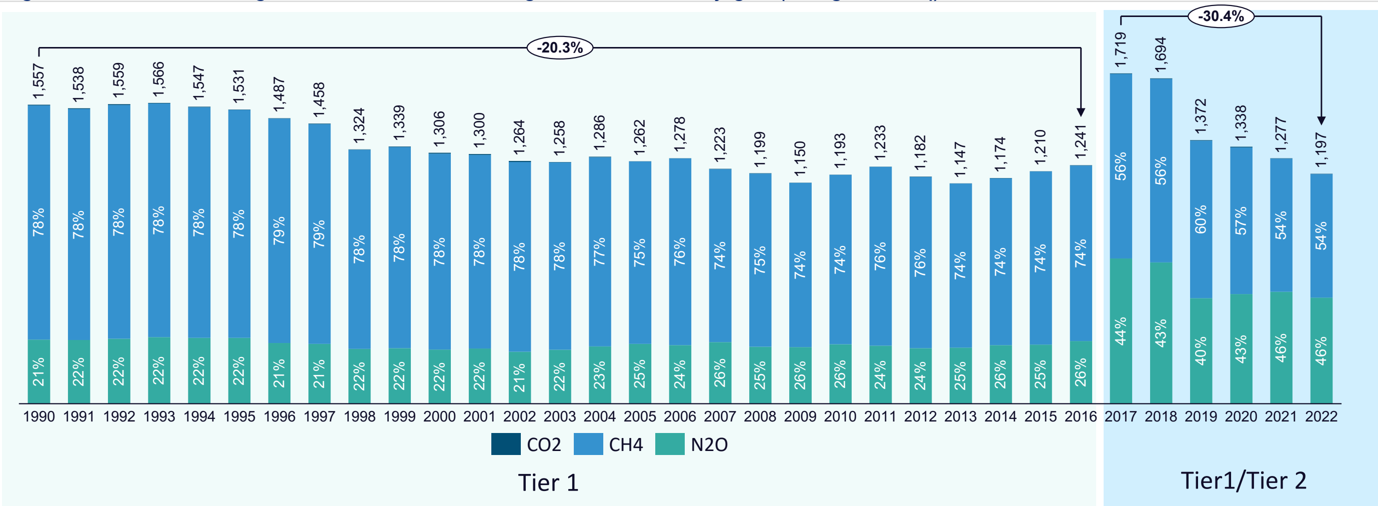
Figure 38. Greenhouse gas emissions from the Agriculture sector by subcategories (in Gg CO2-eq)



Source: IPCC software, team analysis

In terms of the structure by gases, methane (CH_4) has a dominant share in emissions, which for most of the period is around 75–80%, while nitrous oxide (N_2O) contributes 20–25%, and carbon dioxide (CO_2) less than 1% (Figure 39The largest decline is observed in methane emissions after 2017 (Figure 39), which is associated with a reduction in the number of livestock, but also the application of Tier 2 methodology for more accurate calculation of direct and indirect N2O emissions.

Figure 39. Greenhouse gas emissions from the Agriculture sector by gas (in Gg CO2-eq)



Source: IPCC software, team analysis

5.2 Livestock farming

Livestock farming is a significant segment of Macedonian agriculture and is closely linked to tradition, rural development and local markets, but faces structural challenges related to productivity and modernization. Although its share in agricultural GDP has been declining in recent decades, this sector remains key in the context of greenhouse gas emissions, especially in the categories of enteric fermentation and manure management.

Macedonian livestock production is characterized by a dual structure, dominated by individual agricultural holdings, i.e. so-called family farms and large commercial livestock farms. Livestock production depends on the number of heads, average yields per head, but also on the quality of livestock nutrition, as well as investments in housing facilities and equipment used. The structure of Macedonian livestock production does not correspond to world trends due to the socio-economic and natural conditions in the country, as well as the structure of agricultural holdings and tradition. Macedonian livestock production is gradually modernizing, with modest knowledge of modern livestock breeding technologies, which is certainly the reason for the low and weak productivity and uncompetitive products. There is a trend of decreasing the number of livestock, but the productive characteristics and breed composition of livestock are improving. This trend indicates a gradual replacement of indigenous, low-productive livestock breeds with high-value animals that require strictly regulated nutrition and appropriate breeding conditions in order to achieve their genetic potential. Intensive climate change warns of the need to take adaptive measures in livestock farming, primarily raising awareness among stakeholders for the selection and implementation of sustainable conservation of local populations and breeds. The main emphasis is placed on implementing breeding programs in livestock farming that will lead to improved tolerance of farm animals to extreme climatic conditions, increased robustness and resistance of animals to diseases, as well as improved conversion for better utilization of available feed resources. By introducing these principles into the Program for the Protection of Biological Diversity in Livestock (Official Gazette of the Republic of Macedonia, 168/2018), it enables the preservation and use of genetic diversity among farm animal species and provides greater opportunities in a shorter period of time to respond to the challenges brought by climate change.

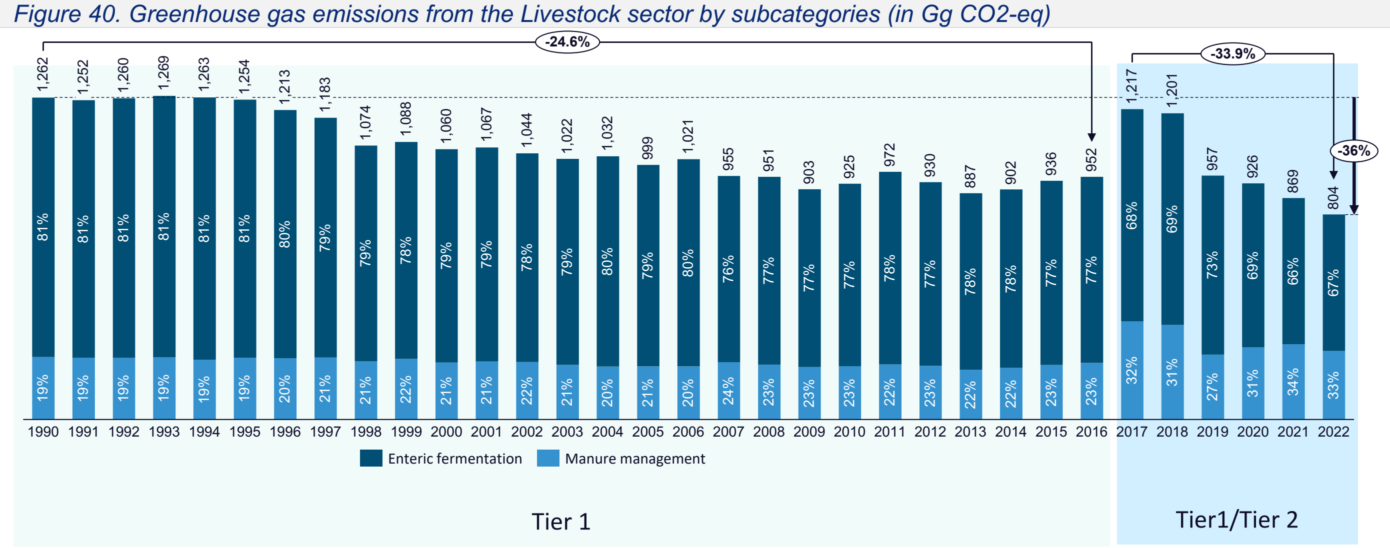
Greenhouse gas emissions from livestock production occur as a result of biological processes in domestic animals and the way manure is managed on farms. The amount of emissions depends on the type of animal, the method of breeding, the type and intensity of production, as well as the practices applied on farms in keeping and managing livestock. The main greenhouse gases produced in livestock production are methane (CH_4), nitrous oxide (N_2O) and ammonia (NH_3). They are emitted directly in the processes of respiration and feeding of animals, and indirectly through the decomposition of excreta (faeces and urine) and their storage or use as manure. The number of animals in the last three years is presented in Table 9.

Table 9. Data on farm animal population used for the inventory of greenhouse gases from Livestock (number of heads)

	Number of heads		
	2020	2021	2022
Total	2760191	2561115	2634456
Cattle	214991	177743	158824
Cattle - dairy cows	110206	105542	99606
Cattle - other	104785	72201	59218
Sheep	511116	524525	533175
Sheep up to one year	119518	108756	113313
Goats	77462	62450	63921
Goats up to one year	17546	13303	16265
Horses	12022	12165	12236
Mules and Asses	18395	20331	21457
Fatteners	145679	165815	161147
Poultry-layers	1482348	1235894	1367092
Broilers	101268	97181	124332
Turkeys	13640	19143	13502
Other poultry	46206	123809	49192

Figure 40 shows the dynamics of greenhouse gas emissions from livestock farming in the Republic of North Macedonia for the period 1990–2022, divided into two main categories according to the IPCC methodology: enteric fermentation and manure management. In the first half of the period (Tier 1 methodology), emissions from enteric fermentation dominate with a share of about 77–81%, indicating that the majority of emissions originate from the processes of feeding and respiration in animals. Total emissions have recorded a continuous decline from 1,262 Gg CO_2-eq in 1990 to about 952 Gg CO_2-eq in 2016, which represents a decrease of approximately 25%. This trend reflects the gradual reduction of livestock, the modernization of agriculture and changes in livestock practices. In the second period (Tier 1/Tier 2), which starts in 2017 with the introduction of a more advanced calculation methodology, an additional reduction in emissions by 35% is observed, from 1,217 Gg CO_2-eq in 2017 to 804 Gg CO_2-eq in 2022 (Figure 40). Although the structure of emissions remains similar, with enteric fermentation dominating (around 73–74%), the share of emissions from manure management is gradually increasing, indicating the need to improve the management of livestock waste products. Overall, the trend indicates a significant reduction in emissions from the livestock sector by around 36% in 2022 compared to 1990, which is the result of a combination of both methodological improvements and real structural changes in livestock farming.

Figure 40. Greenhouse gas emissions from the Livestock sector by subcategories (in Gg CO2-eq)



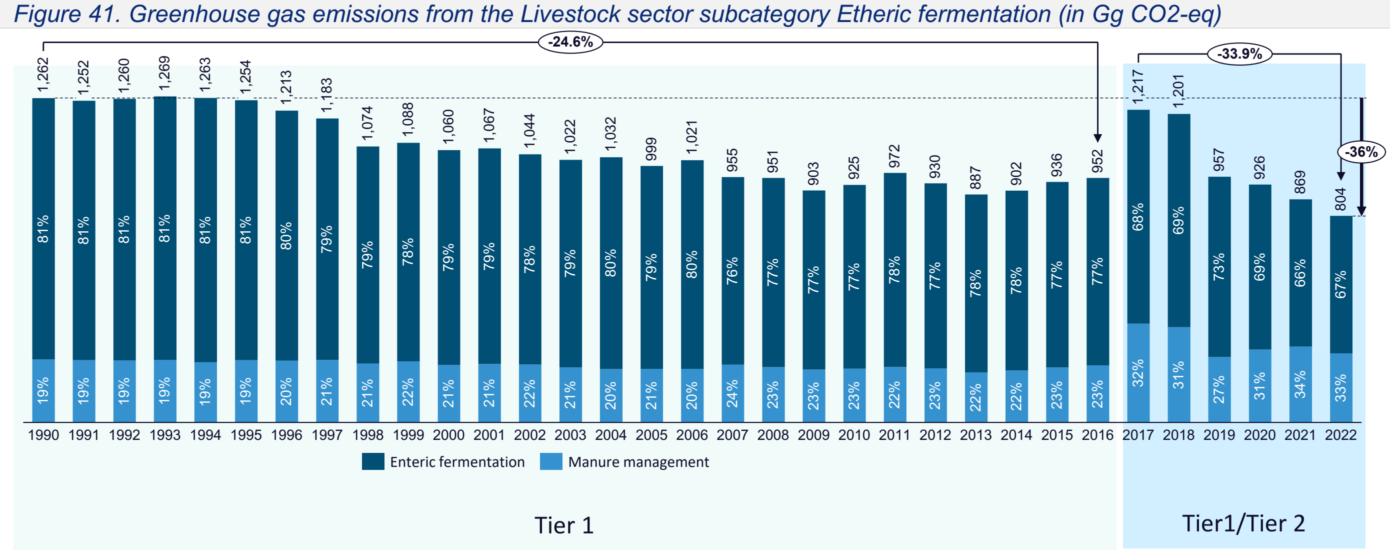
Source: IPCC software, team analysis

5.2.1 Enteric fermentation

Cattle, sheep, goats and horses are predominantly managed in a moderately intensive production system, while a small proportion of dairy farms, and most pig farms and poultry farms (particularly laying hen farms) are managed in a much more intensive manner. The composition of gases released from enteric fermentation is dominated by methane (CH4). Results obtained using IPCC software showed that greenhouse gas emissions from enteric fermentation in 1990 were around 1,017 Gg CO_2-eq, and in 2022 they decreased to 535 Gg CO_2 eq, representing a total reduction of 47% (Figure 41). In 2022, compared to 2017, emissions have decreased by 36%.

The largest share of total emissions comes from dairy cows (about 45–66%) and other cattle (20–29%), which is expected given that cattle are a major source of methane due to their digestive system and diet. The contribution of sheep to total emissions from ether fermentation has decreased by more than half in 2022 compared to 1990 and has accounted for about 15% in the last decade, while emissions from goats, pigs and horses are minimal and together account for less than 5% of the total.

Figure 41. Greenhouse gas emissions from the Livestock sector subcategory Etheric fermentation (in Gg CO2-eq)



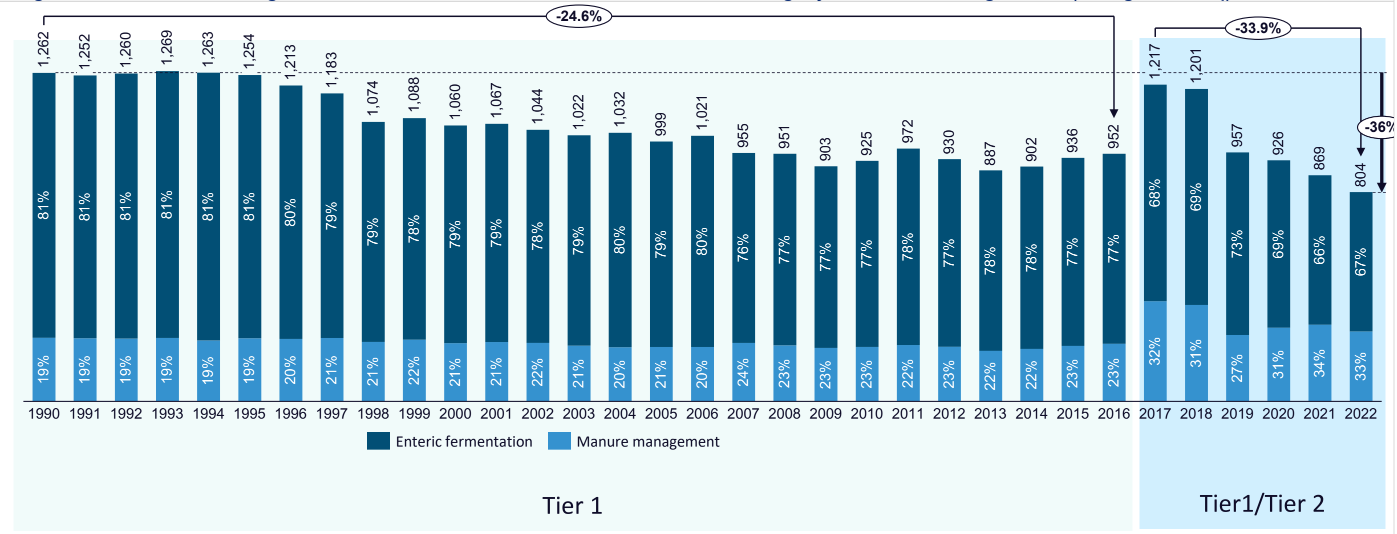
Source: IPCC software, team analysis

5.2.2 Manure management

In the Republic of North Macedonia, there is no relevant data on manure management from small livestock farms, primarily small dairy and pig farms. However, in terms of greenhouse gas emissions from manure management, in 1990, they amounted to 245 Gg CO_2 eq, and in 2022 they increased to 269 Gg CO_2 eq, which is an increase of about 10% (Figure 42), with visible changes in the structure of sources by animal categories.

Again, if we look at the results in two different periods, the largest share of emissions is from dairy cows, with 45–55% in Tier 1, while in the Tier 2 period they participate with 10%-17%. Emissions from pigs are the second most important source, with a growing share (from 13–20% in Tier 1 and from 45%-55% in Tier 2), which indicates more intensive production and changes in housing systems, but above all a change in methodology. The other categories, cattle, sheep, goats, horses and poultry, have a relatively smaller, but one can safely say constant share. The transition to Tier 2 methodology in 2017 allowed for more precise national calculations, based on real parameters for each type of livestock and the method of manure management. However, it is obvious that this way an inconsistent series of results is obtained, which the team will try to further elaborate and correct in the next inventory. Additionally, the amount of manure used for biogas production will be included in the greenhouse gas emissions from farm manure management in the next greenhouse gas inventory.

Figure 42. Greenhouse gas emissions from the Livestock sector subcategory Manure management (in Gg CO2-eq)



Source: IPCC software, team analysis

5.2.3 Indirect N2O emissions from manure management

Manure management is a significant contributor to nitrous oxide (N_2O) emissions, especially when manure is not properly handled. Nitrogen losses begin immediately after the excretion of manure and urine in barns and other associated facilities (such as milking parlours), with nitrogen being released in the form of ammonia (NH_3) and nitrogen oxides (NO_x). An additional portion of N_2O emissions originates from the mineralization of organic nitrogen present in manure. This process is most pronounced during the collection, storage and treatment phases of manure, where conditions such as humidity, temperature and aeration significantly affect the intensity of microbial activity.

During storage in open areas, around barns, feedlots or on pastures, some nitrogen is additionally lost through leaching and drainage into the soil. These losses can indirectly result in increased N_2O emissions at later stages, as nitrates transported to deeper soil layers can later undergo microbial processes that produce N_2O.

The final stage of manure management is its application and incorporation into agricultural soils. If this process is not properly organized, for example, if the manure remains on the soil surface for a long period of time or is applied in adverse weather conditions, significant nitrogen losses can occur through evaporation and leaching, which further increases the potential for N_2O formation.

As previously mentioned, indirect N2O emissions from manure management are mainly a consequence of inadequate management in the process of collection, storage, application and incorporation into soils. Overall, indirect emissions from manure management have been relatively stable over the years with some small fluctuations over the years. In the period 2017-2022, there is a decrease of about 21% (Figure 43).

Figure 43. Indirect N2O emissions from manure management in the Livestock sector (in Gg CO2-eq)

Source: IPCC software, team analysis

5.3 Application of urea

Urea (chemical formula $CO(NH_2)_2$) is one of the most commonly used nitrogen fertilizers in crop agricultural production due to its high nitrogen content (about 46% N).

Incorporated into the soil, urea ($CO(NH_2)_2$), under the influence of the activities of soil microorganisms, is converted into ammonium (NH4+2), hydroxyl ion (OH-) and bicarbonate (HCO3-), in the presence of water and the enzyme urease, releasing CO_2 in the atmosphere (Figure 44). Although this emission is relatively short-term, it is considered that each kilogram of urea contributes to a direct emission of CO_2 at the time of application. The intensity of these processes depends on the water-air and temperature conditions, as well as the acidity (pH) in the topsoil, but also the presence - number and activity of microorganisms. If it is not applied correctly (for example, left on the surface without incorporation), ammonia volatilization and nitrogen loss can occur. Excessive use of urea can lead to soil acidification, nitrate leaching and groundwater pollution.

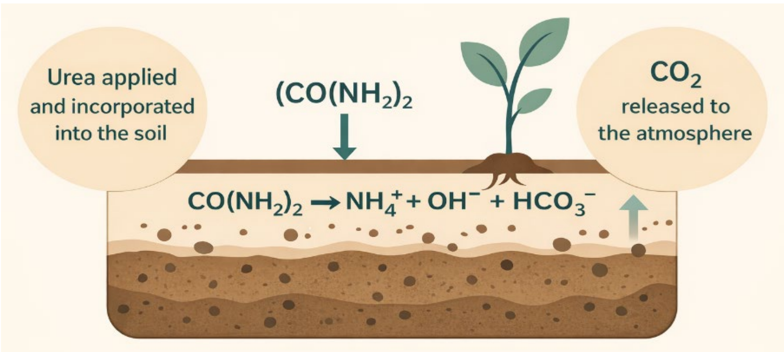
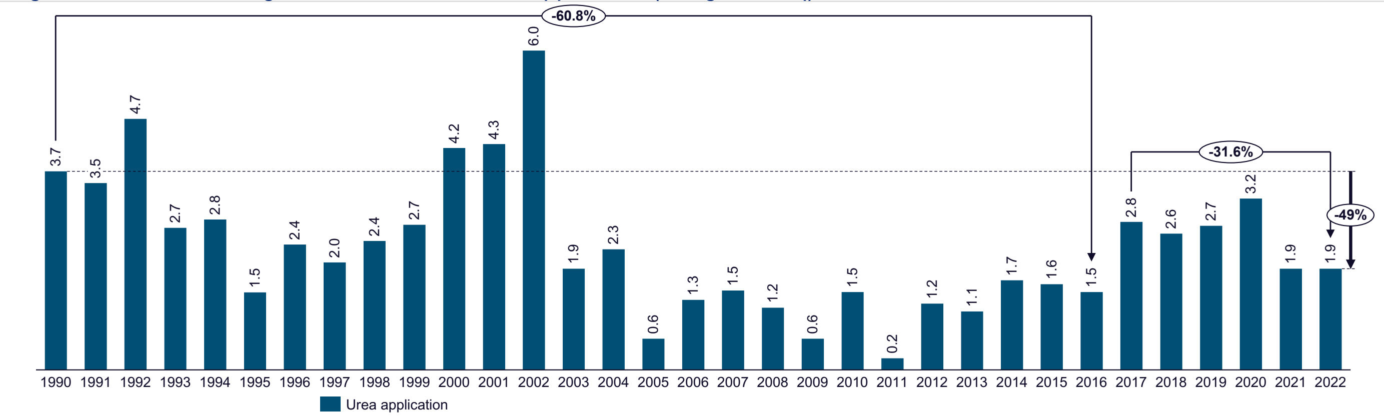


Figure 44. Chemical reaction of urea and creation of CO2 emissions

Emissions from the use of urea in the total emissions from the Agriculture sector contribute less than 0.5%. In the initial part of the series (1990–2003) a significantly higher level of emissions is noticeable, reaching a maximum in 2002 (6.0 Gg CO_2-eq) (Figure 45).Then follows significant decrease, in the period2002–2004the emissions everything reduce for60.8%,when the greatest is observed annual change in the frames on the whole temporal series reaching only 0.2 Gg CO_2-eq. In 2022, emissions are reduced by about 50% compared to 1990. The lower emissions in this period are mostly due to the limited use of urea in agricultural production, mainly on cereals and vegetables, in early spring.

Figure 45. Greenhouse gas emissions from urea application (in Gg CO2-eq)

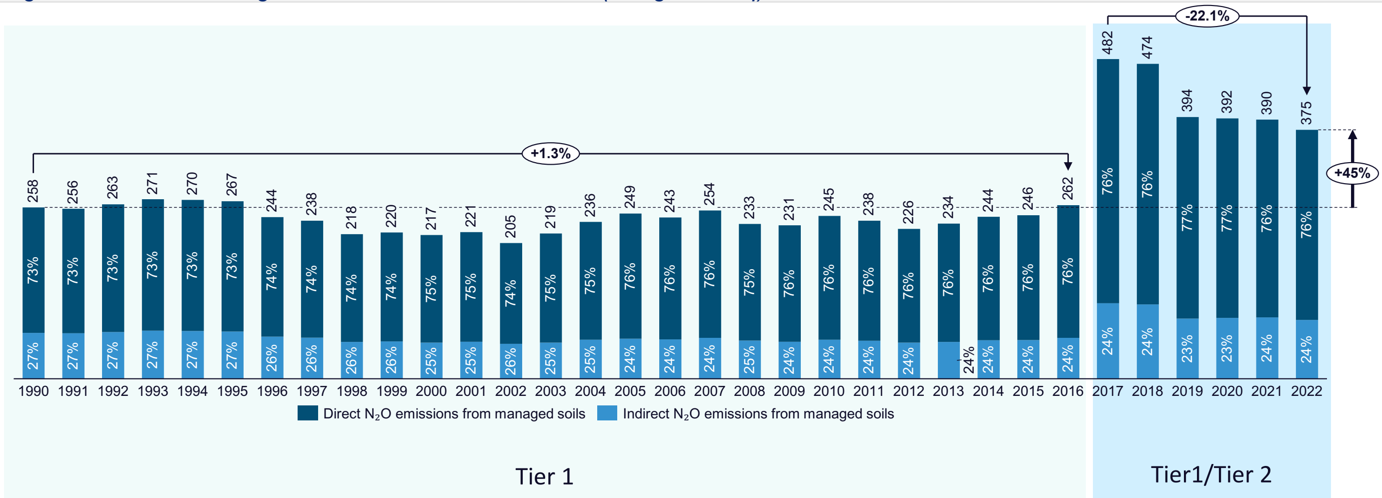


Source: IPCC software, team analysis

5.4 Arable soils

The second largest source of greenhouse gas emissions in the agriculture sector is Arable soils, i.e. direct and indirect emissions of N_2O. Direct emissions mean that N_2O is created and released directly into the soil where the nitrogen is added, as opposed to indirect emissions that originate from leached nitrates or ammonia that are later transformed into N_2O in the atmosphere/water. Figure 46 shows the direct and indirect emissions of N_2O from arable soils in the Republic of North Macedonia for the period 1990–2022. In the Tier 1 period (1990–2016) emissions range within a relatively constant range, with direct emissions dominating, approximately 75%, while indirect emissions contribute around 25%. The emission trend in this period shows a minimal increase of 1.3%, which indicates stable agrotechnical practices and consistent use of nitrogen fertilizers. In the Tier 1/Tier 2 period (2017–2022) the share of direct and indirect emissions is almost identical to the previous period, with emissions initially increasing, reaching a local maximum in 2017 (482 Gg CO_2 eq), followed by a decline of 22.1% by 2022.

Figure 46. Greenhouse gas emissions from Arable soils (in Gg CO2-eq)



Source: IPCC software, team analysis

5.4.1 Direct N_2O emissions from arable soils

Direct emissions of N_2O from arable soils represent one of the most significant sources of emissions of this potent greenhouse gas in agriculture. These are emissions of nitrous oxide (N_2O) that occur directly in the soil as a result of the input and transformation of various forms of nitrogen. These emissions occur on agricultural land itself where nitrogen is applied, either through mineral fertilizers, organic fertilizers (manure, compost, liquid fraction), crop residues or nitrogen fixation by leguminous crops. Direct emissions of N_2O are the result of microbial processes in the soil, most often:

- Nitrification– aerobic process where ammonium (NH_4^+) is converted to nitrate (NO_3^-), which can release N_2Oh.
- Denitrification– anaerobic process where nitrates (NO_3^-) are reduced to gaseous forms (N_2, N_2O). When the process is incomplete, the result is N.$_2$Oh.

Main sources of nitrogen causing direct emissions:

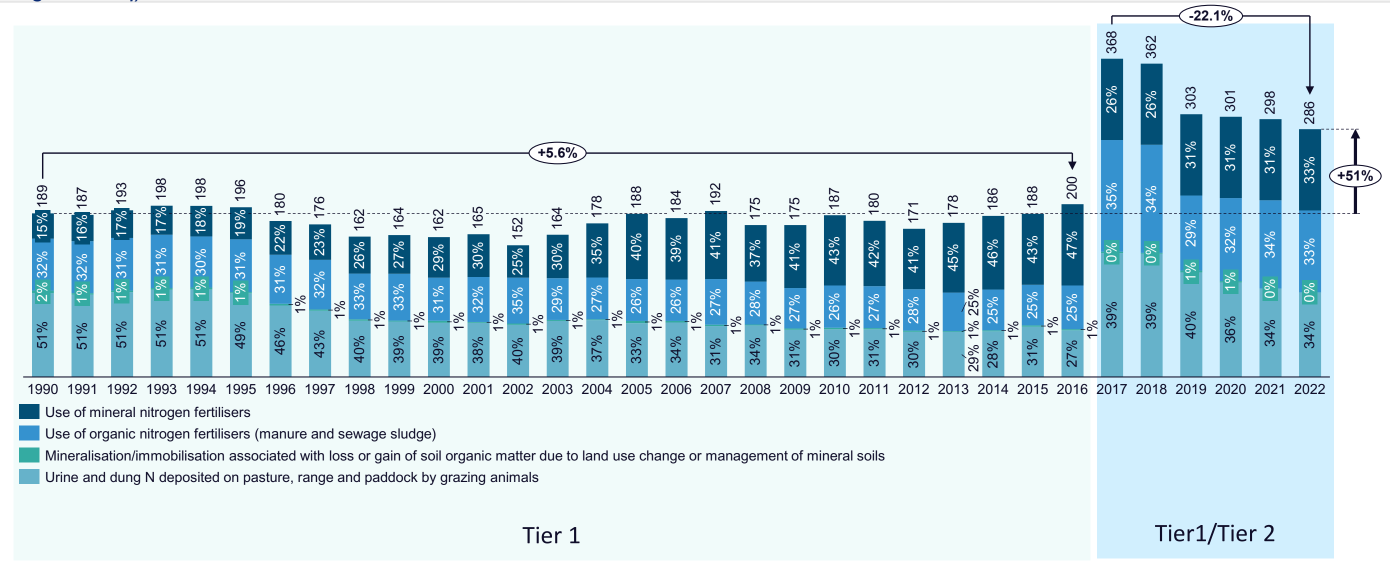
- Mineral nitrogen fertilizers (urea, ammonium nitrate, ammonium sulfate).
- Organic fertilizers (animal manure, compost).
- Crop residues (straw, roots, nitrogen-rich leaves).
- Nitrogen fixed by leguminous crops (beans, peas, alfalfa, chickpeas, soybeans, etc.).
- Deposition of nitrogen from atmospheric sources.

Factors affecting the size and intensity of emissions:

- Amount and form of nitrogen input.
- Soil moisture and structure.
- Soil temperature (higher temperatures in the topsoil accelerate microbiological processes).
- Organic matter and aeration.

Direct N_2O emissions from managed soils show a relatively stable trend with occasional increases, but with a noticeable rise after 2016, when values reached around 370 Gg CO_2-eq, mainly due to the change in methodology. If only the Tier 2 period is analysed, it can be concluded that emissions decreased by about 22% in 2022 compared to 2017 (Figure 47). The largest contribution to total emissions comes from urine and dung deposited on pasture, accounting for approximately 30–51% of total emissions, while organic fertilizers contribute 25–35%, and mineral nitrogen fertilizers about 30% in the last three years. Emissions from mineral nitrogen fertilizers are the only ones in the analysed period 1990–2022 that show a clear increasing trend, reaching a 47% share in 2016 compared with about 15% in 1990. After 2018, a sharp increase is observed across all subcategories, particularly for organic and mineral fertilizers, which may be associated with more intensive agricultural production and increased use of nitrogen compounds. These results indicate that agriculture remains a significant source of N_2O emissions, with manure management and pasture management representing key areas for potential emission reduction measures.

Figure 47. Direct N_2O emissions from arable soils from the use of nitrogenous mineral fertilizers and from the livestock sector (in Gg CO2-eq)



Source: IPCC software, team analysis

5.4.2 Indirect N_2O emissions from arable soils

Indirect emissions of N_2O from regularly cultivated agricultural soils occur as a result of the loss and re-transformation of nitrogen compounds initially introduced into the soil (via fertilizers, urea, organic matter or fixation). Indirect emissions are associated with the transport and transformation of nitrogen away from the point of application.

The most common ways and pathways through which indirect emissions occur are:

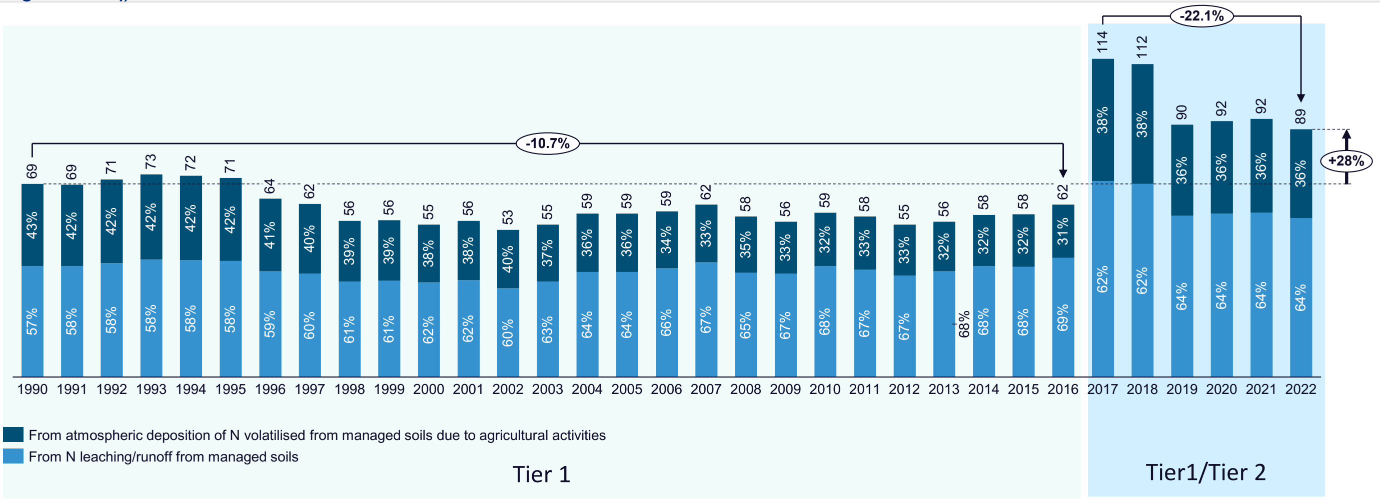
1. Nitrate leaching (NO_3^-), which occurs during rainfall or irrigation when some of the nitrates from the soil are washed into groundwater and surface waters. In aquatic ecosystems or other soil zones they undergo denitrification again, with some of the nitrogen being released as N_2O.
2. Evaporation of ammonia (NH_3) and nitrogen oxides (NO_x). After the application of urea, or manure, some of the nitrogen is converted to gaseous form (NH_3, NO_x). These gases can be transported by air over long distances, where they are re-accumulated (deposition), and enter soil or water systems. There, through microbial processes, some of them end up as N_2O emissions.

3. Surface runoff. Nitrogen bound to soil particles or organic matter can be transported via surface waters. Later, where it is deposited, the nitrogen is mineralized and transformed into N_2O.

According to the IPCC methodology, these indirect emissions are usually estimated through fractions (standardized percentages) of the total nitrogen input or loss into agricultural soil, given that they occur outside the agricultural area to which the fertilizer is applied.

From the data presented on Figure 48, it can be concluded that indirect emissions from soil management show a moderate decrease in the period up to 2016 of about 11%. The decreasing trend continues in the period from 2017-2022 when there is a decrease of about 22%. The largest share is from emissions from N obtained by leaching or runoff from cultivated soils, which account for about 57–70% of total indirect emissions. Emissions from atmospheric deposition of N that has evaporated during agricultural activities contribute approximately 30–45%.

Figure 48. Indirect N_2O emissions from arable soils from the use of nitrogenous mineral fertilizers and from the livestock sector (in Gg CO2-eq)



Source: IPCC software, team analysis

5.5 Rice cultivation

During the reporting period (2020–2022), rice cultivation in North Macedonia, as in many decades before, is concentrated on agricultural areas specifically designated and prepared for rice cultivation, in the municipality of Kočani, as well as in several neighbouring municipalities (Mešino-Obleševo, Zrnovci, Karbinci and Probishtip), which belong to the Kočani Valley geographical area. Together, these municipalities produce approximately 70–80% of the national rice production, which means a high degree of geographical concentration of this agricultural crop.

Rice fields are intensively irrigated by flooding the entire surface - drainage/irrigation systems. The type of soils on which production is carried out are predominantly alluvial. Characteristic of the production plots is that they are very fragmented, i.e. they have high fragmentation of the land and depend on the local irrigation infrastructure (the Bregalnica Hydrosystem).

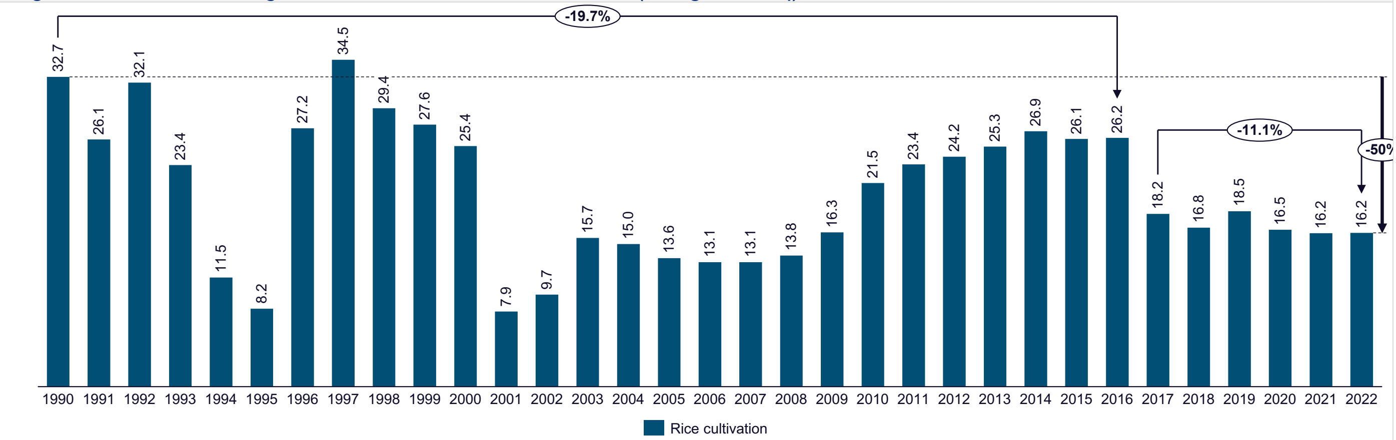
Methane (CH_4) emissions from rice fields are one of the most characteristic categories of emissions from agriculture and are treated separately in the IPCC (Intergovernmental Panel on Climate Change) methodology. Because rice fields are irrigated with continuous flooding (flooded conditions), under these anaerobic (oxygen-free) conditions, organic matter in the soil and plant residues is decomposed through microbial methanogenesis, a process in which methane - CH_4 is released. Typically, the process of methane emissions from rice fields occurs by its evaporation into the atmosphere through transpiration from the leaves of cultivated rice plants and diffusion through water.

When continuous flooding of rice fields occurs, a high intensity of methane emissions occurs. Also, the quantitatively higher use of organic fertilizers (manure, straw, compost) increases emissions due to additional organic carbon. The intensive and high fertilization rates of mineral fertilizers (urea; NH4NO3; NPK; KAN, etc.) can indirectly affect the increase in emissions, but the effect of increasing methane emissions is smaller compared to organic fertilizers. When the temperature (of water and air in rice fields) is higher, warm conditions enhance microbiological activity and emissions.

Greenhouse gas emissions from rice cultivation in the Republic of North Macedonia for the period 1990–2022 show significant variations depending on the area under rice and production practices. In the 1990s, emissions were relatively high, around 33 Gg CO_2-eq, followed by a reduction of about 75% by 1995 when emissions amounted to only 8 Gg

CO_2-eq, i.e. rice production is at its lowest level (Figure 49). From 2004 to 2016, a steady growth was observed, associated with the expansion of areas and the intensification of irrigation, reaching a local maximum around 2014 of about 27 Gg CO_2-eq. After 2016, emissions decline again and in 2022 emissions are at 50% (about 16 Gg CO_2-eq) compared to emissions in 1990.

Figure 49. Greenhouse gas emissions from rice cultivation (in Gg CO2-eq)



Source: IPCC software, team analysis

5.6 Methodology and emission factors

Greenhouse gas emissions are estimated through equations that use coefficients and emission factors specific to each geographical area, type and category of farm animal, type and system of production, feeding method, applied manure technology and manure management. The choice of the level (Tier) of the method for each calculation of greenhouse gas emissions from the Agriculture sector is determined depending on the availability of appropriate national data. In the previous greenhouse gas inventories in livestock production, Tier 1 methods were used, except in the Third Biennial Communication on Climate Change and the Fourth National Plan and Report on the National Greenhouse Gas Inventory, for the period 2017-2019, when the Tier 2 method was used for dairy cattle and pigs. IPCC software is used for gas inventories, and all details related to greenhouse gas emissions in livestock farming are elaborated in the IPCC Guidelines (2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Chapter 10. Emissions from Livestock and Manure Management).

The intensity of greenhouse gas emissions (by type of livestock and emissions by production route – milk, meat, eggs), even if they apply a similar production system, vary greatly from farm to farm. This difference is due to the different practices applied by the farms, as well as to differences in supply chain management. In order to be able to distinguish between the individual systems and the level of practices, it is necessary to have additional more detailed data. Statistical yearbooks do not provide such detailed data. Therefore, as for the previous report, in this report we were forced to apply the Tier 1 methodology and the application of standard emission factors, with certain qualitative improvements based on expert assessments. However, to meet the needs for applying the Tier 2 methodology, we relied on the results of the field research conducted within the framework of the project "Fourth National Climate Change Plan and Third Biennial Report on Climate Change within the framework of the UNFCCC", when an assessment was made of the way of manure management on small farms with dairy cows and pigs. Emission factors were derived according to breed and production system, and then applied to the appropriate population coverage, appropriately distributed in percentage (Table 10).

Table 10. Emission factors used for the inventory of greenhouse gas emissions in livestock farming

Emission factor	BTR1	Comment
Livestock farming		
Dairy cows (enteric - CH4)	kg/head/year	
1_0	52,138	HM=250 kg, without grazing
1_1	50,022	Weight=250 kg, 5 months grazing
1_2	93,494	Weight=250 kg, 7 months grazing
2_0	94,417	Livestock weight=600 kg, without grazing
2_1	143,770	BW=600 kg, 5 months grazing
2_2	113,328	Weight=600 kg, 7 months grazing

3_0	102,703	HM=550 kg, without grazing
3_1	66,669	Weight=550 kg, 5 months grazing
3_2	122,492	Weight=550 kg, 7 months grazing
4_0	108,371	Livestock weight = 650 kg, without grazing
4_1	135,943	Weight=650 kg, 5 months grazing
4_2	145,964	Weight=650 kg, 7 months grazing
5_0	91,182	Livestock=500 kg, without grazing
5_1	116,473	BW=500 kg, 5 months grazing
5_2	130,426	BW=500 kg, 7 months grazing
Other cattle (enteric - CH4)	58	
Sheep (enteric - CH4)	5	40kg weight
Sheep < 1 year (enteric - CH4)	5	Sheep < 1 year with 28 kg of live weight
Goats (enteric - CH4)	5	30 kg of fat
Goats < 1 year (enteric - CH4)	5	Goats < 1 year with 20 kg body weight
Horses (enteric - CH4)	18	
Pigs (enteric - CH4)	kg/head/year	
Fatteners	1,865	Large farms (ADFI=1,541 kg/day)
Fatteners	1,636	Small farms (ADFI=1,352 kg/day)
Sows	3,993	Large farms (FI=3.3 kg/day)
Sows	3,993	Small farms (ADFI=3.3 kg/day)
Dairy cows (manure - CH4)	20	Dairy cows
	0.35 kg/1000 kg of live weight/day	
	18% liquid (40% N loss);	
	67% solid (40% N loss);	
	1% daily spread (22% N loss)	
	13% pasture	
	0.005 direct N2O - N	
Dairy cows (manure - CH4)	kg/head/year	
1_0	4,663	HM=250 kg, without grazing
1_1	3,859	Weight=250 kg, 5 months grazing
1_2	7,082	Weight=250 kg, 7 months grazing
2_0	7,822	Livestock weight=600 kg, without grazing
2_1	10,144	BW=600 kg, 5 months grazing
2_2	6,397	Weight=600 kg, 7 months grazing
3_0	35,098	HM=550 kg, without grazing
3_1	4,764	Weight=550 kg, 5 months grazing
3_2	7,561	Weight=550 kg, 7 months grazing
4_0	8,528	Livestock weight = 650 kg, without grazing
4_1	9,591	Weight=650 kg, 5 months grazing
4_2	9,001	Weight=650 kg, 7 months grazing
5_0	3,805	Livestock=500 kg, without grazing
5_1	7,965	BW=500 kg, 5 months grazing
5_2	8,051	BW=500 kg, 7 months grazing
Other cattle (manure - CH4)	9 kg/head/year	
Dairy cows (manure - N2O)	Annual N excretion (kg N/head/year)	0.005 direct N2O - N
Firmly	53,294	HM=250 kg, without grazing
	59,423	Weight=250 kg, 5 months grazing
	95,474	Weight=250 kg, 7 months grazing
	98,346	Livestock weight=600 kg, without grazing
	138,294	BW=600 kg, 5 months grazing

	108,474	Weight=600 kg, 7 months grazing
	102,199	HM=550 kg, without grazing
	82,763	Weight=550 kg, 5 months grazing
	116,395	Weight=550 kg, 7 months grazing
	106,476	Livestock weight = 650 kg, without grazing
	135,302	Weight=650 kg, 5 months grazing
	136,629	Weight=650 kg, 7 months grazing
	92,061	Livestock=500 kg, without grazing
	111,993	BW=500 kg, 5 months grazing
	124,231	BW=500 kg, 7 months grazing
Liquid/paste	98,346	LW=600 kg, without grazing
	102,199	LW=550 kg, without grazing
Anaerobic digester	98,346	LW=600 kg, without grazing (0.000 direct N2O – N)
Other cattle (manure - N2O)	0.35 kg/1000 kg of live weight/day	
	18% liquid (40% N loss);	
	67% solid (40% N loss);	
	1% daily spread (22% N loss)	
	13% pasture	
	0.005 direct N2O - N	
Sheep (manure - CH4)	0.15 kg/head/year	40 kg weight
Sheep (garbage - N2O)	0.9 kg/1000 kg/day	40 kg weight
	20% solid	
	80% pasture	
	0.005 direct emission N2O - N	
Sheep < 1 year (manure - CH4)	0.15 kg/head/year	Sheep < 1 year with 28kg body weight
Sheep < 1 year (manure - N2O)	0.9 kg/1000 kg/day	Sheep < 1 year with 28kg body weight
	20% solid	
	80% pasture	
	0.005 direct emission N2O - N	
Goats (manure - CH4)	0.17 kg/head/year	30 kg of fat
Goats (garbage - N2O)	1.28 kg/1000 kg/day	20 kg of fat
	20% solid	
	80% pasture	
	0.005 direct emission N2O - N	
Goats < 1 year (manure - CH4)	0.17 kg/head/year	Sheep < 1 year with 28kg body weight
Goats < 1 year (manure - N2O)	1.28 kg/1000 kg/day	Sheep < 1 year with 28kg body weight
	20% solid	
	80% pasture	
	0.005 direct emission N2O - N	
Horses (manure - CH4)	1.64 kg/head/year	
Horses (garbage - N2O)	0.3 kg/1000 kg of live weight/day	100% pasture
Pigs (manure - CH4)	kg CH4/head/year	
Fatteners	14,044	Large farms (FI=1,541 kg/day)
Fatteners	2,918	Small farms (FI=1,352 kg/day)
Sows	46,893	Large farms (FI=3.3 kg/day)
Sows	9,896	Small farms (FI=3.3 kg/day)
Pigs (garbage - N2O)	(year N excretion kg N/head/year)	Direct N2O – N
		Dry 0.02;
		liquid- 0.005;
		Uncovered lagoon – 0.000;
		Under the floor – 0.002;

		Anaerobic digester – 0.000,
Fatteners	197.1	
Sows	248.2	
Poultry (manure - CH_4)	-	1.8 kg of fat
Poultry (garbage - N_2O)	-	1.8 kg of fat
Laying hens (garbage - CH_4)	0.2 kg/head/year	1.8 kg of fat
Laying eggs (garbage - N_2O)	0.82 kg/1000 kg/day 100% poultry manure (50% N loss); 0.001 Direct N_2O - N	1.8 kg of fat
Broilers (manure - CH_4)	0.2 kg/head/year	0.9 kg of fat
Broilers (garbage - N_2O)	1.1 kg/1000 kg/day 100% poultry manure (50% N loss); 0.001 Direct N_2O - N	0.9 kg bw, specific factors for broilers
Turkeys (garbage - CH_4)	0.9 kg/head/year	6.8 kg bw, specific factors for turkeys
Turkeys (garbage - N_2O)	0.74 kg/1000 kg/day 100% poultry manure (50% N loss); 0.001 Direct N_2O - N	6.8 kg bw, specific factors for turkeys
Other (garbage - CH_4)	0.2 kg/head/year	1.8 kg of fat
Other (garbage - N_2O)	0.82 kg/1000 kg/day 100% poultry manure (50% N loss); 0.001 Direct N_2O - N	1.8 kg of fat

5.7 Data sources

The input data used for the preparation of the national greenhouse gas inventory in the Agriculture sector were taken from the SSO's MAKSTAT, the Ministry of Agriculture, Forestry and Water Economy (MAWF) and publicly available data from the database maintained by the Food and Veterinary Agency (Table 11), and refers to the recording of livestock according to the number of registered farms by settlements/regions, number of animals per farm in a settlement/region in the country, breed composition, gender and age category. The data from the online database of MaxStat fully coincide with the data in FAO-stat and Eurostat. The database of the Food and Veterinary Agency in which the number of domestic animals is recorded is used by the Agency for Financial Support in Agriculture and Rural Development (AFPZRR) for the payment of subsidies in livestock farming.

Table 11. Data sources for inventory of greenhouse gas emissions in livestock farming

		Documents	Data source
Livestock farming		MakStat database	State Statistical Office
			Ministry of Agriculture, Forestry and Water Management
		IPPC permits available online	Ministry of Environment and Public Works
		Internal report (on request)	Food and Veterinary Agency
Rice fields	Maxstat database	- State Statistical Office (SSO) - Ministry of Agriculture, Forestry and Water Management	
-Mineral fertilizers and urea quantities - Application of urea	Reports	- Digital databaseFAO-stat - The International Fertilizer Association Database - IFA-stat	

6 Forestry and other land use

6.1 Summary overview

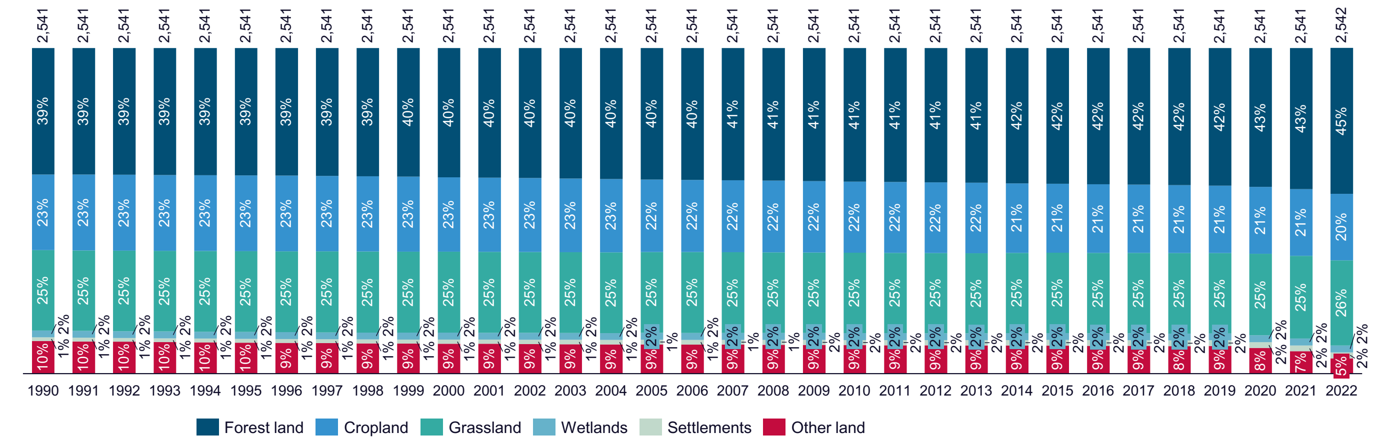
The Forestry and Other Land Use sector is the only sector in the national greenhouse gas inventory that has a net absorption effect and acts as a carbon sink. This sector covers six categories of land, forests, cropland, grasslands, wetlands, urban areas and other land, as well as the conversions between them. Unlike other sectors that emit CO_2, CH_4 and N_2O, this sector, through biological growth processes, biomass accumulation and long-term carbon storage in soils and wood mass, manages to absorb a larger amount of CO_2 than it releases. This positive balance is the result of the constant increase in forest areas, as well as relatively stable management practices. The only factor that can significantly disrupt this balance and lead to net emissions from the sector in a given year are forest fires, which cause a sudden release of stored carbon and a temporary loss of sink capacity. Thus, the sector plays a critical role in reducing total national emissions, acts as a natural offset for emissions from energy, industry, waste and agriculture, and represents a strategic resource for achieving long-term climate goals.

In the period 1990–2022, the land structure in Macedonia shows a clearly expressed long-term transformation, with forest areas gradually increasing their dominant role (Figure 50). The share of forests has been continuously increasing, from around 39% in the early nineties to almost 45% in 2022, which is in line with European trends in the abandonment of agricultural land. The abandonment of agricultural land, i.e. cropland, has been gradually decreasing, from around 23% in 1990 to around 20% towards the end of the analyzed period. This trend indicates structural changes in the agricultural sector, reduced intensity of cultivation or transformation of part of the agricultural land into other categories. Grassland remain extremely stable, around 25% throughout the period, which emphasizes their role as a relatively constant component of livestock production. On the other hand, the fact that grasslands are consistent does not correspond to the figures for livestock, as shown in the previous chapter on livestock, where livestock is significantly decreasing.

Urbanized areas, despite the growing pressure of population and infrastructure, range between 1% and 2%, indicating moderate urbanization compared to regional trends. At the same time, the category of “other land” is decreasing, which generally reflects the conversion or natural transition of part of these areas to forest or agricultural categories. Overall, data for the period 1990–2022 indicate that Macedonia is characterized by strengthening forest ecosystems, moderate withdrawal of cropland and stability of grassland, which in turn fits into broader European patterns of land system transformation.

In the previous national greenhouse gas inventory prepared within the framework of the Fourth National Communication, a significant effort was made to improve the estimates of land use and land use change. For this purpose, a methodology for photointerpretation of satellite images from multiple sources (Landsat and Sentinel) was developed. The analysis covered several reference years, such as 1989, 1990, 2000 and 2005, as well as the period 2014–2019. For the time intervals in which sufficient quality images were missing (1991–1999, 2000–2003 and 2006–2012), statistical interpolation methods were applied, and the obtained values were cross-checked with data from the SSO and CORINE. Higher accuracy was achieved in more recent years thanks to Sentinel images with a resolution of 10 m, which represent a significant improvement over the Landsat images with a resolution of 30 m that were available in previous decades.

Figure 50. Areas by subcategories (in million hectares)

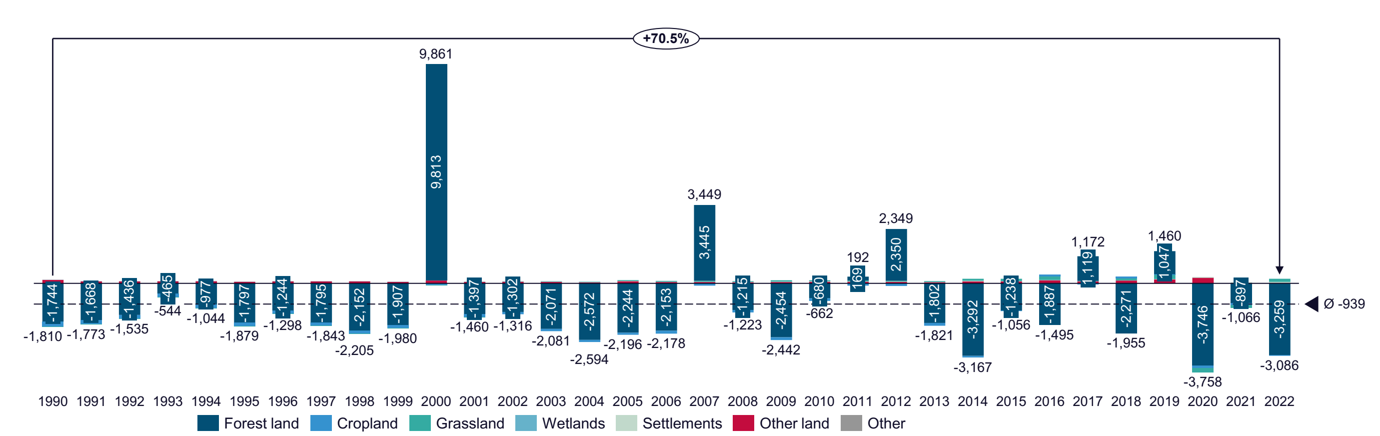


Source: IPCC software, team analysis

The results from the Forestry and Other Land Use sector confirm its role as a unique and structurally stable carbon sink in the national inventory, with characteristic inter-annual variability that is typical for this sector and in the European context. For most of the period considered, this sector generated consistently negative net emissions (approximately –1,500 to –3,000 Gg CO_2-eq) (Figure 51), which indicates sustainable biomass management. Extreme deviations, such as the positive peak in 2000, 2007, 2012, 2017, 2019, are a typical example of a disruption in sink capacity and are most often associated with forest fires, diseases, intensive logging, extreme climate conditions or revisions in methodology and land activities. In the case of Macedonia, it is fires.

In the period 1990-2022, the average sinks were around 940 Gg CO_2-eq. In recent years (2018–2022), an increased sink capacity has been observed with the lowest values of –3,758 Gg CO_2-eq, which indicates possible improvements in forest productivity, i.e. reduced logging and better management. The comparison of 2022 and 1990 shows that the sinks in 2022 increased by 70% compared to 1990.

Figure 51. Greenhouse gas emissions from the Forestry and other land use sector by subcategories (in Gg CO2-eq)



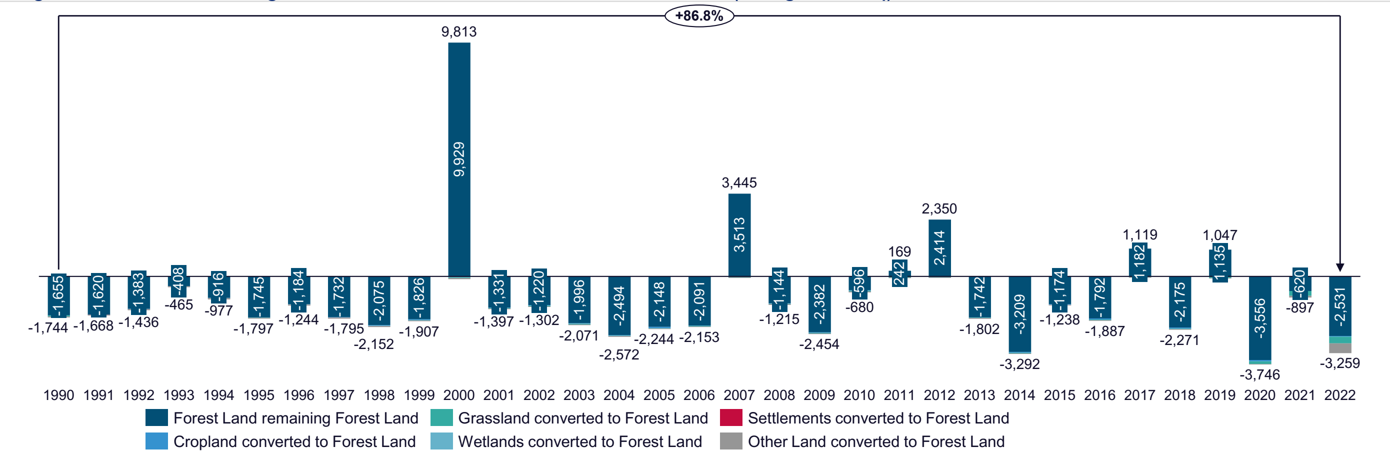
Source: IPCC software, team analysis

6.2 Forests and forest land

Forests and forest land represent a significant net CO_2 sink over the period 1990–2022, with annual values ranging from approximately 500 to 3,800 Gg CO_2, while in certain years extreme deviations occur (Figure 52). A comparison of the results for 2022 with those for 1990 shows that the sinks increased by about 87%, reaching approximately 3,300 Gg CO_2-eq in 2022. The most dominant subcategory is “Forest land remaining forest land”, which in most years generates a sink of 1,500 to 2,500 Gg CO_2, with several notable exceptions: in 2000 exceptionally high emissions of 9,813 Gg CO_2 were recorded due to forest fires. In recent years, the sinks have again stabilized in the range of approximately 2,000 to 3,500 Gg CO_2, as observed in 2018 (–2,175 Gg), 2020 (–3,556 Gg) and 2022 (–2,531 Gg), reflecting the natural dynamics of forest ecosystems.

The conversion of other land-use categories to forest land contributes additional, but smaller, sinks. The transition from cropland generates a sink that typically ranges between 5 and 60 Gg CO_2. The conversion of grassland to forest land shows a stronger effect, particularly in the last three years: from typical sinks of 10 to 40 Gg, the values increase to around 110 Gg in 2019, 200 Gg in 2020, and reach approximately 300 Gg in 2022. Conversions from wetlands and settlements result in minimal sinks (<1 Gg annually) and have a negligible impact on the sector. Finally, the category “Other land converted to forest land” generates moderate sinks of 20 to 50 Gg; however, similarly to grassland conversions, larger deviations are observed in the last three years, such as 72 Gg in 2021 and 413 Gg in 2022. These values usually do not reflect an actual one-year change, but are also the result of incorporating additional data for previously unrecorded areas or the use of different data sources. As a result, the greenhouse gas inventory team will attempt to establish a more appropriate and consistent database for the next inventory in order to avoid or confirm the variations observed in the results.

Figure 52. Greenhouse gas emissions from Forests and forest land (in Gg CO2-eq)



Source: IPCC software, team analysis

The results are in line with the data on Forests and Forest Land in Macedonia which show a stable growth in the total area for the period 1990–2022. In 1990, forest areas that were forested amounted to 953 thousand ha, while in 2022 they reached 1.09 million ha, which represents a total increase of about 14% (Figure 53). On average, about 6000 ha are converted into forest land annually, primarily from grasslands and other land, while in the last three years the conversions have been much larger and amount to up to 40000 ha in 2022 (Figure 54). This trend results from a combination of natural expansion of forest areas, implemented afforestation and integration of previously unrecorded forest areas, as well as improved recording methods and greater harmonisation of data from institutions.

Figure 53. Forests and forest land (in ha)

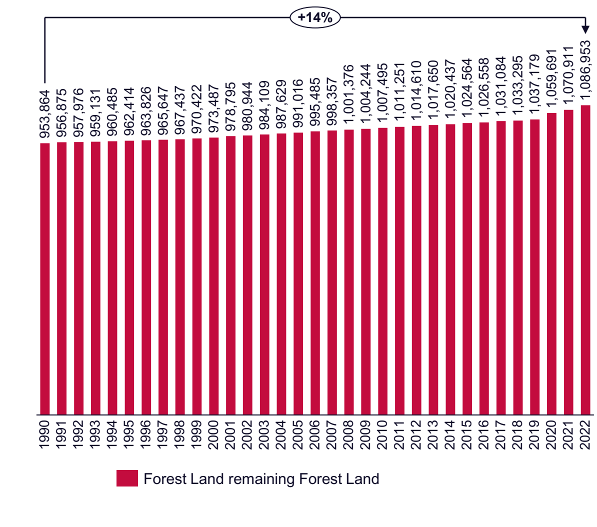
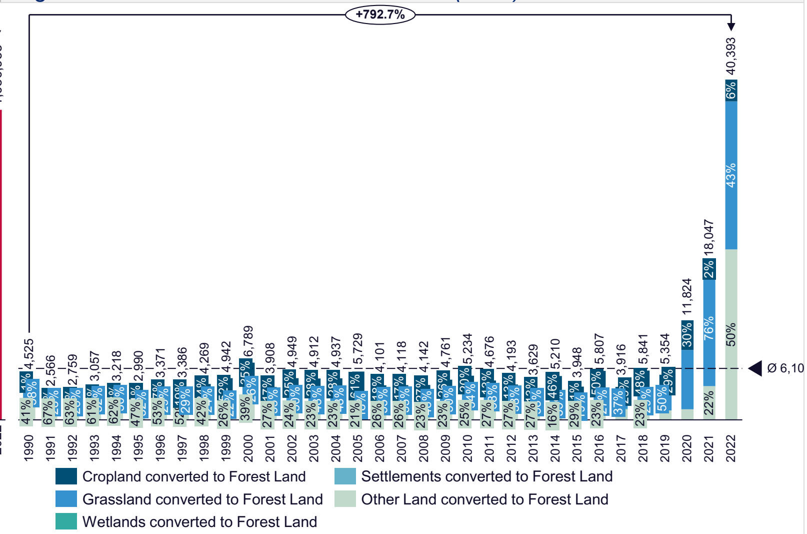


Figure 54. Other land converted to forest (in ha)

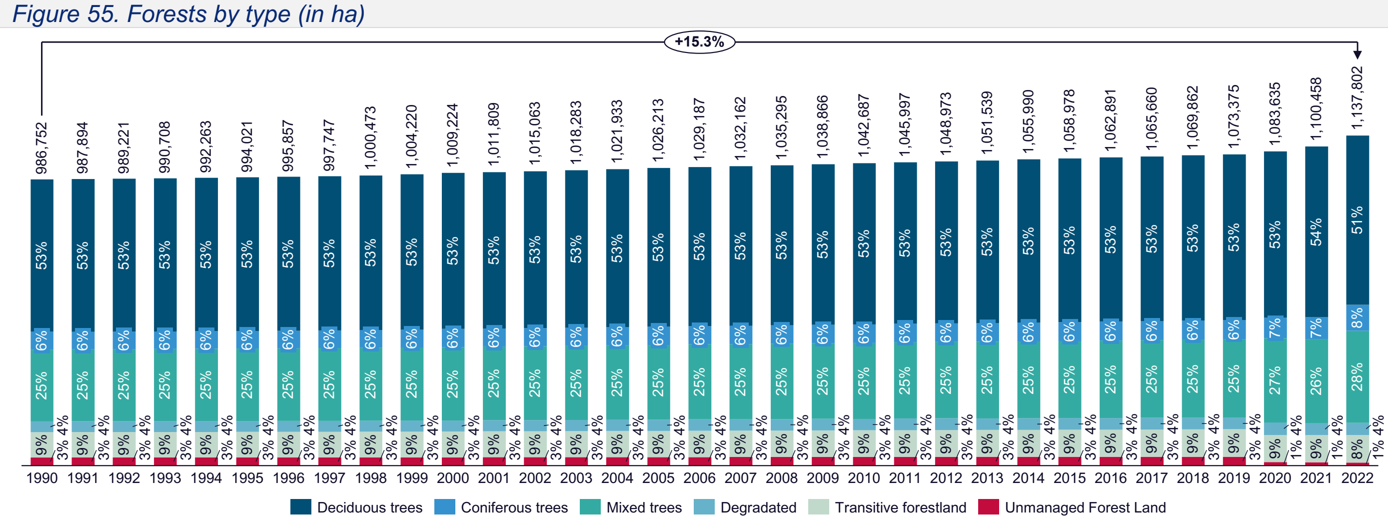


Source: IPCC software, team analysis

A large part of the forest area in Macedonia belongs to the Mediterranean type, which is characterized by low trees and shrubs, i.e. more than 70% of the forests are of vegetative origin (low-stemmed). It should also be emphasized that almost 90% of the forests are state-owned. Despite the increase in the total forest area by about 15.3% in the analyzed period, the structural composition of the forests remains almost unchanged over the years with minor changes, especially in the last three years (2020-2022) (Figure 55). Deciduous forests dominate with a share of about 53%, while coniferous and mixed forests range around 6% and 25%. Degraded areas remain at a low level of about 4%, and transitional forest land accounts for about 9%. The share of unmanaged forests has decreased from 3% in the last three years to 1%, which is primarily a result of their inclusion in managed forests and in special forest management plans (management plans). The increase in forests after 2019 is particularly pronounced, around 30,000 ha in 2020, 17,000 ha in 2021 and around 40,000 ha in 2022. This trend results from a combination of natural expansion of forest areas, implemented afforestation and integration of previously unrecorded forest areas, as well as improved recording methods and greater harmonisation of data from institutions.

The total timber reserve is estimated at around 70 million m3, and the total annual increment is estimated at around 1.7 million m3. The increment values are taken from national tables covering the different tree species, their age and growing conditions.

Figure 55. Forests by type (in ha)



Source: IPCC software, team analysis

Data on the total forest area in Macedonia are obtained from several sources: Statistical Yearbooks of the State Statistical Office, forest management plans of the PE "Macedonian Forests" and other forest management entities, data from the Ministry of Agriculture, Forestry and Water Management, as well as analysis and expert assessments from the Faculty of Forestry Sciences, Landscape Architecture and Eco-Engineering "Hans Em". These sources differ from each other due to different years of preparation, methodological approaches and the degree of harmonization, which required their detailed comparison. Additionally, to improve the quality, continuity and consistency of data on forest and forest land areas, LU/LUC data from CORINE Land Cover were used, combined with the SSO databases. This approach was particularly important because quality information was lacking for the period before 2000. On the other hand, due to the limited possibility of applying modern remote sensing methods for the last period (2020–2022), classic administrative and institutional sources, the SSO Statistical Yearbooks, forest management plans and data from competent institutions were used again, after their prior harmonisation.

Despite the efforts made, the sector continues to face structural constraints: there is no legal obligation to annually record changes in forest resources, and most data are collected in ten-year cycles. The country has not yet developed a modern national forest inventory that would enable the systematic application of remote sensing and rapid, consistent and spatially detailed recording of changes.

6.2.1 Data that influences the reduction of carbon sinks

In addition to the conversion of different land categories to forest land, the dynamics of sinks in this sector are also significantly influenced by processes that change carbon stocks in forests. Two key components determine the annual variation of sinks:

- the commercial use of wood pulp and firewood and
- burned forest areas.

Commercial logging and the use of firewood reduce aboveground and belowground biomass, and thus directly reduce the CO_2 sink in the year of logging. The effect of logging depends on the amount of wood, its structure and age. Greater use of wood for commercial purposes leads to lower sinks or relatively increased emissions, while in years with reduced logging, forest ecosystems have a greater absorption capacity. Data on the use of wood from forests shows a continuous decline, i.e. in the period 1990-2022 there was a decrease of about 40% (Figure 56). What is characteristic is that even in the years with the highest consumption of about 1.05 million m3 (1996), the natural increase was not exceeded, which, as stated above in this chapter, was about 1.7 million m3. Expressed in percentage, the utilization of wood mass from forests is about 60% of the natural increase. This indicates good forest management. Firewood accounts for about 80-85% of the total consumption of wood mass. What is characteristic of the period 2020-2022 is that the demand and consumption of firewood is decreasing, due to various reasons. One of the biggest is the emigration of young people, leaving rural areas, as well as incentives to switch to another way of heating the premises.

On the other hand, forest fires result in immediate CO_2 emissions and a significant reduction in biomass, which reduces the sink in subsequent years until regeneration begins. The extent of the burned areas, their location, and the type of forest affected have a direct impact on annual emissions and sinks (Figure 57). The analysis of fires shows that in years when there are emissions instead of sinks from the forestry sector, the burned areas are over 15 thousand ha. For example, in 2021, about 11 thousand hectares of forest were burned, but despite this, no net emissions were recorded, because the total increase in forest mass was greater than the loss caused by fires. On average, about 7000 ha are burned annually.

Figure 56. Commercial use of wood pulp and firewood (in thousand m3)

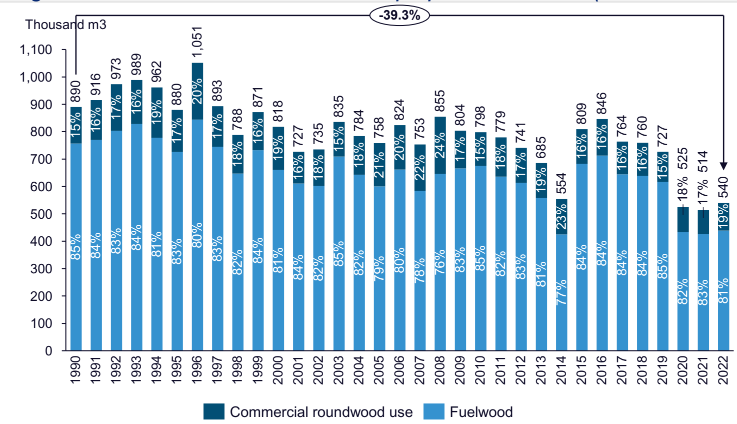
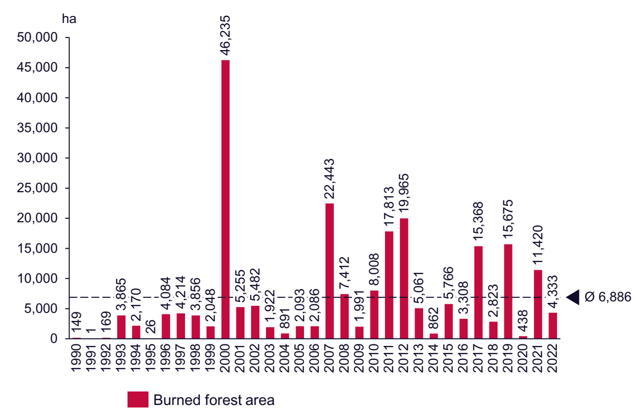


Figure 57. Burned areas (in ha)



Source: IPCC software, team analysis

6.3 Cropland

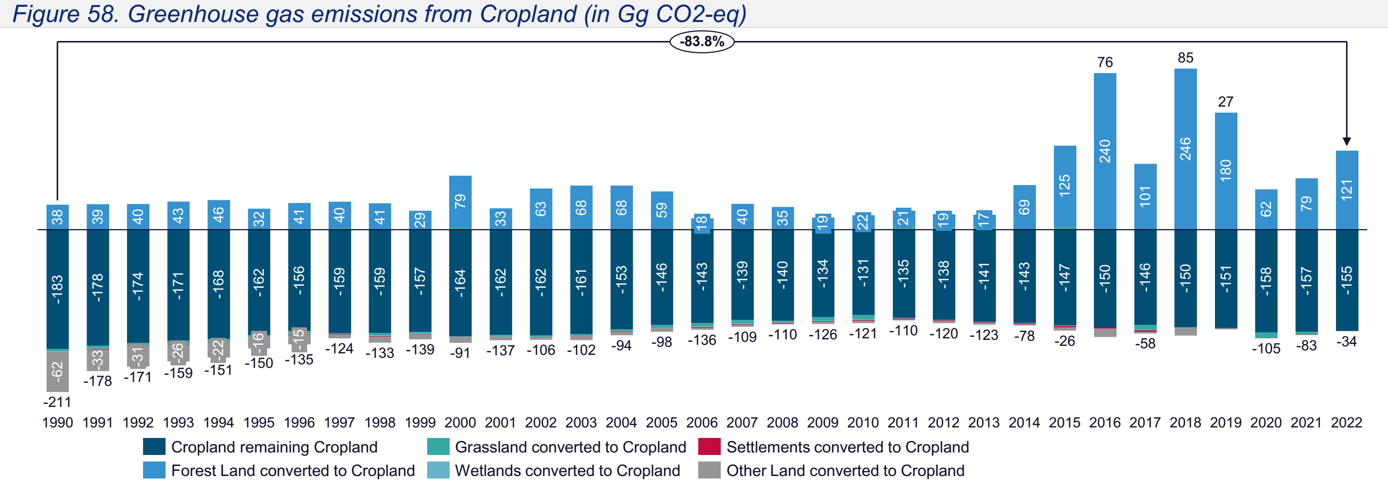
Crop production is one of the key segments of the agrarian sector in Macedonia. It provides food for the domestic market, provides raw materials for the processing industry, is a significant factor in export earnings and plays a crucial role in the development of rural communities. According to data from (https://investnorthmacedonia.gov.mk/), about 435,500 people are involved in agribusiness, who are fully or partially engaged in agricultural activities, which represents about 25% of the total population. Agricultural holdings are predominantly small, family-owned and characterized by a highly fragmented land structure.

According to the methodology of the State Statistical Office (SSO), the term crops refers to cropland that is actively used for agricultural production, i.e. for growing crops with annual or multi-annual yields. This class covers the entire category of arable agricultural land, i.e. all areas on which agricultural activities are carried out and which are sown or planted with annual crops (cereals, industrial crops, vegetables, fodder crops) or with multi-annual plantations, such as vineyards, orchards and grasslands, including meadows and grasslands.

Sinks from cropland show a decreasing trend in the period 1990–2022, and in certain years there are emissions from this category, as is the case with 2016, 2018 and 2019 (Figure 58). The category "cropland that remained cropland" is the main factor determining the dynamics of this subsector and for most of the period generates a permanent sink in the range of 130 to 180 Gg CO_2 per year. The sink gradually decreases, from 183 Gg in 1990 to approximately 155 Gg in 2022, which indicates a decrease in soil organic matter. These changes are directly related to the dynamics of carbon pools. Namely, sinks from cropland mostly arise from perennial crops (vineyards, orchards and other permanent crops), which through their above-ground and below-ground biomass and through permanent plant cover contribute to carbon accumulation. On the other hand, emissions occur during the conversion of perennial to annual crops, since the uprooting of vineyards and orchards leads to the immediate release of the entire biomass, according to the Tier 1 methodology.

The largest emissions in the subsector arise from the conversion of forest land to cropland, as this transformation results in the loss of a significant amount of carbon stored in above-ground and below-ground biomass. When forest vegetation is cleared, through logging, burning or mechanical removal, the carbon accumulated in the wood mass is released into the atmosphere as CO_2. In addition, the disturbance of soil layers during land preparation for agricultural use leads to the decomposition of organic matter in the soil, which creates additional emissions. Due to these processes, the conversion of forest land to cropland generates emissions of 20 to 70 Gg CO_2 in most years, and has seen significant increases since 2015. In 2015, emissions reached 125 Gg, in 2016 240 Gg, and the highest values were in 2018 and amounted to 246 Gg CO_2, which confirms the key role of this category as a dominant emission source. Conversions from remaining land to cropland have very little impact, with the exception of remaining land converted to cropland in the period 1990-1996.

Figure 58. Greenhouse gas emissions from Cropland (in Gg CO2-eq)



Source: IPCC software, team analysis

In terms of input data, primarily LU/LUC data from CORINE LC are used, which are cross-referenced with data from the SSO. The data analysis shows a gradual decrease in the total area of cropland in Macedonia in the period 1990–2022. Starting from around 587,000 ha in 1990, cropland decreases to approximately 517,000 ha in 2022, representing a total decrease of around 12% (Figure 59). The category "cropland that remained cropland" dominates in all years and determines the overall trend. Conversion from grassland, forest land or other areas to cropland is present continuously and on average in the period 1990-2022 the converted areas amount to about 1600 ha (Figure 60). In the last three years, most grassland areas have been converted to cropland. The data show that for most of the period there has been almost no significant new cropland, as the cropland area has been decreasing, indicating that the decrease is predominantly a result of abandonment and conversion of cropland to other types of land (especially forest land and grassland).

Figure 59. Cropland (in ha)

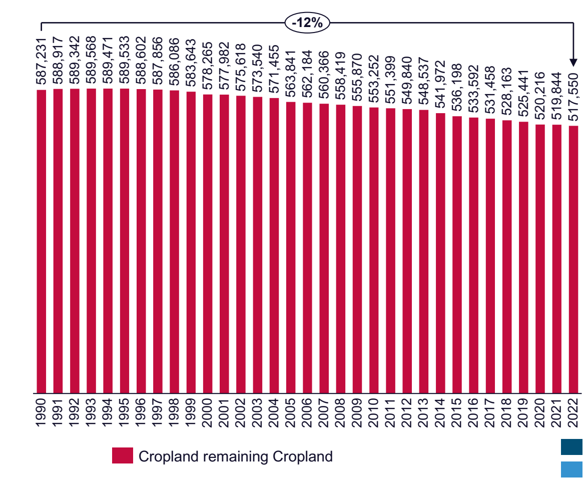
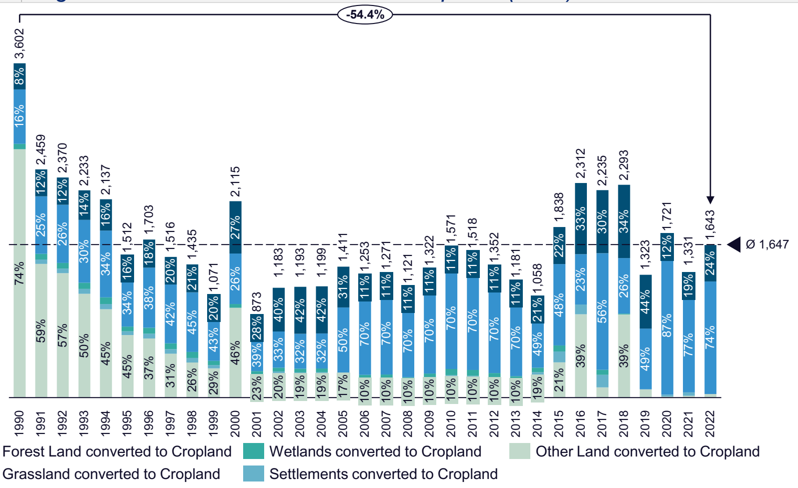


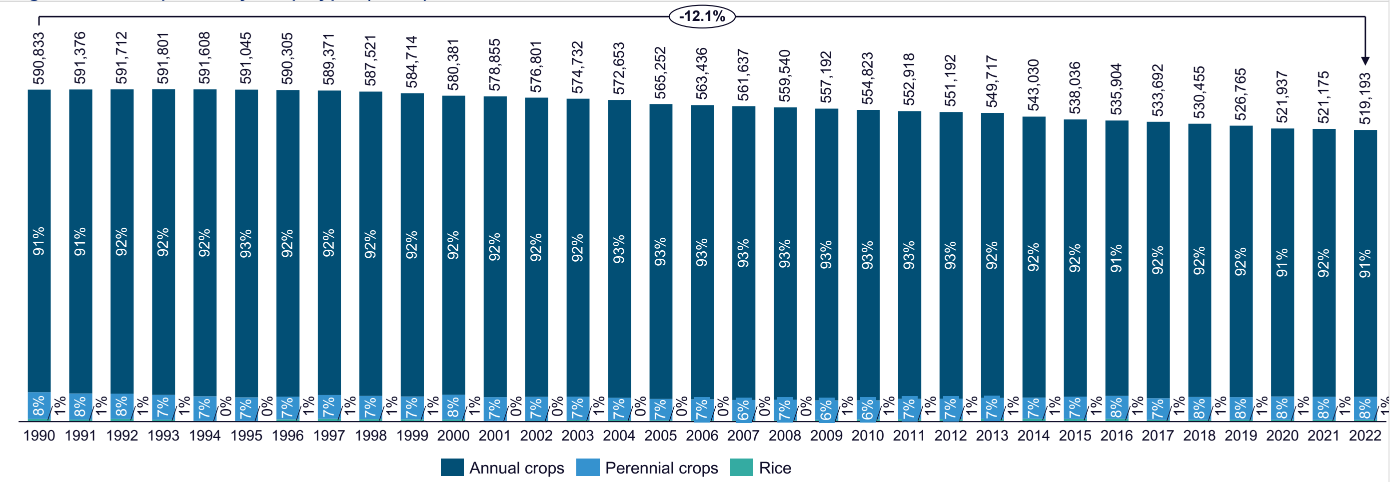
Figure 60. Other land converted to cropland (in ha)



Source: IPCC software, team analysis

The structure of cropland by crop type (annual crops, perennial crops and rice) is relatively stable throughout the period, with the dominance of annual crops, which account for between 91–93% of the total area (Figure 61). Perennial crops (orchards, vineyards) occupy about 6–8% of the cropland, without significant changes over the years. The share of rice is relatively small, but consistent, with a share of about 1% in all years. This is expected, since rice production is concentrated on specific soils and regions (mainly Kochansko Pole) and is limited by agroclimatic conditions.

Figure 61. Cropland by crop type (in ha)

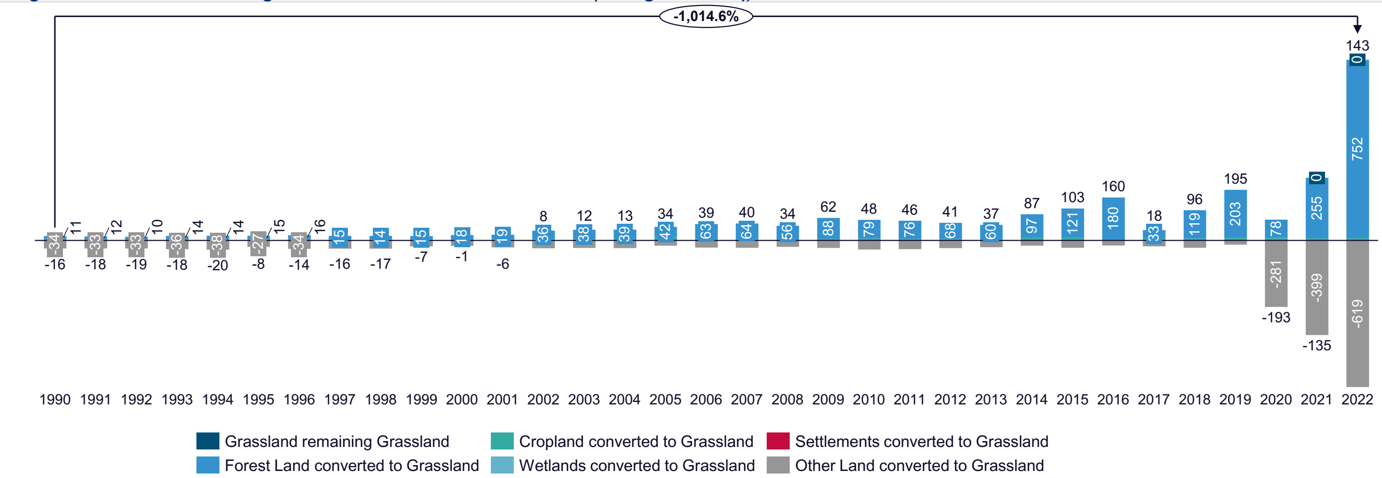


Source: IPCC software, team analysis

6.4 Grassland

The category "Meadows and pastures" is part of agricultural land and includes areas used for the production of animal feed, such as natural or cultivated meadows, or pastures used for direct grazing of livestock. Grassland ecosystems provide permanent plant cover, contribute to soil stability, prevent erosion, regulate the water regime and store carbon. Therefore, for most of the period 1990–2022, pastures contribute to relatively small CO_2 emissions, which are more pronounced in cases where forest land is converted to pasture, as the soil is disturbed and stored biomass is lost, i.e. the loss of forest biomass and its role as a carbon sink leads to high one-off emissions in the year of conversion. This is clearly seen after 2020, when the conversions lead to emissions: 255 Gg CO_2 in 2021 and 752 Gg CO_2 in 2022 (Figure 62). On the other hand, the conversion of remaining land into pastures leads to sinks that are again most pronounced in the period after 2020, reaching 619 Gg CO_2 in 2022. Net emissions in 2022 amount to 143 Gg CO_2, which is more than 10 times higher than in 1990 when they were 11 Gg.

Figure 62. Greenhouse gas emissions from Grassland (in Gg CO2-eq)



Source: IPCC software, team analysis

In the period 1990-2019, there was almost no change in the total area of grassland, while in the last three years there has been an increase, so the area under grassland, including converted, in 2022 is 6% larger compared to the area in 1990. The category "Grassland that remained grassland" dominates in all years and accounts for between 97% and approximately 100% of the total area of grassland. Between 2,000-4,000 ha of other land is converted into grassland, but in the last three years larger areas of other land have been converted into grassland, so that the area in 2022 reached around 40,000 ha (Figure 64). However, the overall changes are marginal and do not have a significant impact on the overall structure of the land. Such minimal conversions reflect the role of grassland as relatively permanent land systems, which are often associated with natural, mountainous and semi-mountainous areas where alternative uses are limited. This stability is consistent with the traditional role that grassland have in the agricultural sector, providing forage through direct grazing or the production of silage and hay, but also with their ecological importance in maintaining permanent vegetation, preventing erosion and preserving soil carbon.

Figure 63. Grassland (in ha)

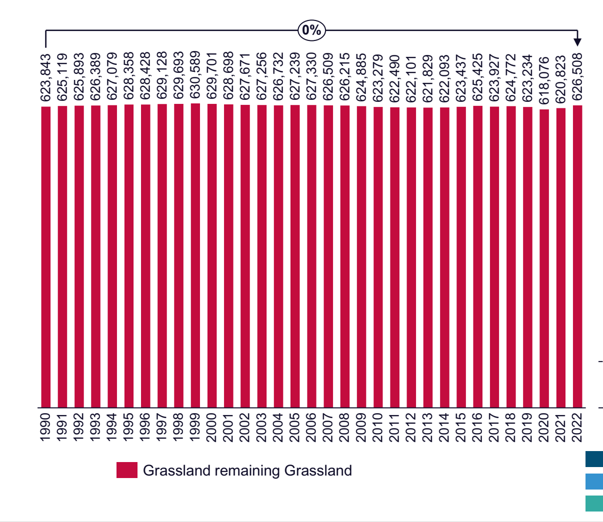
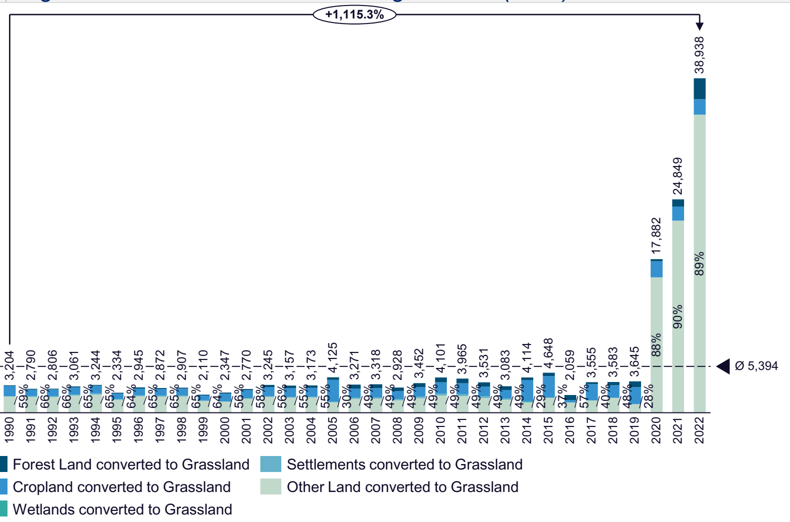


Figure 64. Other land converted to grassland (in ha)

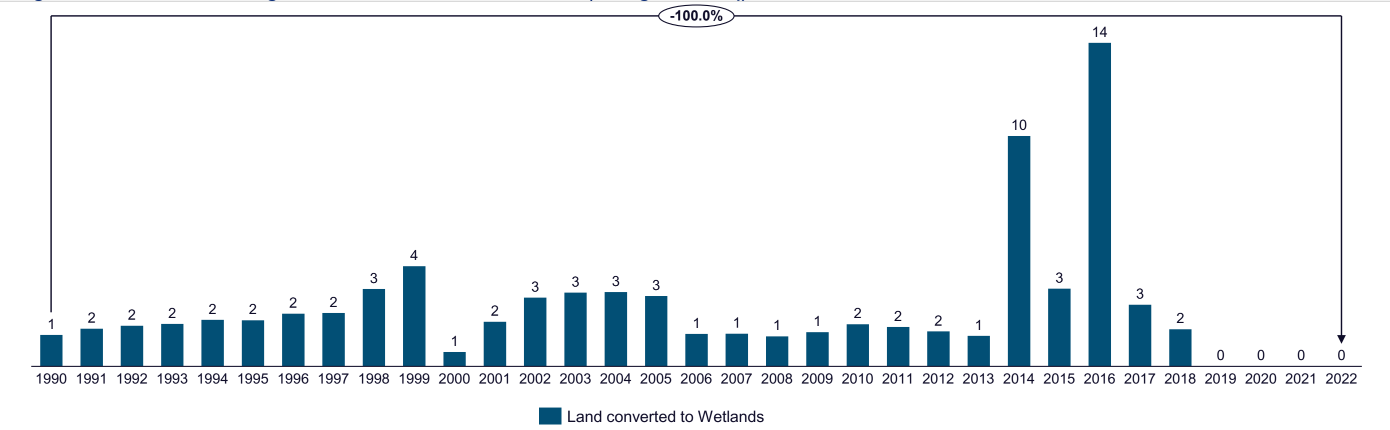


Source: IPCC software, team analysis

6.5 Wetland

The category "Wetlands" within the Forestry and Land Use sector, according to IPCC guidelines, includes wetlands, peatlands and flooded lands. This category formally includes natural lakes and rivers, but they are considered unmanaged subcategories and are not subject to land transitions or emissions assessments according to the IPCC. Emissions recorded from this category are very small, with the exception of 2014 (10 Gg CO2) and 2016 (14 Gg CO2) (Figure 65). Emissions are primarily a result of conversion of other lands into wetlands.

Figure 65. Greenhouse gas emissions from Wetlands (in Gg CO2-eq)



Source: IPCC software, team analysis

According to available spatial data, water areas in the country cover approximately 54,000 ha (Figure 66), while true wetlands occupy only 2,154 ha. Although there has been almost no change in the total area in the period 1990-2022, historical records show that in the 1960s, wetlands were much more widespread (over 86,000 ha), but today their area has been halved due to land reclamation, agricultural expansion and urbanization. Despite this, there are still about thirty active sites, including Kalishta, Studenchiskoto Blato, Ljubanishta, NikoliMand Ezerani, as well as a number of smaller, ecologically important areas along rivers and valleys. Peatlands, on the other hand, are spatially very limited, the most significant being Monospitovsko Blato (227 ha), Janchište (41 ha) and Lukovo Pole (18 ha) and have a minimal impact on the national greenhouse gas balance.

Flooded lands are areas that are permanently submerged by water as a result of human activities, most commonly the construction of dams and reservoirs. In Macedonia, 318 artificial reservoirs have been recorded, of which 206 are planned infrastructure facilities, and 112 have been formed indirectly as a result of mining, industrial or construction activities. All of these water bodies, according to the IPCC AFOLU classification, are included in the Flooded Lands category. The latest example of such land transformation is the Konjsko reservoir (completed in 2024), where about 10.8 ha of forest and grassland have been permanently converted into an artificial water surface, which emphasizes the need for regular monitoring of new flooded areas. In terms of land conversion from other types of land to wetlands, cropland and grassland dominate. The largest conversion was achieved in 2005 of 355 ha, followed by 2016 of 316 ha (Figure 67On average, 122 ha are converted annually in the period 1990-2022.

Figure 66. Wetland (in ha)

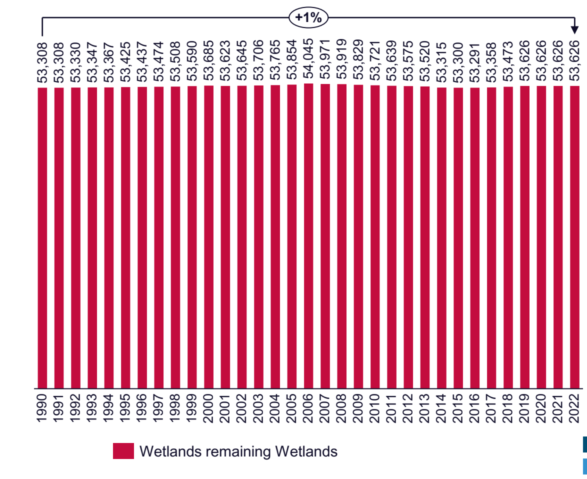
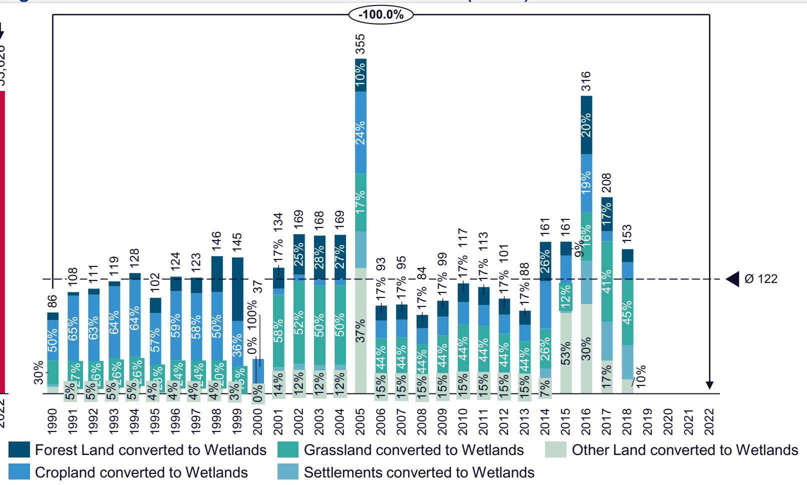


Figure 67. Other land converted to Wetland (in ha)



Source: IPCC software, team analysis

However, there are no official national data in Macedonia that would allow for systematic monitoring of changes in wetlands. In addition, there is no separate class for this category in the CLC+Backbone databases, so a detailed land transition matrix cannot be developed. The currently available analysis is based on Corine Land Cover Level 3 for 2018. Although wetlands and peatlands in the country cover a relatively small area, their importance in the Forestry and Land Use sector is high, they store carbon, regulate water in ecosystems and support high biodiversity. However, due to their limited distribution and the lack of national data on managed changes, the category "Wetland" is currently presented as a static cross-section, without the possibility of calculating annual transitions and associated emissions. This means that higher Tier methods cannot be applied in the current cycle.

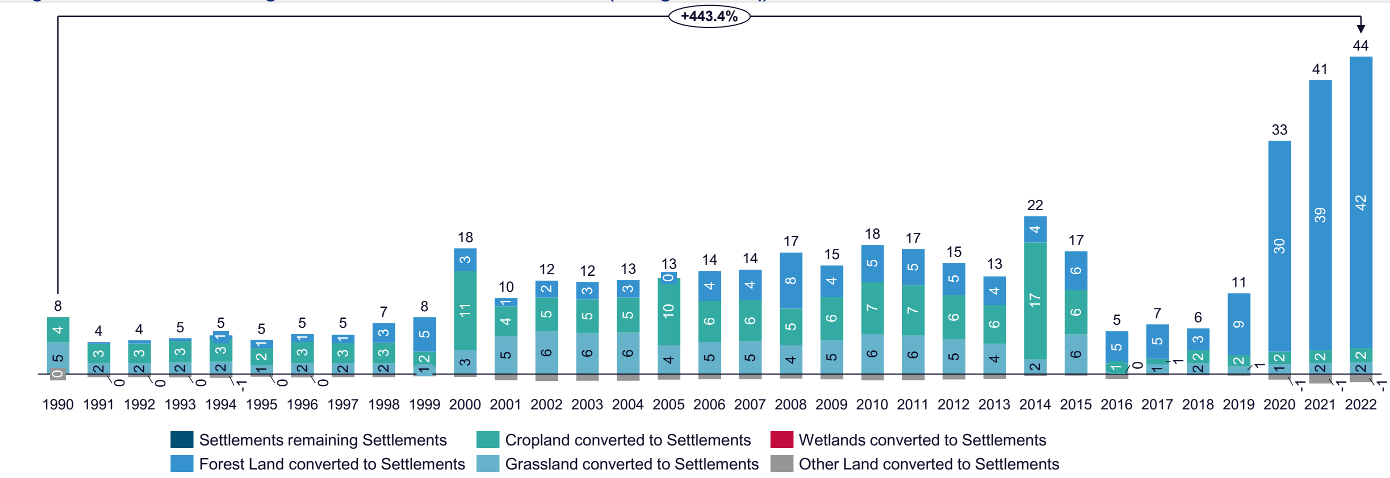
In the next greenhouse gas inventory, the priority will be to provide better spatial data on managed wetlands. The launch of CORINE 2024 and the integration of additional national geospatial sources will allow for a more complete monitoring of their dynamics and consistent reporting of emissions in line with IPCC guidelines.

6.6 Settlements

According to the IPCC guidelines, the category "Settlements" includes all areas covered by infrastructure created by human activities, urban and rural settlements, transport networks, industrial and commercial complexes, as well as sports, recreational and other anthropogenically developed spaces. This category also includes associated green areas, such as parks, tree-lined areas and sports fields, as they are an integral part of the urban structure. For the purposes of the national inventory, settlements are identified through the CLC+Backbone spatial data (2018 and 2021) and is monitored through two subcategories: areas that remain urban and areas that are converted from other types of land to urban. This system, based on the IPCC Approach 2, allows for precise monitoring of transitions and dynamics of urbanization.

From the category "Settlements" there are only emissions from other types of land that transition to "Settlements" that occur during the removal of biomass and due to losses of organic carbon in the soil as a result of the conversion to impervious surfaces. According to the IPCC guidelines from 2006 and 2019 Refinement, these emissions are reported for all conversions to settlements, while the areas that remain in the category "Settlements" are considered carbon neutral. The emission trend is moving in an upward direction and follows the dynamics of urbanization, with the largest share from the conversion of cropland land and grassland. Total emissions reach about 44 Gg CO2-eq in 2022, of which 95% are from the conversion of forests and forest land to settlements. In the remaining period, emissions are relatively small and do not exceed 22 Gg CO2-eq.

Figure 68. Greenhouse gas emissions from settlements (in Gg CO2-eq)



Source: IPCC software, team analysis

The area under settlements increased from around 28 thousand ha in 1990 to over 46 thousand ha in 2022, representing a total increase of approximately 62% (Figure 69). This trend reflects the ongoing urbanization, expansion of settlements and development of infrastructure. On the other hand, the conversion of land to urban areas shows that new urban areas predominantly originate from grassland, and a significant part from cropland (Figure 70). In the period 2000–2015, annual conversions were high (often over 800 ha per year), reaching a peak of 1,287 ha in 2015. After 2015, there was a decrease and the conversions were around 300 ha, but after 2019 the dynamics increased again and moved around 600 ha per year. On average, over the entire period under review, the conversion from other land to settlements amounted to around 700 ha.

Figure 69. Settlements (ha)

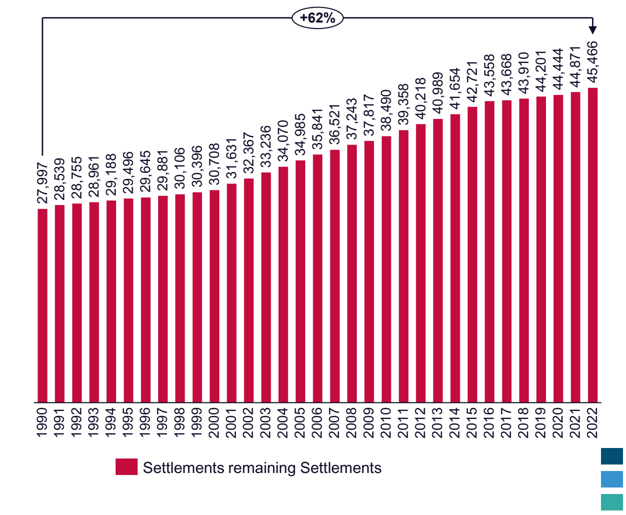
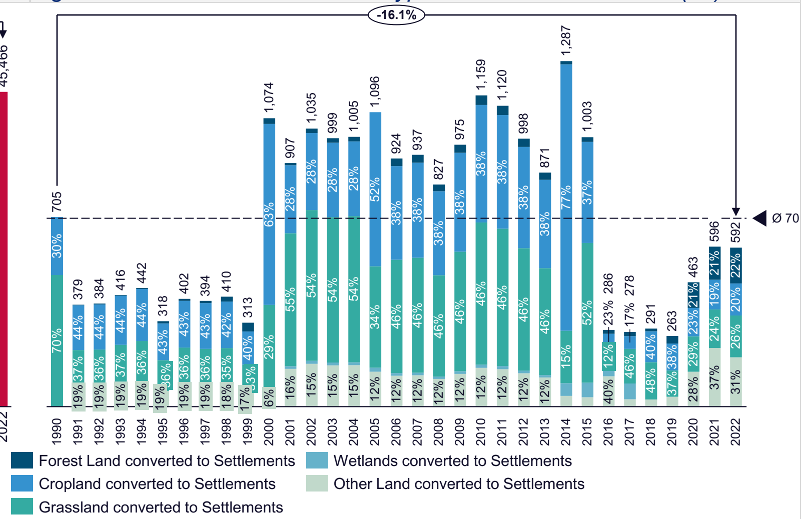


Figure 70. Conversion of another type of land to Settlements (ha)



Source: IPCC software, team analysis

6.7 Other land

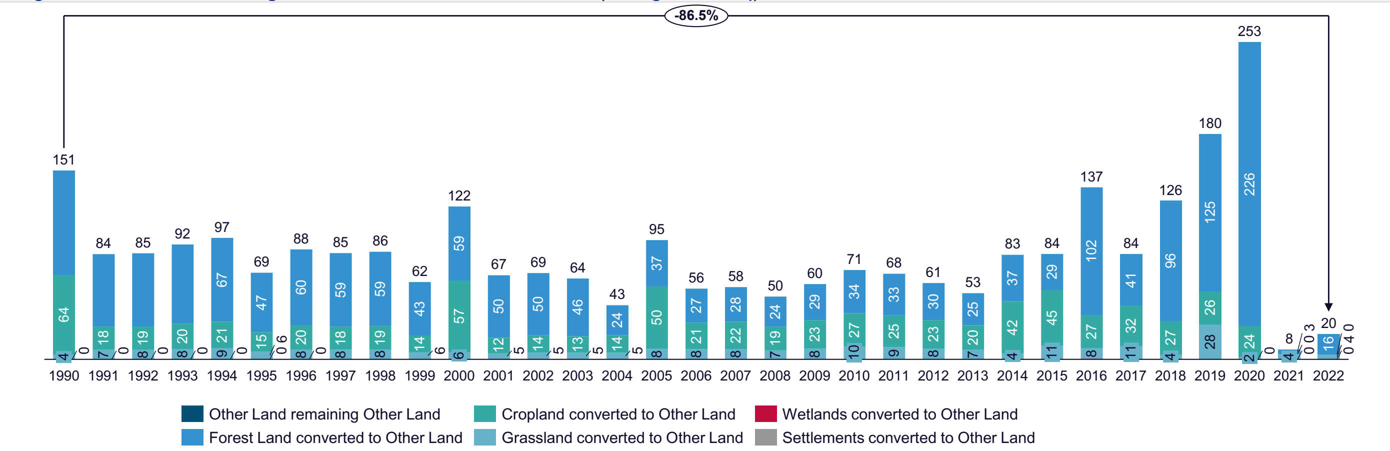
In previous national reports, the category "Other land" was estimated indirectly, as the difference between the total territory of the country and the areas of the other categories (Forest Land, Cropland, Grassland, Settlements and Wetlands). Such an approach was applied in order to ensure the closure of the total land balance, but without a direct spatial basis.

To maintain temporal consistency and comparability with previous reports, the same approach has been maintained in this reporting cycle. This ensures consistency across the series, although it is not the best possible solution in terms of methodology and transparency.

The category "Other land" has traditionally been a residual class in national inventories, defined as the difference between the total territory of the country and the sum of all other land categories (forest, cropland, grassland, settlements and wetland). This approach, also applied in this inventory to maintain temporal consistency, is not based on direct spatial data, but serves to close the land balance. For this reason, variations in the category “Other land” often reflect more the accuracy of data for other categories than actual physical changes on the ground.

The results shown on Figure 71 confirm this character. In the initial years, especially in 1990, emissions are high and amount to around 151 Gg CO_2, followed by a gradual decline of over 86 Gg CO_2, with a series of years with relatively low values. In the period 2000–2015, emissions stabilize at a much lower level, and the dominant source is the transitions from forests and forest land to cropland. In 2016, emissions increase again, reaching a maximum value in 2020, of 253 Gg CO_2, mostly due to revised data in other categories and incomplete spatial definition of “other land”. In 2022, emissions decrease again. In contrast to 2020, in 2022 emissions are around 40 Gg CO_2.

Figure 71. Greenhouse gas emissions from Other land (in Gg CO2-eq)



Source: IPCC software, team analysis

The approach to determining the areas under other land allows for temporal consistency with previous reports, but at the same time creates sensitivity to any changes or revisions in the other categories. This can also be clearly seen in the area trends: “other land” decreases from around 255,000 ha in 1990 to 119,915 ha in 2022 (a decrease of -52 %) (Figure 72), which is mainly due to the gradual conversion into forest areas, grassland ecosystems and urbanized zones. The changes between the categories show marked variability: from 1990 to the early 2000s, significant areas of forest land were converted into "other land" (often over 1000 ha per year. In the period after 2000, the conversion from cropland to other land dominated, while in 2019 50% of the converted area came from grassland (around 1600 ha). On average, around 2000 ha of other land is converted into other land annually, but this is not enough to avoid the downward trend in areas under other land. These variations show the limitations of the indirect method, since the changes are often not a consequence of real dynamics on the ground, but of corrections in the other categories.

In parallel, new, much higher quality geospatial data from CLC+Backbone (2018, 2021) with a resolution of 10 m are available, which allow for direct identification of “Other land”. Although the national inventory in this cycle still retains the indirect approach for consistency, the aim is to move to a fully spatial assessment in the next cycle. The expected publication of CORINE 2024 will allow for verification and reconciliation of the transitions, which will bring much greater accuracy, transparency and compliance with the IPCC Guidelines.

Figure 72. Other land (ha)

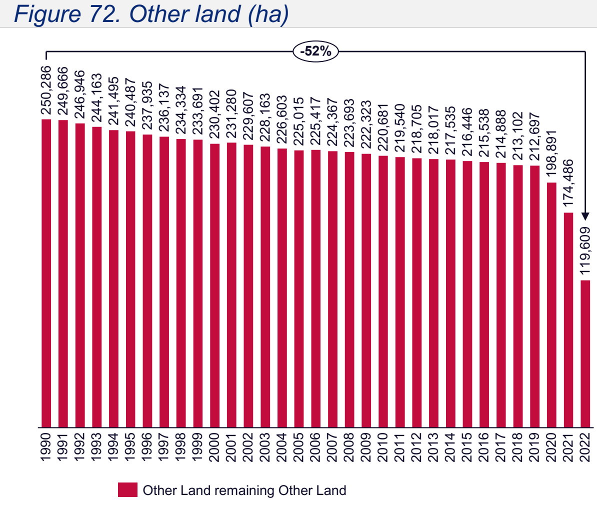
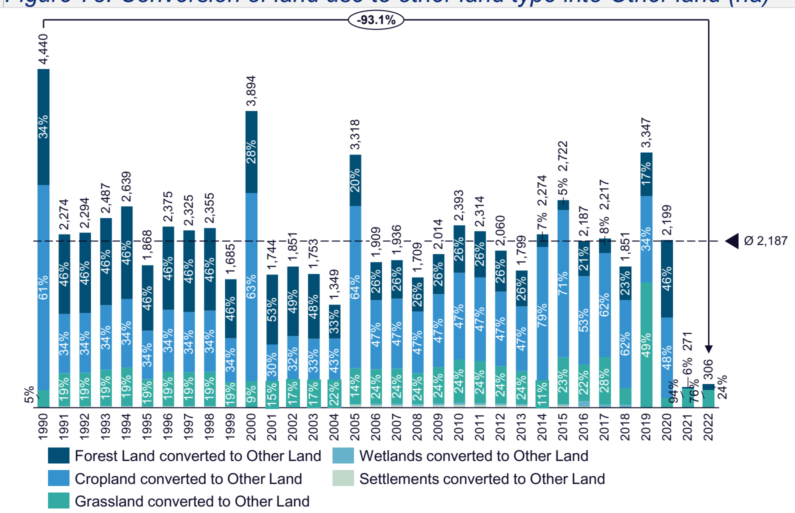


Figure 73. Conversion of land use to other land type into Other land (ha)



Source: IPCC software, team analysis

6.8 Wood products and soil management

Due to certain problems with the IPCC software, emissions from this category were not generated.

6.9 Methodology and emission factors

In the previous national greenhouse gas inventory prepared within the framework of the Fourth National Communication, a significant effort was made to improve the estimates of land use and land use change. For this purpose, a methodology for photointerpretation of satellite images from multiple sources (Landsat and Sentinel) was developed. The analysis covered several reference years, such as 1989, 1990, 2000 and 2005, as well as the period 2014–2019. For the time intervals in which sufficient quality images were missing (1991–1999, 2000–2003 and 2006–2012), statistical interpolation methods were applied, and the obtained values were cross-checked with data from the SSO and CORINE. Higher accuracy was achieved in more recent years thanks to Sentinel images with a resolution of 10 m, which represent a significant improvement over the Landsat images with a resolution of 30 m that were available in previous decades.

In the absence of national emission factors, global emission factors recommended in the IPCC guidelines or a different land use category were used. InTable 13The emission factors used to estimate: biomass carbon stocks in perennial crops and conversions, soil organic carbon stocks, methane emissions from rice fields, and urea application are listed.

Table 12. Emission factors used for greenhouse gas emissions for the Land sector

Emission factors	BTR1	Comments
Cropland that remains in the same use category		
1a. Carbon content in biomass	• 2.1 t/ha annual biomass accumulation in perennial plantations (first 20 years) -∆CG, 63 t/ha biomass loss by clearing (digging) of perennial plantations -∆CL	IPCC Handbook – Chapter 5, Tables 5.1 and 5.3
1.b Dead organic matter		In Method 1, dead organic matter is not calculated.
1.c Soil Organic Carbon	• 0.9 t/ha for FLU (land use) content change factor • 1 t/ha for FMG content change factor (management) 1 t/ha for the factor of change of the FI content (input)	IPCC Handbook – Chapter 5, Table 5.5
Forest land converted to cultivated land	120 t/ha biomass loss through cleaning during conversion	IPCC Handbook – Chapter 4 Tab 4.7 to 4.12
Grassland converted into cultivated land	6.5 t/ha biomass loss through cleaning during conversion	IPCC Handbook – Chapter 6, Table 6.4
Grass area that remains in the same use category		
2.a Carbon content in biomass		In grasslands where there are no changes in intensity or management, biomass will remain in a roughly stable state.
2.b Dead organic matter		Method 1 assumes that dead wood and leaf litter quantities are in balance.
2.c. Soil Organic Carbon	• 1.0 t/ha for FLU (land use) content change factor • 0.95 t/ha for FMG content change factor (management) 1.0 t/ha for the factor of change of the FI content (input)	IPCC Handbook – Chapter 6, Table 6.2
2.1 Forest land converted to grassland	120 t/ha biomass loss through cleaning during conversion	IPCC Handbook – Chapter 4 Tab. 4.7 to 4.12
2.2 Cultivated land converted to grassland	10.0 t/ha biomass loss through cleaning during conversion	IPCC Handbook – Chapter 5, Table 5.1
3. Application of urea	0.2 evaporation/rinse factor	IPCC Handbook – Chapter 11 Table 11.3
Rice fields	1.3 CH4 emission factor in permanently flooded fields	IPCC Handbook – Chapter 11 Table 11.3

Tier 2 has been applied to the category "Settlements", which is based on spatial representation and allows for monitoring of transitions. Tier 1 has been applied to the categories "Other Land" and "Water Land", where data are presented at an aggregated level without spatial distribution and without the possibility of monitoring transitions, in order to ensure temporal consistency and comparability with previous reports.

6.10 Data sources

This chapter presents the sources of input data used to prepare the GHG inventory for the Forestry and Land Use sector. The data are grouped by land category, in accordance with the IPCC Guidelines (2006), and include a combined approach based on official statistics, geospatial databases, satellite imagery and internal expert analyses.

6.10.1 Forestry

The data for the preparation of this report were obtained from several different sources: SSO, MAFWE, PE "Macedonian Forests", Forest Management Entities, UKIM - Faculty of Forestry Sciences, Landscape Architecture and Eco-Engineering "Hans Em", Crisis Management Center, Fire Fighting Association of Macedonia, expert opinions and other domestic and international sources. They are presented inTable 13for different sectors.

Table 13. Data sources for forest land

Forestry	Documents	Data source
Forest area	SSO Yearbooks; Forest management plans	State Statistical Office; ESA-Copernicus product – SENTINEL 2, Entities that manage forests (PE Macedonian Forests, National Parks, Association of Private Forest Owners), MAFWE.
Types of forests	SSO Yearbooks; Forest management plans	State Statistical Office; Entities that manage forests (PE Macedonian Forests, National Parks, Association of Private Forest Owners), MAFWE.
Annual growth	Forest management plans Department of Forest Management	Entities that manage forests (PE Macedonian Forests, National Parks, Association of Private Forest Owners), MAFWE. UKIM Faculty of Forestry Sciences, Landscape Architecture and Eco-Engineering "Hans M."
Change in land use	SSO Yearbooks;	State Statistical Office;
Forest cutting	SSO yearbooks, Department of Forest Operations and Techniques, UKIM Faculty of Forestry Sciences, Landscape Architecture and Eco-Engineering "Hans M." Monthly and annual reports	State Statistical Office Entities that manage forests (PE Macedonian Forests, National Parks, Association of Private Forest Owners), MAFWE
Burned forest area	SSO Yearbooks, Annual Reports, Internal Documents, UKIM Faculty of Forestry Sciences, Landscape Architecture and Eco-Engineering "Hans Em", Department of Forest Protection	Entities that manage forests (PE Macedonian Forests, National Parks, Association of Private Forest Owners), MAFWE, CMC, PPSM, UKIM Faculty of Forest Sciences, Landscape Architecture and Eco-Engineering "Hans Em", Department of Forest Protection

6.10.2 Cropland and grassland

Data on agricultural areas have been collected and analyzed from multiple official sources, in order to provide reliable and representative results. Basic information on cropland, grassland, perennial crops and other agricultural categories has been taken from the annual publications of the SSO for the period 2020–2022 (http://makstat.stat.gov.mk), which are based on standardized methodologies for collecting and processing statistical data. The same data are verified through the digital database MakStat (http://makstat.stat.gov.mk announcements: No.: 5.1.20.03 of 30.03.2020; 5.1.21.03 of 30.03.2021;5.1.22.03 of 30.03.2022 and No.: 5.1.23.03 of 30.03.2023), whose annual update provides a consistent overview of official statistics. Additionally, for the same period, the annual agricultural reports of the Ministry of Agriculture, Forestry and Water Management (MAWF) were also used, which provide a detailed Figure of the state and dynamics of agricultural production (https://www.mzsv.gov.mk/MMMMMMMMMMMMM_M_MMMMMMMMM_MM_MMMM_MMMMMMMMMMMMMMaspx).

To improve data quality and verify the spatial distribution of agricultural categories, digital land use and change (LU/LUC) data from CORINE Land Cover were integrated into the analysis, which were further compared with official national statistical sources. Due to the fact that in North Macedonia there are no national scientifically validated emission factors for different types of land use, the calculations of emissions in this category were performed using the global IPCC emission factors, recommended for different types of agricultural areas and activities. The data sources are summarized inTable 14.

Table 14. Data sources for inventory of greenhouse gas emissions in Agricultural land (cropland and grassland)

	Documents	Data source
- Arable agricultural land **- Grassland**	Maxstat database Reports	- State Statistical Office (SSO) - Ministry of Agriculture, Forestry and Water Management. - CORINE CLC Level-3 2018 - CLC+Backbone (Copernicus Land Monitoring Service) 2018/2021 Geodetic and Cadastral Information System (GCIS)

6.10.3 Water/Wetland, Settlements and Other Land

Data for the categories "Settlement" and "Other land" were obtained from CLC+Backbone (Copernicus Land Monitoring Service), which provides a spatial resolution of 10 m for 2018 and 2021. For the category "Water/Wetland" CORINE CLC Level-3 2018 was used as a starting point for 2018, as CLC+Backbone does not provide a separate class for this category. Python was used to process these data, using rasterio for reading and analyzing raster data and NumPy for numerical calculations (aggregations by class and area calculation).

In addition to these data, data from the MAKSTAT database of the State Statistical Office (SSO) were also used, as well as data from the database of the Geodetic Cadastral Information System (GCIS), which is a unique and integrated information system in the Republic of North Macedonia, which enables the collection, processing, maintenance, management, use, distribution, issuance and unique access to all spatial and descriptive data under the jurisdiction of the Real Estate Cadastre Agency. The data sources are summarized inTable 15.

Table 15. Data sources for inventory of greenhouse gas emissions in other lands

	Documents	Data source
Settlements	MakStat database Internal report (on request)	- CLC+Backbone (Copernicus Land Monitoring Service) 2018/2021 - Satellite sources such as Sentinel-2, Copernicus High Resolution Layers (HRL) - State Statistical Office Geodetic and Cadastral Information System (GCIS)
Other land	MakStat database Internal report (on request)	- CLC+Backbone (Copernicus Land Monitoring Service) 2018/2021 - Satellite sources such as Sentinel-2, Copernicus High Resolution Layers (HRL) - State Statistical Office Geodetic and Cadastral Information System (GCIS)
Wetlands	MakStat database Internal report (on request)	- CORINE CLC Level-3 2018 - State Statistical Office Geodetic and Cadastral Information System (GCIS)

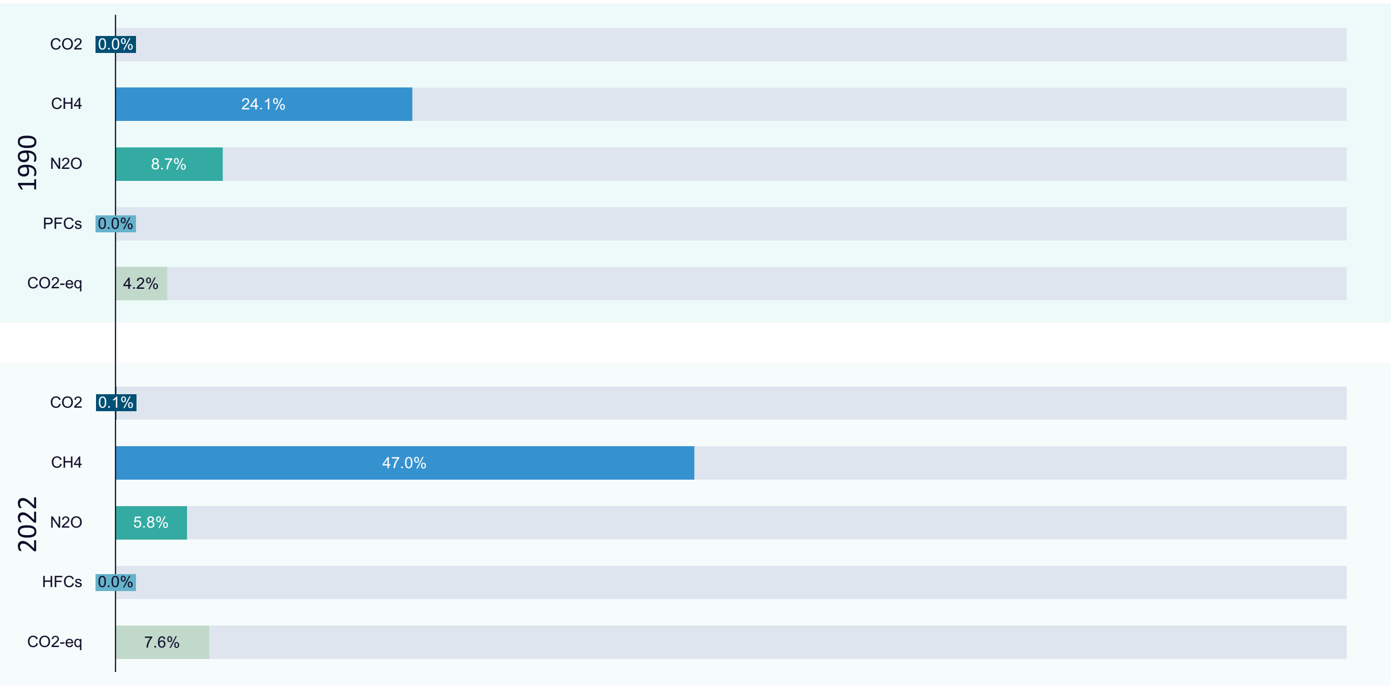
7 Waste

7.1 Summary overview

The Waste sector covers the assessment of greenhouse gas emissions arising from the treatment and disposal of various types of waste, as well as from wastewater treatment and discharge processes. The categories covered within this sector are solid waste disposal, biological treatment of solid waste, incineration and open burning of waste, and wastewater treatment and discharge, in accordance with the IPCC methodology.

Figure 74 shows the share of the Waste sector in total greenhouse gas emissions in 1990 and 2022. It is noticeable that methane (CH_4) dominates the emissions structure, with a drastic increase in its share – from 24.1% in 1990 to 47.0% in 2022. These emissions mainly originate from the landfilling of solid waste, as well as from the treatment and discharge of wastewater, with the anaerobic decomposition of organic materials being the main process leading to the creation of methane. Most notably, the total share of the Waste sector in national emissions (CO_2-equivalents) has recorded a drastic increase, from 4.2% in 1990 to 7.6% in 2022. This indicates that, unless urgent and systematic measures are taken to improve waste management, an even more intense growth in emissions is expected in the coming years.

Figure 74. Share of the Waste sector in total greenhouse gas emissions in 1990 and 2022 (%)



Source: IPCC software, team analysis

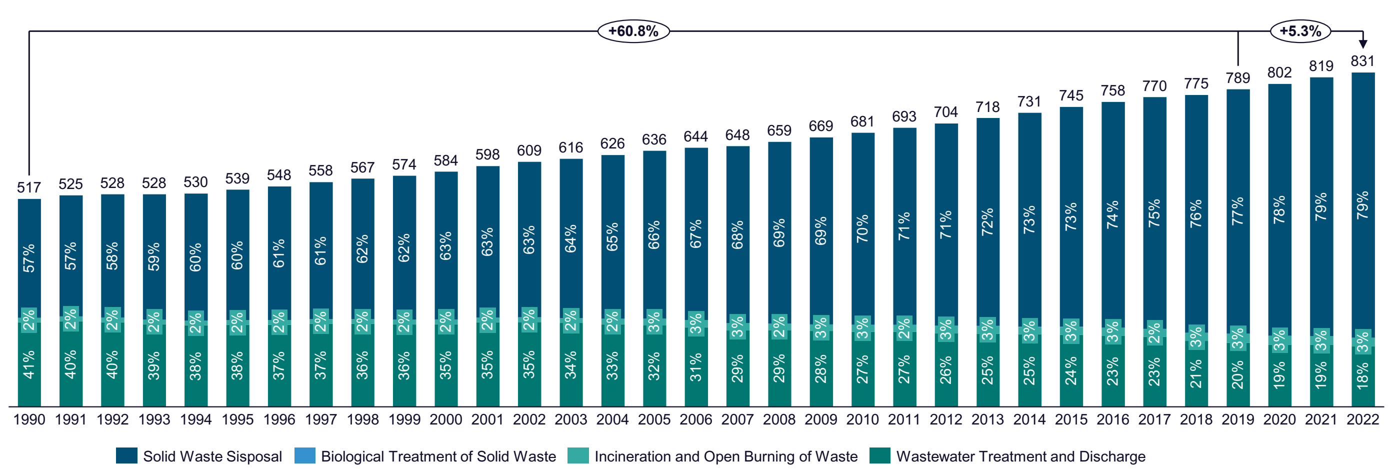
These alarming results also stem from the fact that there is only one landfill with an operating permit from the MoEPP (JP Drisla), and waste continues to be disposed of in substandard landfills that are not in accordance with the Landfill Directive and the national waste law. In order to address this challenge, according to the National Waste Management Plan 2020–2030, the priority is to establish an integrated system of regional centers for collection, selection, recycling and energy recovery of waste, in order to reduce the amount of waste ending up in landfills and gradually close illegal and substandard landfills.

Given the regional nature of addressing the waste problem, in this inventory, for the first time, the Waste sector is analysed by regions. Emission modeling is performed at the regional level, including all input data. In this way, a more accurate comparison between regions in the country is enabled, both in terms of historical and current emissions, as well as for future scenarios for reducing emissions upon the opening and operation of each regional waste management center.

Although waste management generates a relatively low level of emissions compared to the energy and industrial sectors, it can be noted that it is one of the sectors with the largest increase in the share of total national emissions.

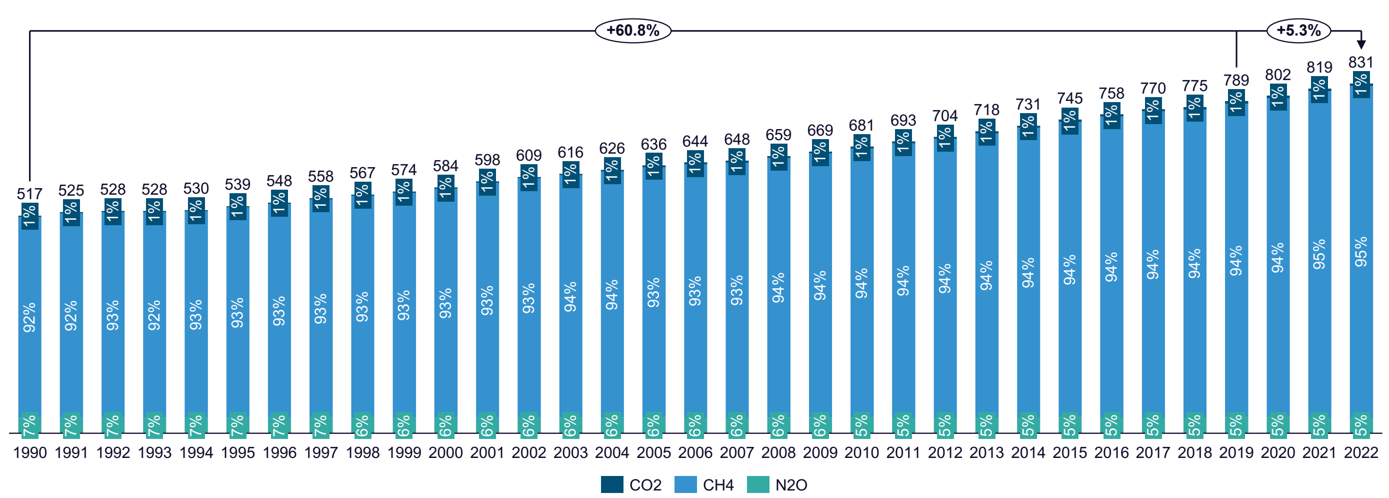
The data show an increase in total emissions from the Waste sector of around 60.8% in the period 1990–2022 and 5.3% in the period 2019-2022. Figure 75 confirms that solid waste landfilling is the dominant source of emissions and its share is continuously growing, reaching almost 80% of total emissions from the Waste sector in 2022. The wastewater sub-sector shows a decreasing trend, indicating improvements in wastewater collection and treatment systems. Biological treatment of solid waste and waste incineration have a relatively small share and insignificant changes during the analyzed period. Figure 76 further confirms the dominance of methane in the emissions structure, with a share of about 92–95% in total emissions, while CO_2 and N_2O have a minimal share.

Figure 75. Greenhouse gas emissions by subsectors of the Waste sector, by category (in Gg CO2-eq)



Source: IPCC software, team analysis

Figure 76. Greenhouse gas emissions by gases from the Waste sector, by gases (in Gg CO2-eq)

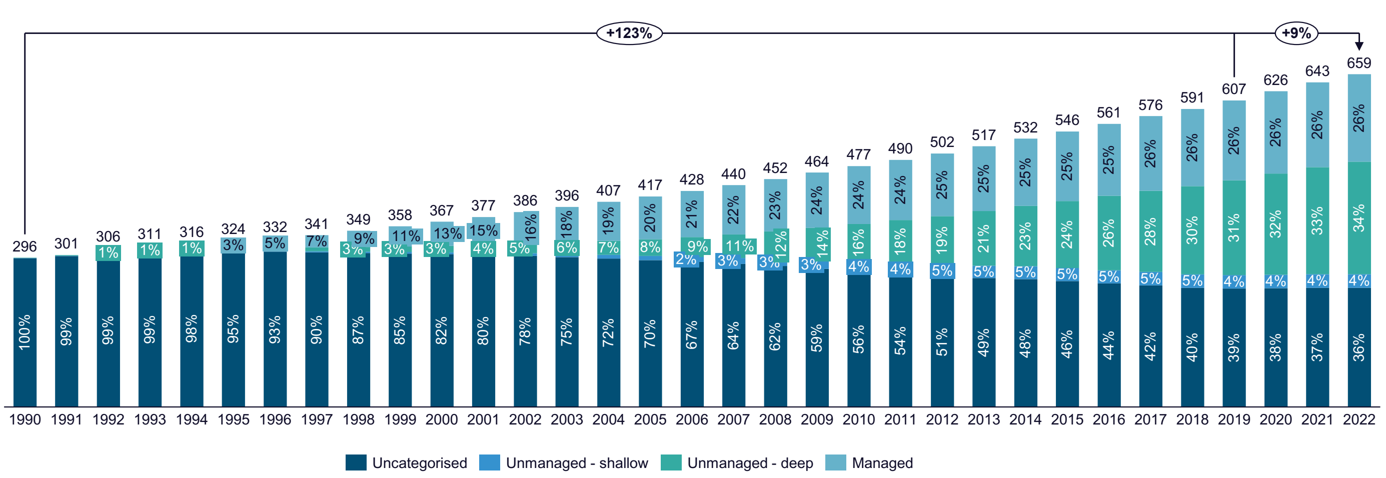


Source: IPCC software, team analysis

7.2 Solid waste disposal

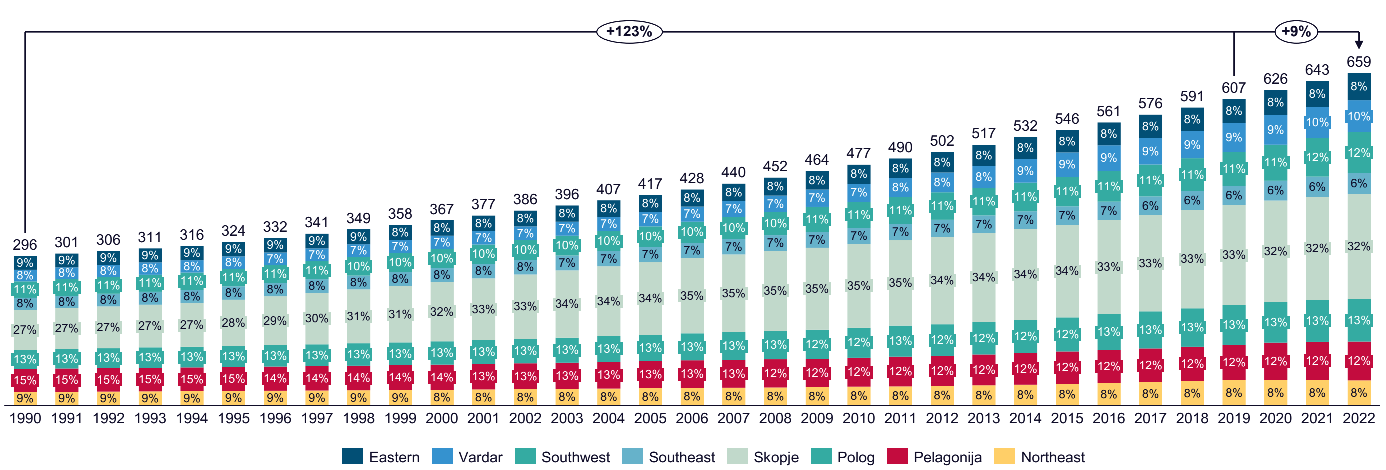
From Solid Waste Disposal, it can be noted that in the period from 1990 to 2022 there is a constant growth of over 120% compared to the initial year (Figure 77). The increase in emissions is a result of the continuous accumulation of waste and limited landfill management capacities, especially in conditions where the majority of waste is disposed of in uncategorized, unmanaged shallow and deep landfills, which together account for more than two-thirds of total emissions. Although a small increase in the share of managed landfills has been observed in recent years, their share still remains around 26%. Figure 78 shows that the largest contributors to total emissions are the Skopje, Polog, Pelagonia and Southwest regions, which together account for around 70% of national landfill emissions in 2022. However, an increasing trend is observed in all regions.

Figure 77. Greenhouse gas emissions from solid waste landfilling, by landfill type (in Gg CO2-eq)



Source: IPCC software, team analysis

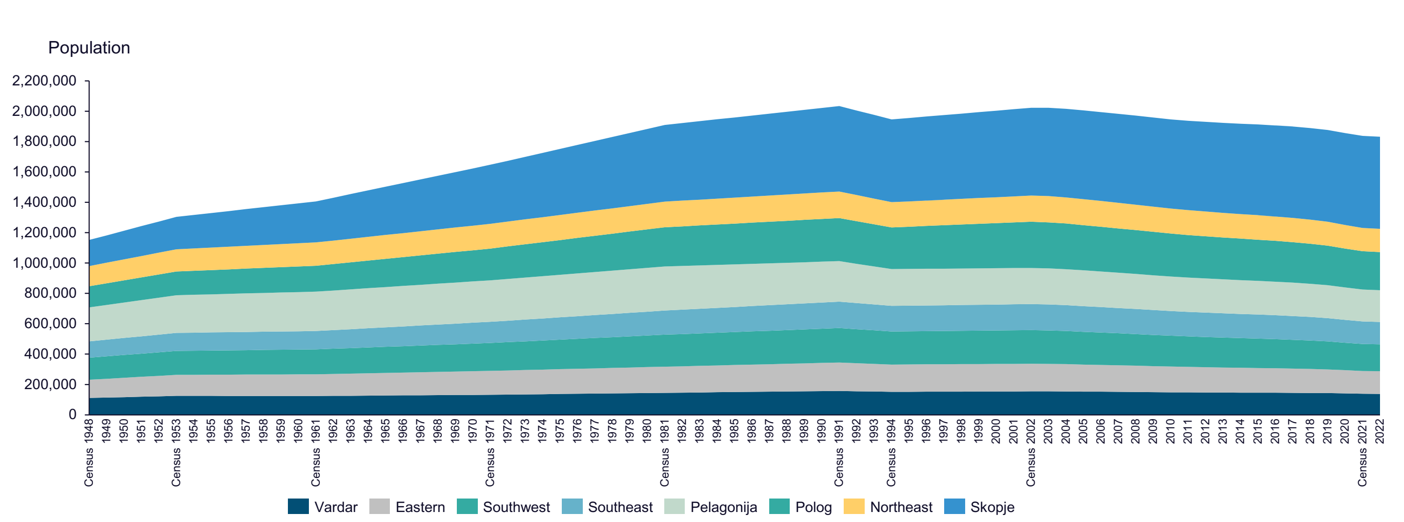
Figure 78. Greenhouse gas emissions from solid waste landfilling, by region (in Gg CO2-eq)



Source: IPCC software, team analysis

In terms of input data, the population is one of the key ones in this sector and it is entered for the period from 1950 to 2022 by regions. The data are taken from the censuses held in the country in the years 1948, 1953, 1961, 1971, 1981, 1991, 1994, 2002, 2021. Interpolation has been made for the periods between the censuses. For the period from 2003 to 2023, updated data have been taken after the census in 2021.

Figure 79. Population, by region



Source: State Statistical Office, Population Census and Revised data for the period 2003-2020, according to the 2021 Census

The amount of waste per capita and the composition of waste are also key parameters in this sector. For this purpose, data for the entire period from 1950-2022 by region have been entered, according to the values given in Table 16 and Table 17, respectively.

Table 16. Data on the amount of waste per capita

Period	Value	Data source
1950-1990	260 kg/capita	Estimated value (selected as a minimum value by all European countries in 1990)
1990-2003	Interpolation	/
2004	313 kg/capita	According to the National Waste Management Plan 2006-2012 (https://www.moepp.gov.mk/wp-content/uploads/2014/12/Nacionalen-Plan-za-upravuvanje-so-otpad.pdf)
2005-2007	Interpolation	/
2008-2022	Data from the Statistical Office, by regions	According to data on Municipal Waste Generated by Regions and updated data on the number of inhabitants according to the 2021 census

Table 17. Waste composition

Period	Data source
1950-1995	Data from IPCC Guidelines
1996-2015	Interpolation
2016-2022	Data on regions in Macedonia according to Regional Plans

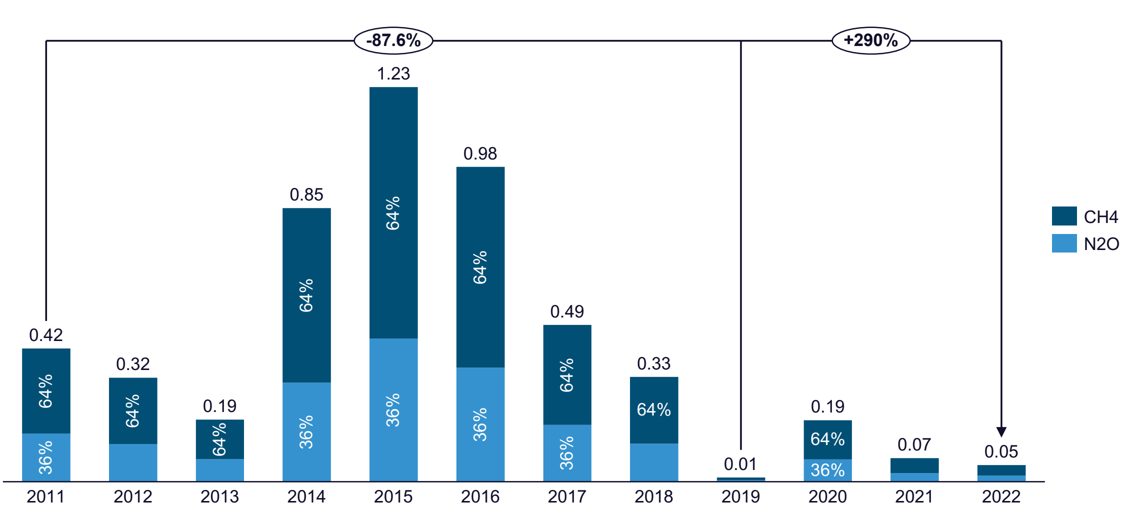
In terms of landfill type, in 1950 it is assumed that all landfills belong to the “Uncategorized” category, since there were no established landfills at that time. With the opening of the first organized landfill in a given region, part of the waste moves to the “Unmanaged Shallow” landfill type. As the amount of landfilled waste gradually increases, this type of landfill moves to the “Unmanaged Deep” landfill category. This classification process is carried out separately for each region and for each individual landfill, based on the available data on their development and capacity. The only landfill that falls into the “Managed” category is the Drisla landfill.

7.3 Biological treatment of solid waste

Biological waste treatment is a process in which the organic component of solid waste is decomposed by microorganisms, resulting in products such as compost. This type of treatment aims to reduce the amount of waste that ends up in landfills and at the same time allow for the reuse of organic matter. The category "Biological solid waste treatment" includes emissions from composting waste.

Emissions from this subsector in Macedonia are relatively low and in the analyzed period from 2011 to 2022, emissions are below 1.3 Gg CO_2-eq (Figure 80) (no emissions from composting were registered before 2011). The composition of total emissions is dominated by methane (CH_4), which accounts for about 64%, while the remaining 36% refers to nitric oxide (N_2O). Although the absolute values are small, the data indicate that the practice of composting has become widespread enough to be included in the national inventory, which is a positive step towards systematic management of organic waste and reduction of landfilling.

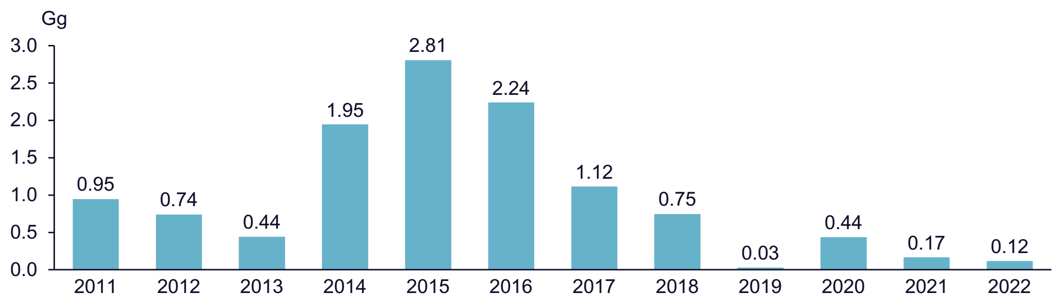
Figure 80. Greenhouse gas emissions from Biological treatment of solid waste, by gases (in Gg CO2-eq)



Source: IPCC software, team analysis

The input data in this subsector is the amount of waste that is composted (Figure 81). These data are taken from the Annual Environmental Quality Reports of the Ministry of Environment and Physical Planning (Annual Environmental Quality Report - Annual Report - Information - Ministry of Environment and Physical Planning - Republic of North Macedonia). The corresponding default values for CH_4 and N_2O are used for emission factors.

Figure 81. Amount of waste that is composted (in Gg)



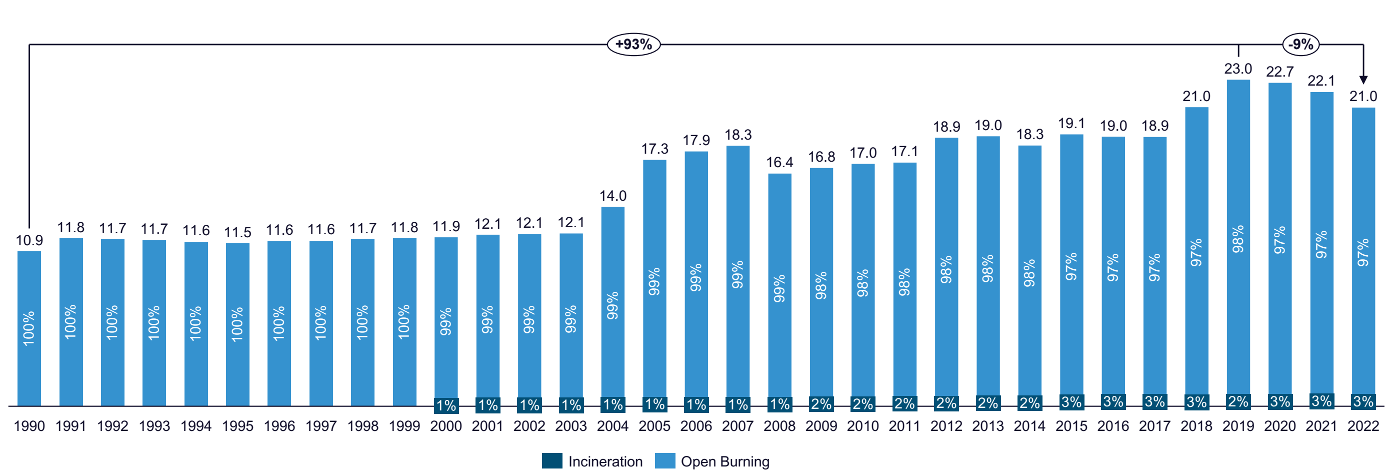
Source: IPCC software, team analysis

7.4 Incineration and open burning

Incineration and open burning are methods of treating solid waste in which waste is burned with or without process and emission control. Incineration takes place under controlled conditions, in special facilities. Medical waste is most often burned, in order to destroy potentially infectious and hazardous materials. In contrast, open burning takes place in landfills or in open spaces, without a system for controlling temperature and emissions. It involves the burning of discarded combustible materials, such as paper, wood, plastic, textiles, rubber, waste oils and other residues, in nature (outdoors) or in unregulated landfills where smoke and other emissions are released directly into the air, without first passing through a stack.

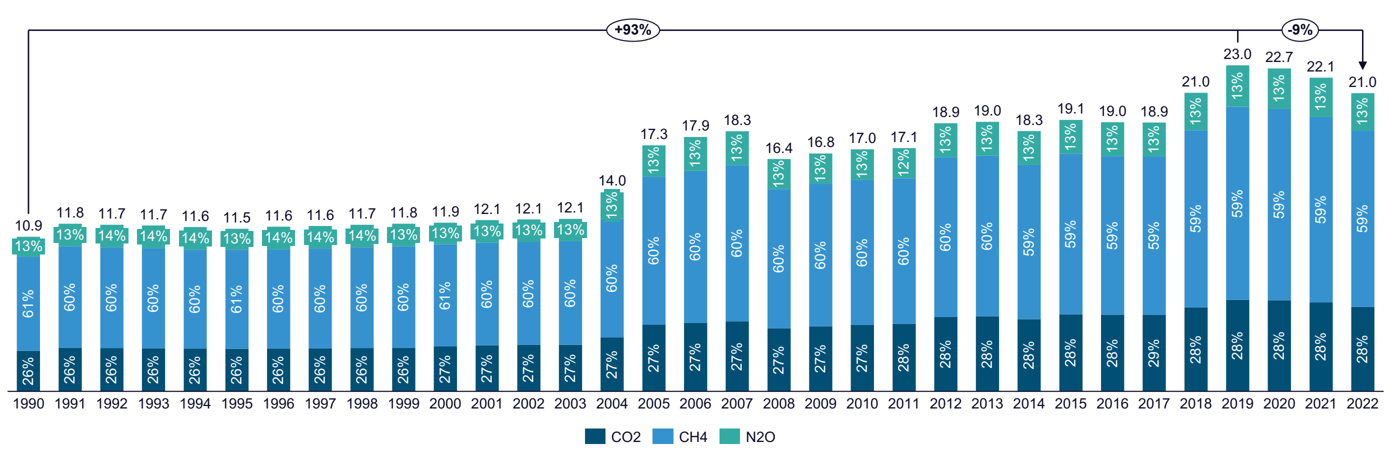
Greenhouse gas emissions from incineration and open burning of waste in the period 1990–2022 in Macedonia show a clear increasing trend, with an almost doubling of total emissions (by about 93%) by 2022, but with a slight decrease in the last 4 years of 9% (Figure 82). Open burning dominates the emissions structure with about 97–100%, while the share of controlled burning is minimal and reaches a maximum of 0.7 Gg CO2-eq in the entire period. Given that open burning of waste occurs in uncontrolled conditions, methane has a significant share in emissions, accounting for about 60% (Figure 83).

Figure 82. Greenhouse gas emissions from Combustion and open burning, by category (in Gg CO2-eq)



Source: IPCC software, team analysis

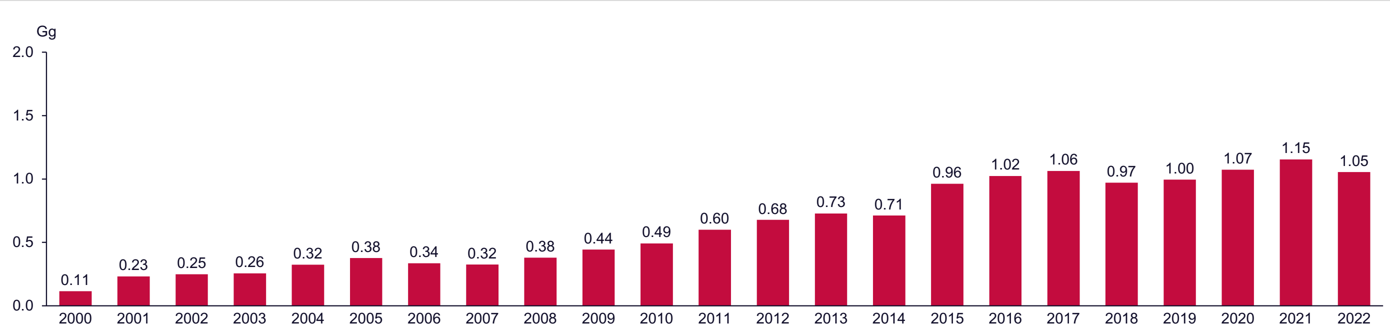
Figure 83. Greenhouse gas emissions from Combustion and open burning, by gas (in Gg CO2-eq)



Source: IPCC software, team analysis

Regarding the input data for incineration, in Macedonia the landfill "Drisla" is the only landfill that has a medical waste incineration plant. Accordingly, the data on the quantities of medical waste that is incinerated are provided by the PE Drisla (Figure 84). The remaining input parameters are taken in accordance with IPCC standards and recommendations.

Figure 84. Amount of medical waste incinerated (in Gg)



Source: PE Drisla Skopje -[Hazardous waste treatment - drisla.mk]

For the input data on open burning, as recommended in the 2006 IPCC Guidelines, it is assumed that the fraction of waste that is burned is equal to the fraction of waste that is not landfilled (including uncategorized landfills). This approach was used to calculate these values for the entire period covered by this report. It is assumed that over the entire period 90% of waste is landfilled, while the remaining waste is incinerated.

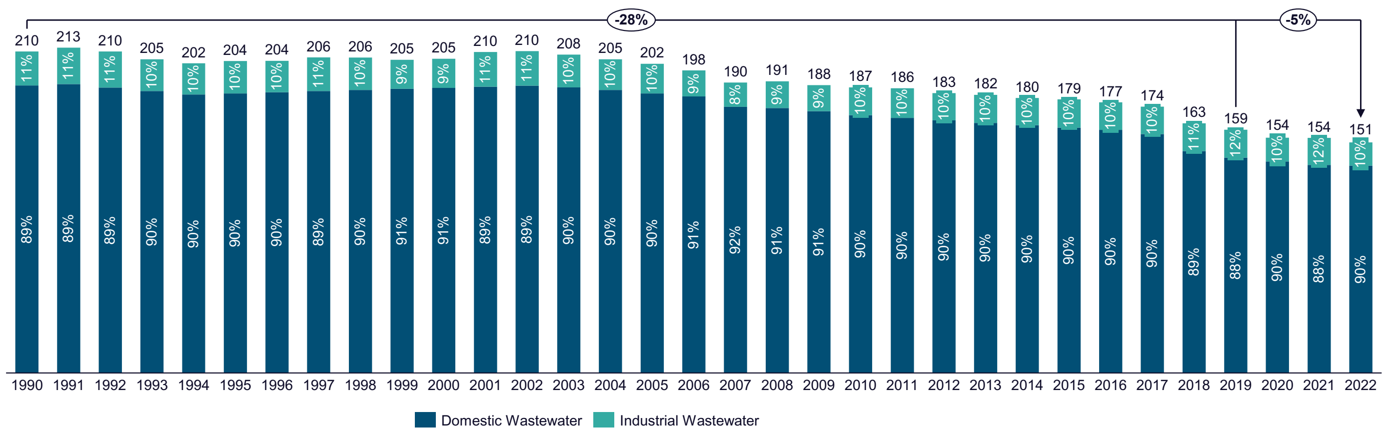
7.5 Wastewater treatment and discharge

When treated and discharged anaerobically, wastewater can be a source of methane (CH4) and can also be a source of N_2O emissions. Carbon dioxide (CO_2) emissions are not taken into account according to the methodology provided in the IPCC Guidelines due to their biogenic origin and are not included in the total emissions at the national level.

Wastewater comes from various sources from households, the commercial and industrial sectors and can be treated at the point of origin (uncollected), transported to a centralized filtration station or discharged untreated.

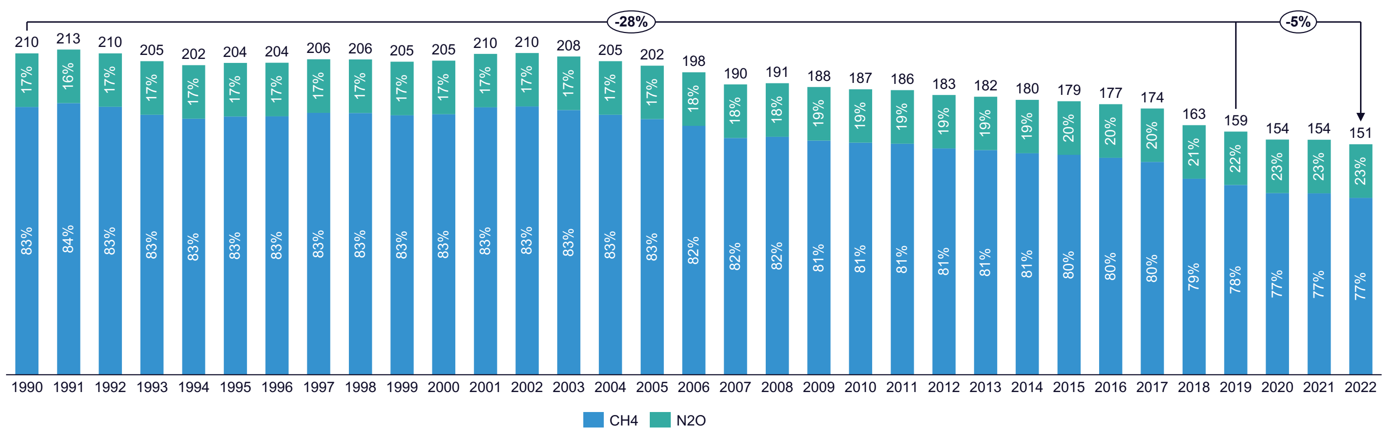
Emissions from wastewater treatment and discharge from households account for about 90% of total emissions from the wastewater treatment and discharge category (85). Considering that the opening of the treatment plants is taken into account, a trend of reducing emissions from this category by 28% in the period from 1990 to 2022, or 5% in the last 4 years, can be observed. About 80% of emissions from Wastewater Treatment and Discharge are methane emissions (Figure 86). The methane is a unique gas that is emitted as a result of industrial wastewater treatment and discharge.

Figure 85. Greenhouse gas emissions from Wastewater treatment and discharge, by category (in Gg CO2-eq)



Source: IPCC software, team analysis

Figure 86. Greenhouse gas emissions from Wastewater treatment and discharge, by gas (in Gg CO2-eq)



Source: IPCC software, team analysis

In this sector, standard parameters and emission factors are used. Greenhouse gas emissions in this category depend on the population, but also on the type of household connection: connected to sewerage, septic tanks, without installation and free flow. (Data on the number of households connected to sewerage are used from the 2002 and 2021 censuses and interpolation is made.) The opening of the treatment plants is also taken into account according to the time when they are open.

For the calculation of emissions from Industrial Wastewater Treatment and Discharge, the data are classified into the following industrial sectors: Alcohol Production, Beer and Malt Production, Coffee Production, Dairy Production, Meat and Poultry Production, Organic Chemical Production, Petroleum Refineries, Plastics and Resins Industry, Paper and Printing Industry (Combined), Soap and Detergent Production, Starch Production, Sugar Refining, Vegetable Oils, Vegetables, Fruits and Juices, Wine and Vinegar. A correlation was made with the SSO data using NACE codes. Standard values for the generated wastewater and the chemical oxygen demand parameter were adopted, in accordance with the methodology in the 2006 IPCC Guidelines. It is important to note that, unlike the previous inventory, it was found that there is no wastewater from paper production according to the national classification, and therefore the emissions from this sector are lower than previously calculated.

7.6 Methodology and emission factors

For all categories in the waste sector, standard emission factors from Tier 1, i.e. Method 1, are used, except for the category Biological waste treatment - composting, for which emission factors according to Method 2 (Tier 2) are applied. In addition, the use of regionally disaggregated waste data, including region-specific information on waste composition, can be considered as the application of Method 2 (Tier 2), although the level of detail approaches that of Method 3.

Table 18. Emission factors used to calculate emissions of precursors and indirect gases from the Waste sector

Emission factor	BTR1	Comment
Incineration of medical waste	Table 3-1 from the 2019 EMEP/EEA Air Pollutant Emission Inventory Manual, Chapter 5.C.1.b.iii Incineration of medical waste	
Open burning of waste	Table 3-1 from the 2019 EMEP/EEA Air Pollutant Emission Inventory Manual, Chapter 5.C.2 Open burning of waste	
Wastewater treatment	Table 3-1 from the 2019 EMEP/EEA Air Pollutant Emission Inventory Manual, Chapter 5.D.Wastewater treatment	

7.7 Data sources

Although the input data are shown in several places in the waste chapter itself in order to make it clearer for which part they are used, a table of data sources is also provided here. The main data source is the State Statistical Office, as well as relevant reports from institutions, such as the MoEPP (Table 19).

Table 19. Data sources for calculating emissions of precursors and indirect gases from the Waste sector

	Documents	Data source
Incineration of medical waste	Data on quantities of incinerated medical waste from the Drisla landfill	Drisla landfill website, environmental reports from the MoEPP
Open burning of waste	Report on non-standard waste disposal in the Republic of Macedonia, 2011 Municipal waste	MoEPP, State Statistical Office
Wastewater treatment	Public water supply and sewerage, Water use and protection from pollution in industry, Industrial production	State Statistical Office

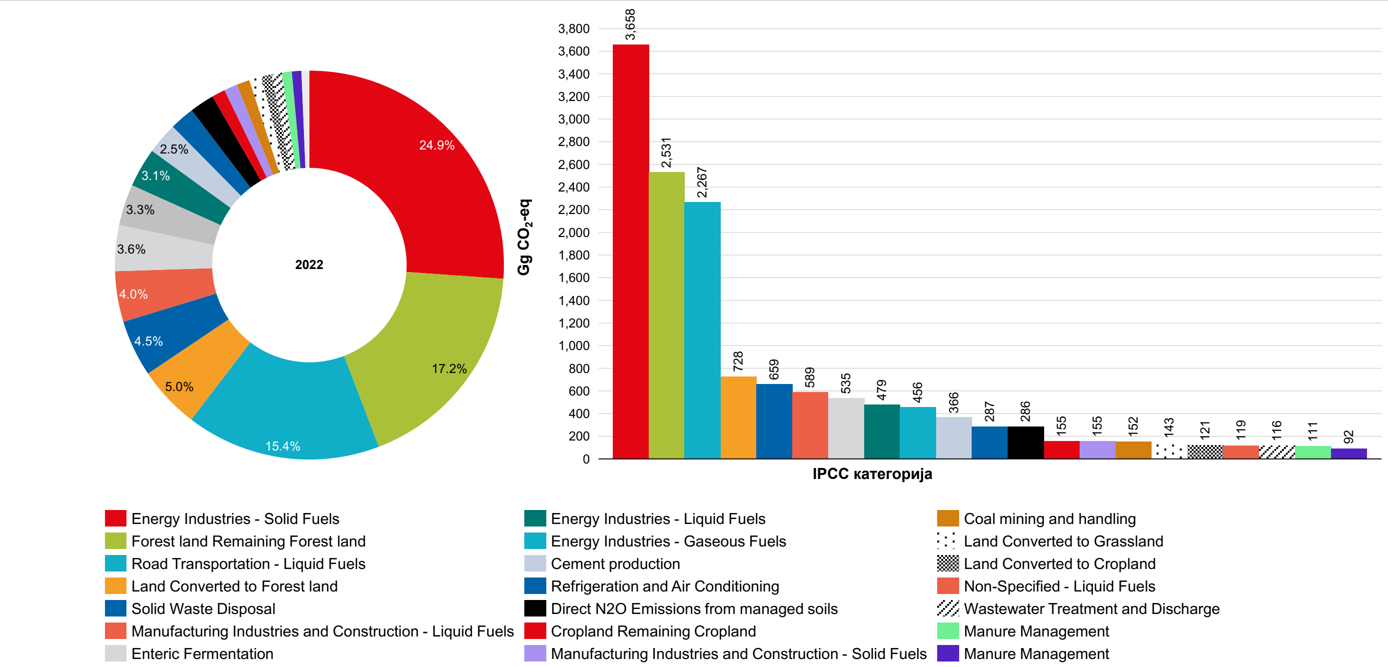
8 Analysis of key categories

Key Category Analysis is a fundamental step in the preparation of a national greenhouse gas inventory and serves to identify those categories that have the greatest impact on total emissions and sinks. The purpose of this analysis is to determine where it is most important to focus efforts to improve data quality, methodologies and policies to reduce emissions.

According to the IPCC methodology (2006 Guidelines), the analysis can be carried out in two ways – according to the level of emissions (level assessment), which shows which categories have the largest share in total emissions in a given year, and according to the trend of emissions (trend assessment), which shows which categories have the most influence on the change in emissions over time. In this procedure, all categories are sorted according to their contribution to total emissions, from the largest to the smallest, and then the so-called cumulative emissions threshold is determined. According to the standard approach (Approach 1), all categories that together account for up to 95% of total emissions or the change in emissions are considered key categories.

The results of the analysis of key categories according to Level Assessment clearly show that the energy sector is the dominant source of greenhouse gases in Macedonia. The category "Energy industries - solid fuels" has the largest share with 24.9% (Figure 87), which confirms the key role of coal-fired electricity generation in total national emissions. This result clearly indicates that any strategy for reducing emissions must start precisely with the energy sector. It is immediately followed by “Forest land remaining forest land” (17.2%) and “Road transport – liquid fuels” (15.4%), which together with energy account for more than half of total net emissions. The Forestry sector in this case acts as a sink, indicating that forests should be preserved, while transport shows a constant growth in emissions due to the increase in the number of vehicles and the consumption of petroleum derivatives. In the middle of the ranking are “Land converted to forest land” (5.0%), “Solid waste disposal” (4.5%) and “Manufacturing industries and construction – liquid fuels” (4.0%), which also indicates a significant contribution that should be given priority. Agricultural activities, especially enteric fermentation (3.6%) and direct N_2O emissions from managed soils (2.0%), have a smaller share, but are still relevant within the agricultural sector. The estimated levels of key categories in 1990 and 2022 are given in Annex I.

Figure 87. Assessment of the level of contribution of key categories and their share in emissions in 2022



Source: IPCC software, team analysis

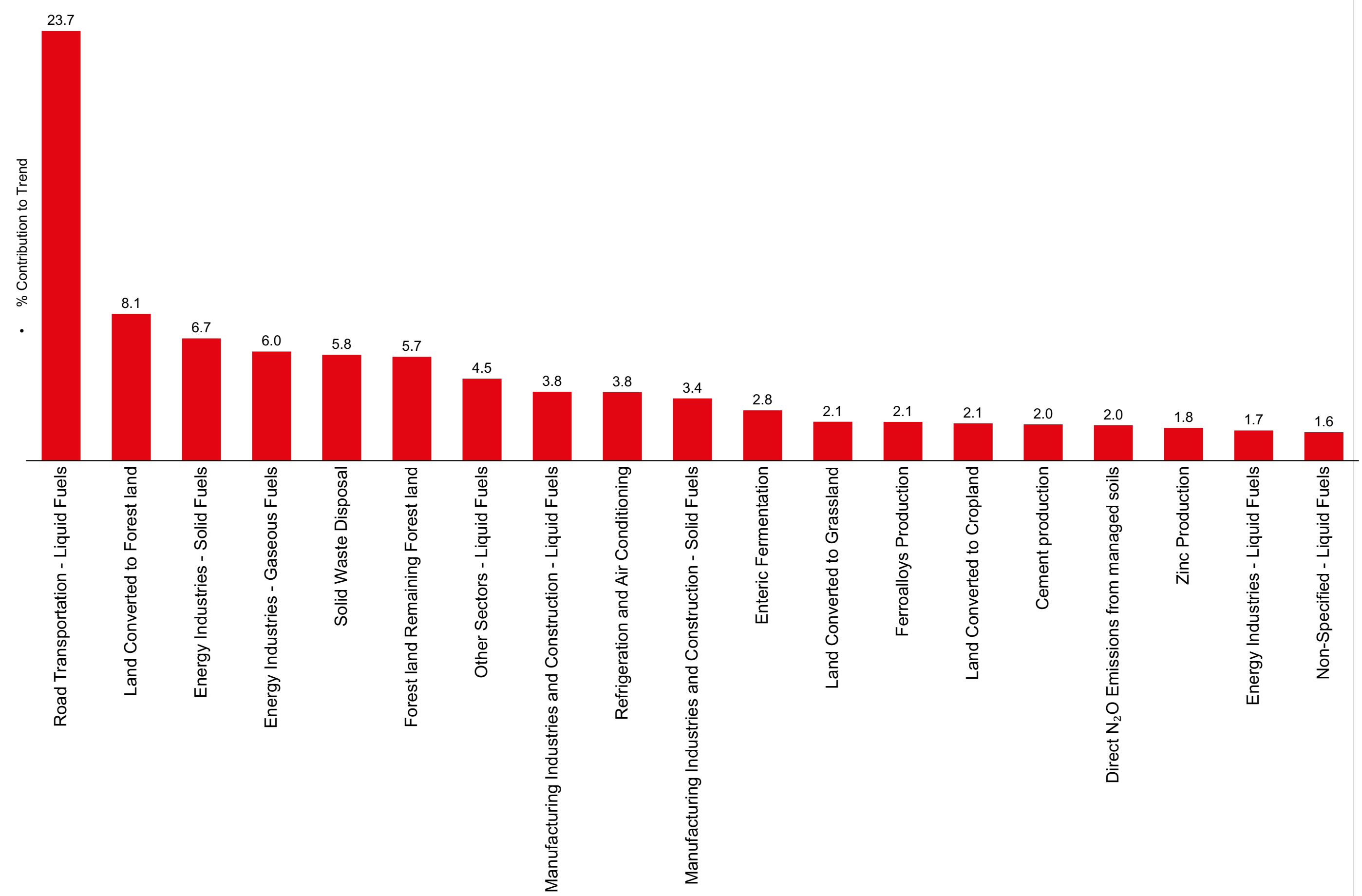
In addition to the assessment of the level of emissions, an assessment of the trend of key categories was carried out, in order to determine how the main sources and sinks of greenhouse gases have changed over time. For this analysis, 1990 is taken as the base year, and 2022 as the last year of the reporting period. The aim of this approach is to identify categories whose trend of change is significantly different from the trend of the overall national inventory, regardless of whether these categories are increasing or decreasing emissions, and regardless of whether they represent a source or sink of greenhouse gases. In this way, a deeper understanding of the dynamics of emissions in the national system is obtained, i.e. which categories contribute most to the increase or decrease in total emissions over the years.

The highest contribution to the changes is made by road transport – liquid fuels, with as much as 23.7% (Figure 88), which confirms it as the sector with the most pronounced dynamics and continuous growth of emissions. This result is expected because with the increase in the number of vehicles, urbanization and mobility intensity, transport increasingly affects the trend of total emissions in the country. The categories "Land converted to forest land" (8.1%) and "Energy industries - solid fuels" (6.7%) follow, which also have a significant contribution to the variations in emissions. The first category is related to changes in land management and forest sinks, while the second reflects the fluctuation in electricity production from coal. Furthermore, the participation of the categories "Energy industries - gaseous fuels" (6.0%) and "Solid waste disposal" (5.8%) indicate an increased impact of natural gas and the waste sector in recent years.

The comparison between the inventory up to 2019 and the this inventory up to 2022 shows a clear change in the structure of the key drivers of emissions: while in 2019 the dominant contribution to the trend was made by the energy industries (especially the production of electricity from solid fuels), and transport was in third position, in 2022 transport comes out on top. This change is due to the decrease in coal production and the partial substitution with natural gas, which reduces the relative contribution of the electricity industry, while emissions from road traffic continuously grow as a result of an increase in the number of vehicles and the transport of passengers and goods. Hence, by 2022 transport becomes the main structural factor determining the trend of emissions in the Energy sector.

The analysis in terms of both approaches is another confirmation that the energy sector remains the most significant source of greenhouse gases in Macedonia, with a dominant share of coal-fired electricity production, followed by transport and forestry, which have a major impact on the national emissions balance and sinks.

Figure 88. Contribution of key categories to emissions trend (1990, 2022) in percent



Source: IPCC software, team analysis

The identified key categories, with both a level assessment and a trend assessment, for 2022 are shown inTable 20For one of the three categories identified as key in the inventory by trend assessment alone (Zinc Production - CO2), such processes no longer exist in the country, i.e. there has been no zinc production since 2003.

Table 20. Overview of key categories for 2022

	IPCC Category	Greenhouse gas	Assessment criterion
1	Energy industries – solid fuels	CO2	L1, T1
2	Forest land that remains forest land	CO2	L1, T1
3	Road transport – liquid fuels	CO2	L1, T1
4	Land converted to forest land	CO2	L1, T1
5	Solid waste disposal	CH4	L1, T1

6	Manufacturing industries and construction – liquid fuels	CO2	L1, T1
7	Enteric fermentation	CH4	L1, T1
8	Energy industries – liquid fuels	CO2	L1, T1
9	Energy industries – gaseous fuels	CO2	L1, T1
10	Cement production	CO2	L1, T1
11	Cooling and air conditioning	HFCs, PFCs	L1, T1
12	Direct N_2O emissions from managed soils	N2O	L1, T1
13	Cropland remaining cropland	CO2	L1
14	Manufacturing industries and construction – solid fuels	CO2	L1, T1
15	Coal exploitation and handling	CH4	L1
16	Land converted into grassland	CO2	L1, T1
17	Land converted into cropland	CO2	L1, T1
18	Unspecified - liquid fuels	CO2	L1, T1
19	Wastewater treatment and discharge	CH4	L1
20	Manure management	N2O	L1
21	Manure management	CH4	L1
22	Other sectors – liquid fuels	CO2	T1
23	Production of ferroalloys	CO2	T1
24	Zinc production	CO2	T1
25	Energy industries – solid fuels	CO2	L1, T1
26	Forest land that remains forest land	CO2	L1, T1

Note: L = Key category according to level assessment; T = Key category according to trend assessment; L1 – Level assessment, Approach 1; T1 – Trend assessment, Approach 1; NO = Not Occurring;
**Unspecified - as a subcategory of the Manufacturing Industries and Construction category in Activities which burn fuel in the Energy sector*
***Other sectors – as a category in Fuel combustion activities in the Energy sector, which consists of the subcategories Commercial/Institutional Sector, Households and Agriculture/Forestry/Fisheries/Ponds*

9 Precursors and indirect emissions

Precursor and indirect greenhouse gases are a special group that, although not direct greenhouse gases, have an indirect impact on climate change through their participation in chemical processes in the atmosphere. They act as "helpers" or "mediators" in the creation or destruction of the actual greenhouse gases. The most important such gases are:

- carbon monoxide (CO) – is produced during incomplete combustion of fuels (for example in cars or old stoves);
- nitrogen oxides (NO_x) – are formed during the combustion of fuels at high temperatures, such as in vehicle engines and thermal power plants;
- non-methane volatile organic compounds (NMVOCs) – these are various gases that evaporate from gasoline, paints, solvents, and industrial processes;
- Sulfur oxides (SO2) – are created when fuels containing sulfur, such as coal and fuel oil, are burned.
- ammonia (NH_3)– most often everything releases from agricultural activities,how what everything the use on nitrogenous fertilizers,storage and treatment on stable garbage,but and in smaller quantities from industry and combustion on fuels.

These substances react with oxygen and sunlight in the atmosphere to form other compounds that affect the climate. For example, CO, NOx and NMVOCs contribute to the formation of tropospheric ozone (O_3) and are therefore called "ozone precursors". This gas is not found high in the atmosphere, but close to the ground and acts as a strong greenhouse gas. On the other hand, SO2 contributes to the creation of small particles in the air (aerosols) that reflect sunlight and cool the atmosphere. NH3 has a similar role to SO2. Therefore, some precursors have a warming effect, while others have a cooling effect, and their impact is very complex.

Although they are not reported as direct greenhouse gases in national inventories, their monitoring is very important, as it shows us how air pollution and climate change are linked. Understanding these processes further helps both scientists and policymakers to develop more effective measures that will both provide cleaner air and reduce the effects of climate change.

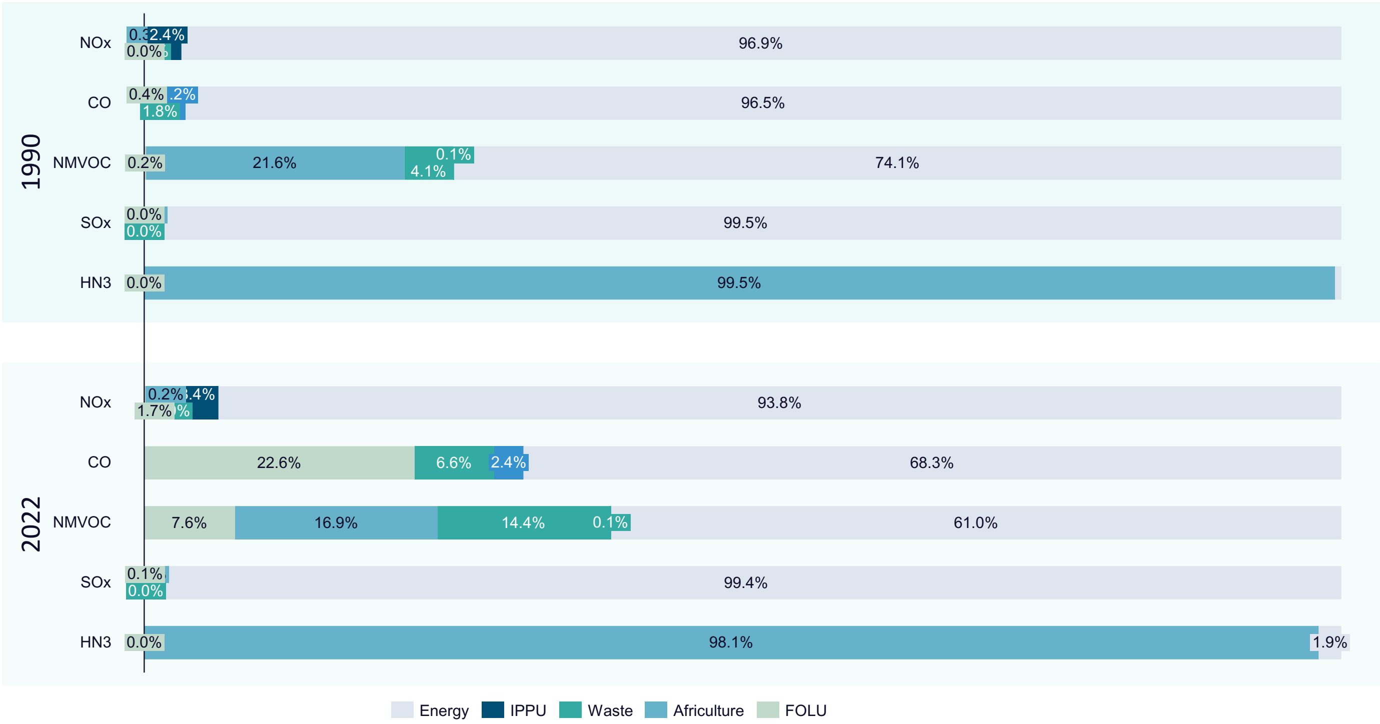
According to paragraph 16 of the Annex to Decision 17/CP.8, non-Annex I countries are encouraged to report on anthropogenic emissions of indirect greenhouse gases, such as CO, NO_x and NMVOC, and according to paragraph 17 of the same decision, countries may optionally include other gases not controlled by the Montreal Protocol, such as SO_x, if they are covered by the Revised IPCC Guidelines of 1996.

The 2006 IPCC Guidelines for National Greenhouse Gas Inventories, in Chapter 7: Precursors and Indirect Emissions, introduce ways to adopt methodologies for calculating non-greenhouse gas emissions and provide a link to the relevant chapters in the EMEP/CORINAIR Methodology Manual for Inventory Preparation. Some of the methodologies and emission factors in the EMEP/CORINAIR Methodology Manual are specific to different technologies and are relevant to conditions and categories in developed and developing countries.

In North Macedonia, these emissions were first systematically estimated within BUR2, which covered emissions of NO_x, CO, SO_2 and NMVOC for the period 1990–2014. In BUR3, data for 2015 and 2016 were added, applying the EMEP/EEA methodology (2019), and part of the previously reported data were revised. In addition, emissions of ammonia (NH_3) were included where applicable. The most recent update also incorporates estimates for the period 2020–2022, ensuring consistency with current international standards, while the data for the period 1990–2019 were recalculated again due to changes in emission factors.

The Energy sector is the dominant source of most precursors, although certain changes in the distribution and intensity of emissions can be observed. In 1990, almost all precursor emissions originated from the Energy sector, accounting for more than 95% of NO_x and CO emissions and over 99% of SO_2 emissions (Figure 89). This reflects the situation at that time, when the energy system was almost entirely based on coal and heavy fuel oil, and the transport sector relied on an older vehicle fleet. By 2022, the structure becomes somewhat more diversified and shows a reduced dominance of the Energy sector for some gases. For CO, the share of the Energy sector decreases from 96.5% to 68.3%, with an increasing contribution from the Forestry sector (22.6%) and Waste (6.6%), indicating increased biomass and waste combustion, as well as emissions from organic processes. For NO_x and SO_2, the Energy sector still remains the dominant source (93.8% and 99.4%, respectively), although with slightly lower values compared to 1990, reflecting the effects of gradual modernization and the phase-out of sulphur-containing fuels.

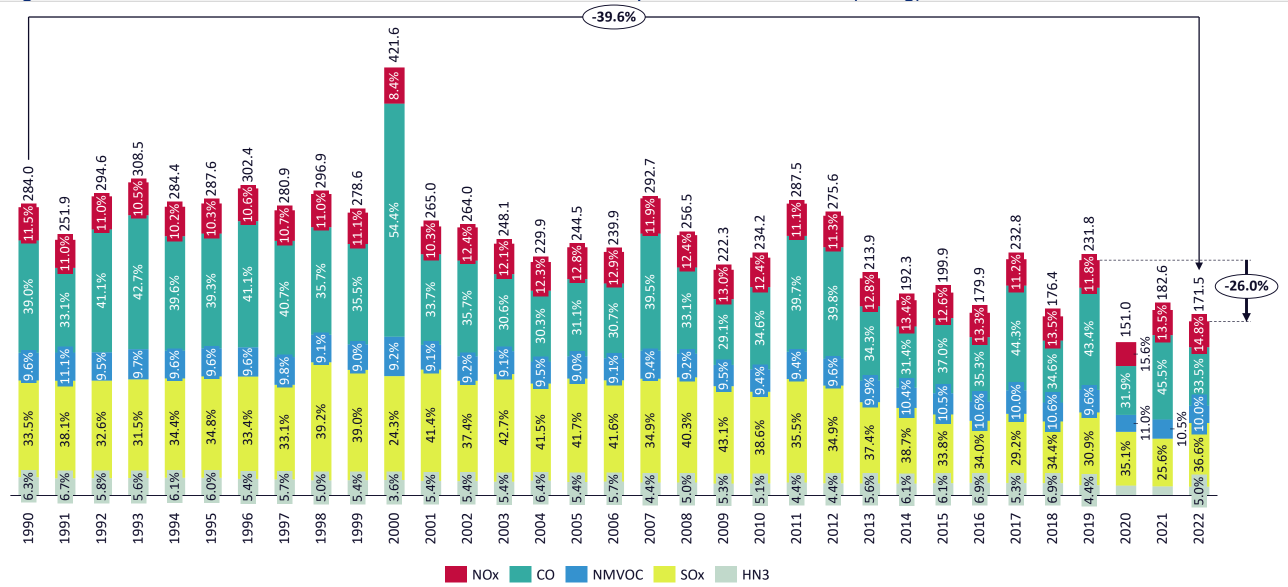
Figure 89. Share of all sectors in Precursors and Indirect Emissions in 1990 and 2022 (%)



Source: IPCC software, team analysis

For the period 1990–2022, a decrease of approximately 40% can be observed in total precursor and indirect emissions (Figure 90), representing a positive trend and indicating an improvement in air quality. However, the trend is not linear, and in some years emission peaks can be observed, particularly related to increased CO and NMVOC emissions resulting from large wildfires. Over the last ten years, emissions show an overall declining trend, especially for NOMand SO_2, reflecting reduced coal use. A decreasing trend is also observed for CO emissions, which is associated with the gradual renewal of the vehicle fleet.

Figure 90. Emissions of nox, co, nmvoc, so2 and nh3 in the period 1990 – 2022 (in Gg)



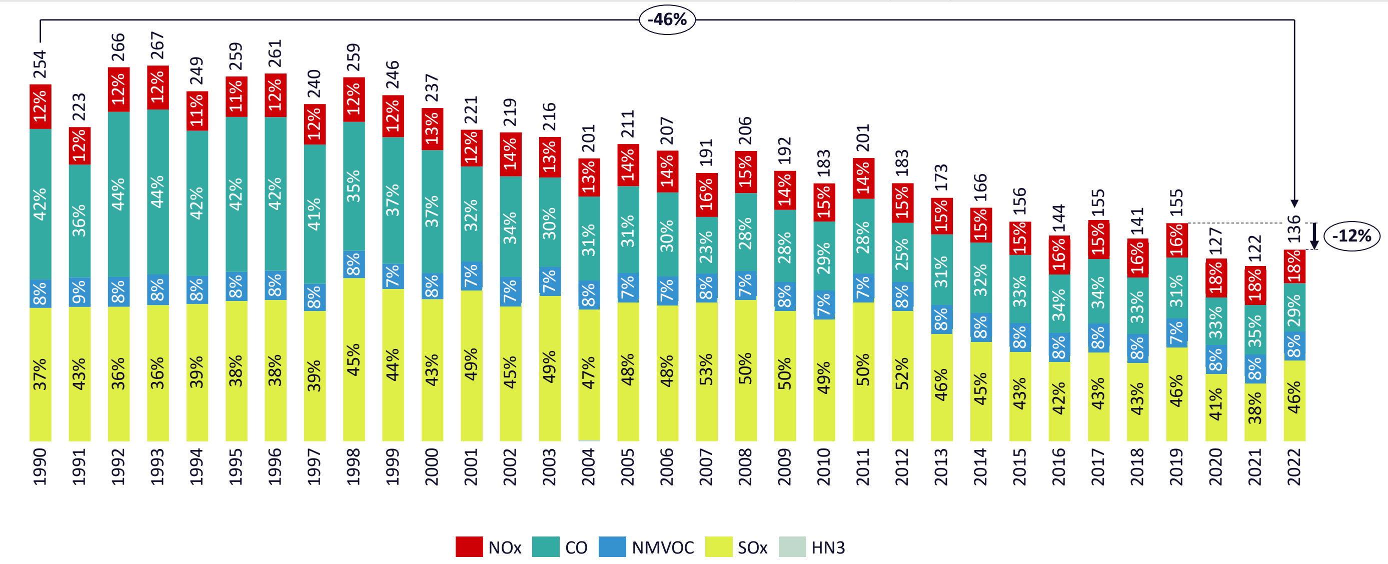
Source: Developed Excel model by the team and team analysis

9.1 Energy

The results obtained for total precursor emissions from the energy sector in Macedonia show a pronounced downward trend of around 46% in the period 1990–2022 (Figure 91). This positive trend is the result of several factors such as improving energy efficiency, modernizing plants and gradually reducing the use of coal, as well as the increasing role of renewable sources but also an increase in electricity imports. The largest reductions were observed in sulfur dioxide (SO_2) and carbon monoxide (CO), which mostly originate from coal-fired electricity production. The reduction in activities in this sector directly contributed to the decline in these emissions, which is a significant step towards improving air quality and reducing the indirect impact on climate change.

In the period 2019–2022, a further decrease of around 12% is observed, again mostly related to the reduction in electricity production from lignite. The share of NOMremains relatively stable, in the range of 12% to 18%. NMVOCs are also constant throughout the period at around 8%. In general, precursor emissions follow the dynamics of greenhouse gas emissions from the Energy sector, confirming that, despite progress, the sector remains a significant source of pollution. This only confirms that future policies should be even more firmly focused on the accelerated introduction of cleaner technologies, renewable sources and emission control systems.

Figure 91. Emissions of NOx, CO, NMVOC, SO2 and NH3 from the energy sector (in Gg)

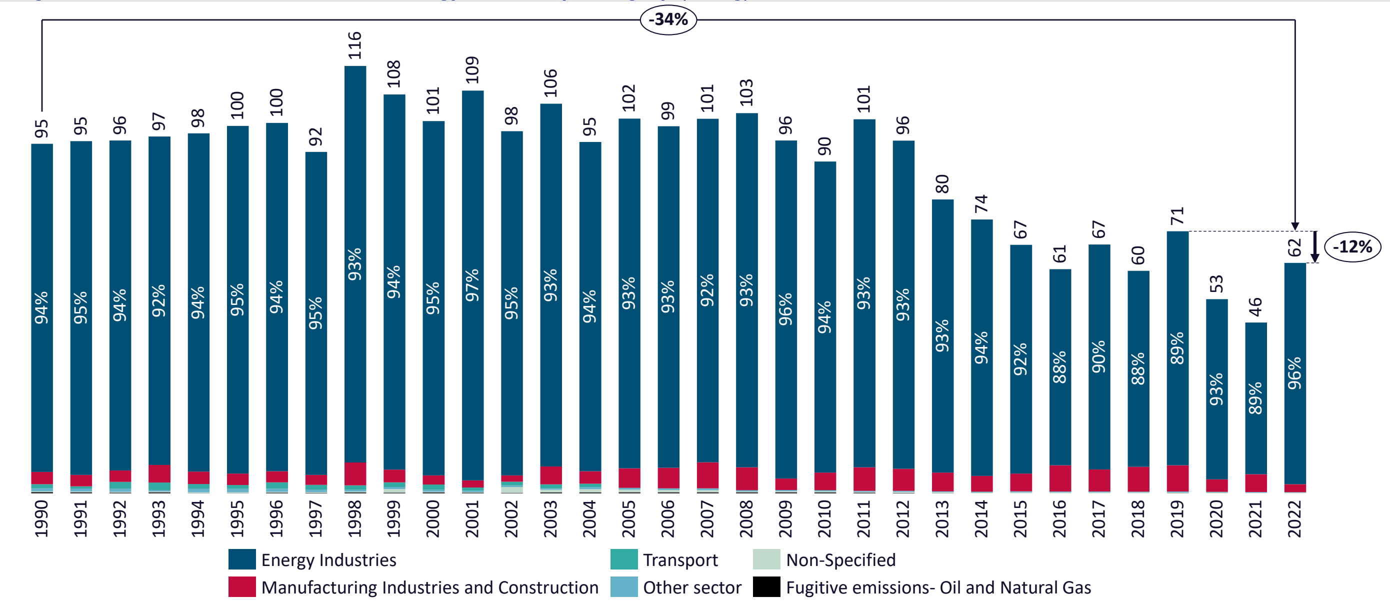


Source: Developed Excel model by the team and team analysis

The results for SO_2 emissions from the Energy sector show a significant reduction of around 34% in the period 1990–2022 (Figure 92). In the emissions structure, electricity production dominates with a share of over 90% in most of the analyzed period, which confirms that the electricity system is the main source of SO_2 in the country. Therefore, this decline is mostly the result of the reduced use of high-sulfur coal, as well as the replacement with cleaner fuels, but also the increase in electricity imports. In the last period (2019–2022), a decrease of about 12% is observed, which is again closely related to the reduction of activities in lignite thermal power plants and partly to the increased use of natural gas and renewable sources.

Although clear progress is being made, the results show that emissions are still strongly dependent on the operation of existing thermal power plants, especially in years with reduced and increased domestic production, such as the case in 2021-2022. In the future, further reductions in SO_2 emissions will depend on a gradual reduction in coal use through increased use of natural gas and renewable energy, as well as modernization of filtration systems. This will allow for further emission reductions, but also improve air quality and meet the obligations of the EU directives on industrial emissions and ambient air quality.

Figure 92. SO2 emissions from the energy sector, by category (in Gg)

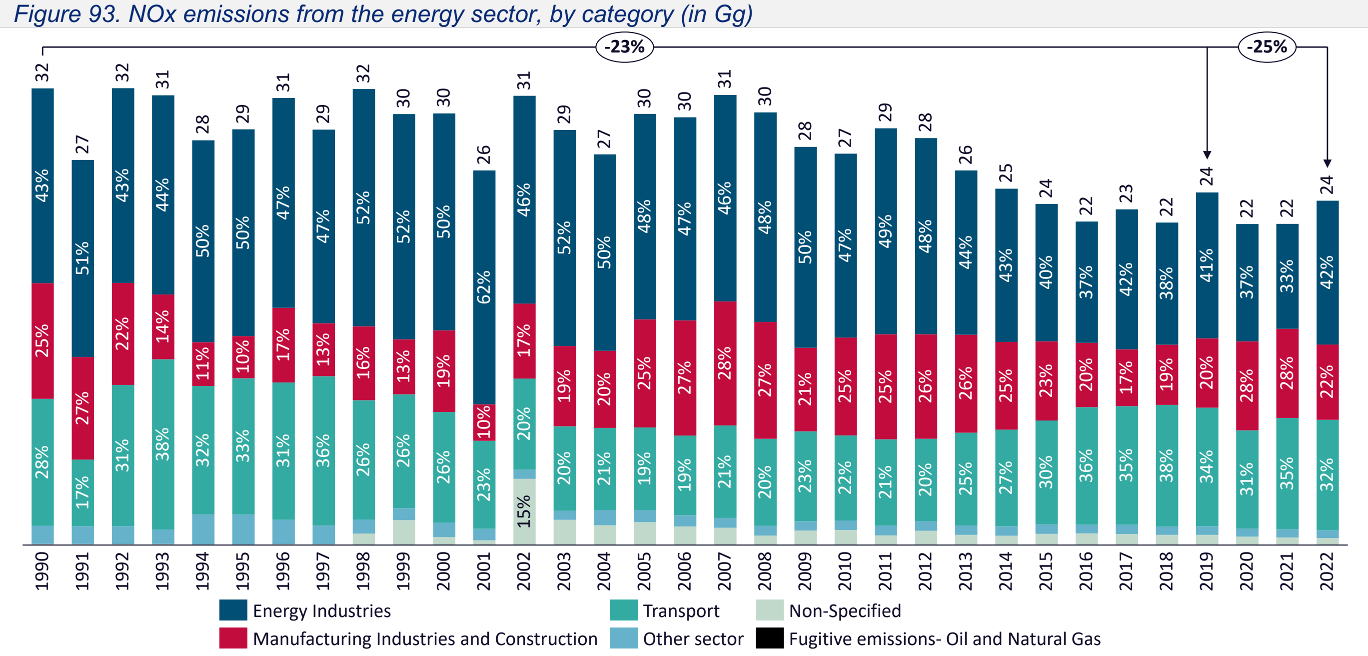


Source: Developed Excel model by the team and team analysis

Unlike previous SO_2 emissions, where electricity generation accounted for over 90% of total emissions, a different and more dispersed picture is observed for NOMHere, in addition to the electricity sector, industrial plants and transport also make a significant contribution. Total NOMemissions have decreased by about 25% in the period 1990–2022 (Figure 93), while in the more recent period (2019–2022) the reduction is only 2%, which shows a gradual improvement in the management of these pollutants, but at the same time that the reduction of NOx is slower compared to other precursor gases.

The largest source remains coal-fired power plants with 30%-40%, where the combustion of fuels at high temperatures leads to the formation of nitrogen oxides. Transport is an increasingly dynamic source of precursor emissions, whose role is continuously increasing in the total energy balance of Macedonia. Unlike the electricity sector, transport has seen an increase in activities and consumption of fossil fuels, resulting in an increased share in NOMemissions. This is particularly due to the increase in the number of passenger and freight vehicles, the dominance of diesel engines, as well as the age of the vehicle fleet, which creates higher emissions even without a significant increase in mileage.

Figure 93. NOx emissions from the energy sector, by category (in Gg)

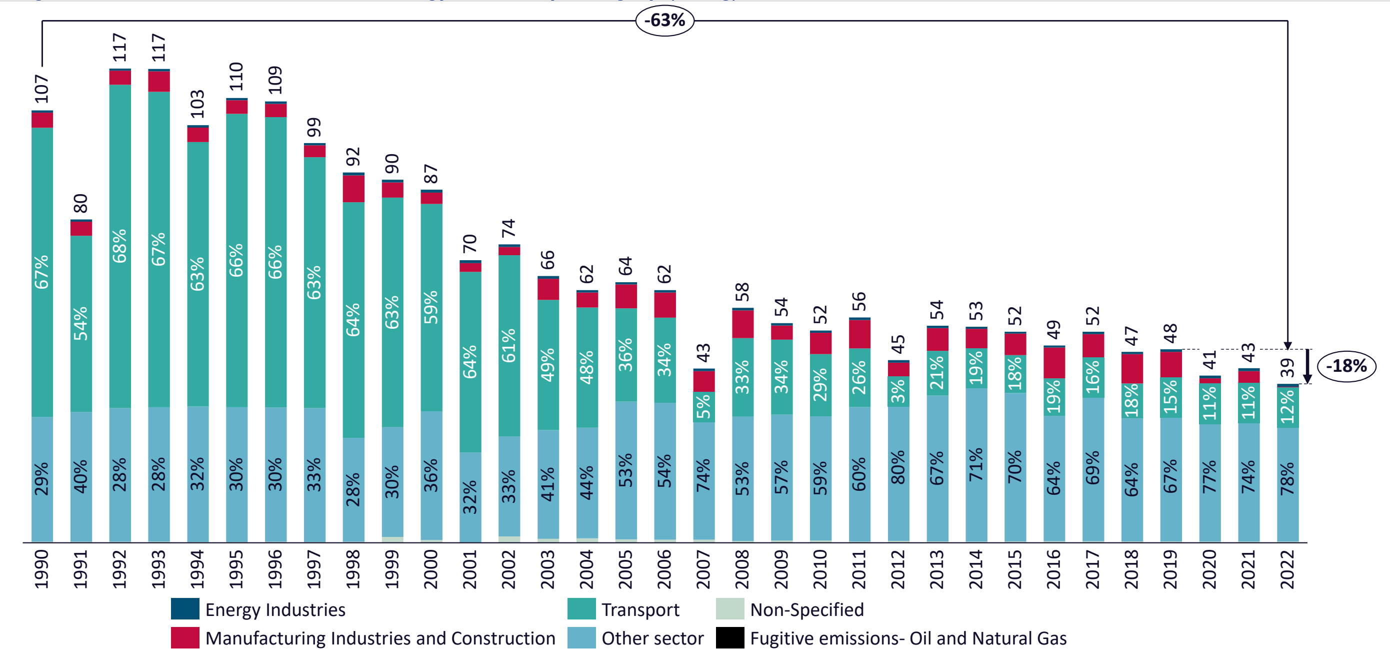


Source: Developed Excel model by the team and team analysis

Compared to previous precursor emissions, CO shows the most pronounced decline in the period 1990–2022, with a decrease of about 63% (Figure 94), which represents the most significant improvement among all the gases analyzed.

Instead of the electricity sector, the main driver of the reduction is the transport sector, where over time there has been an improvement in fuel quality, the introduction of 3-way catalysts in vehicles and the renewal of part of the vehicle fleet. It is these measures that have led to a significant limitation of emissions from incomplete combustion, which used to be the dominant source of CO in urban areas. With the reduction in the share of CO emissions from transport from 67% in 1990 to only 12% in 2022, households now play a dominant role with a share of 78% in 2022. In the most recent period (2019–2022), a decrease of 18% has been observed, which is primarily a result of emissions from Manufacturing Industries.

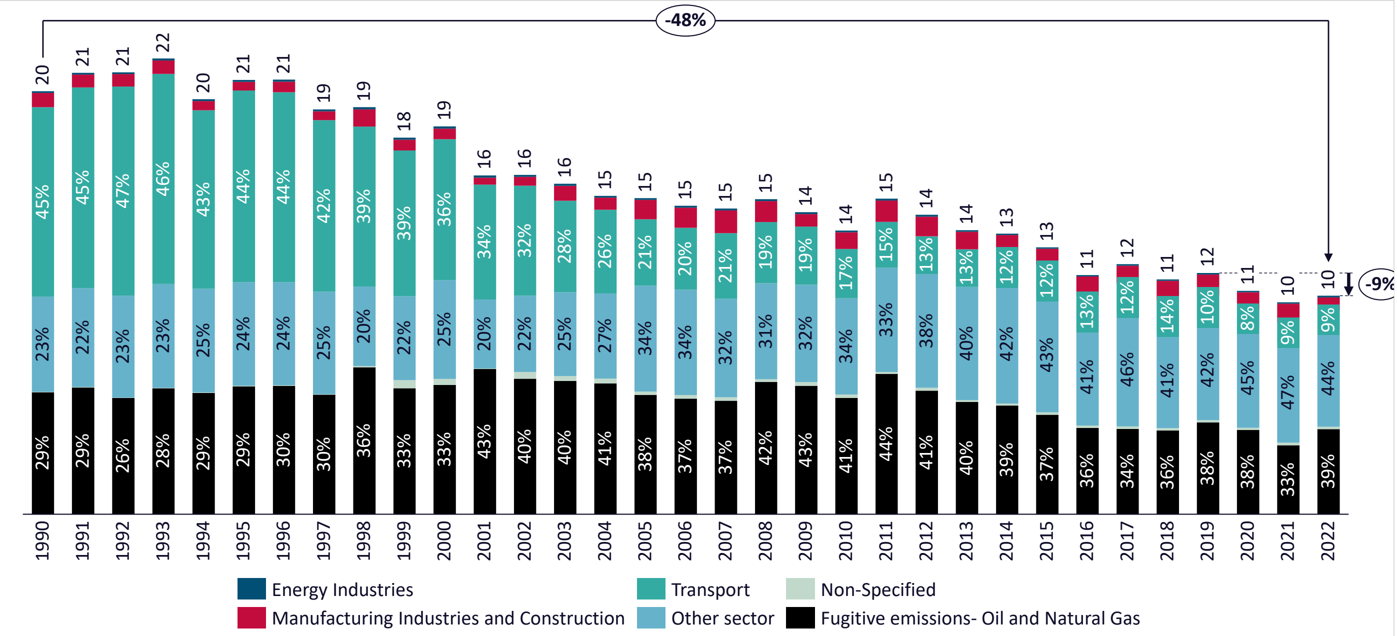
Figure 94. CO emissions from the energy sector, by category (in Gg)



Source: Developed Excel model by the team and team analysis

NMVOCs for the period 1990–2022, are decreasing by about 48% (Figure 95). Most of the emissions come from transport, which in the early years accounted for over 45%, but over time this share has significantly decreased thanks to the improvement of fuel quality, the introduction of catalysts and the renewal of the vehicle fleet. Fugitive emissions, together with households, have recorded minimal changes.

Figure 95. NMVOC emissions from the Energy sector, by category (in Gg)



Source: Developed Excel model by the team and team analysis

9.1.1 Methodology and emission factors

The IPCC Guidelines contain links to information on methods used under other agreements and conventions for calculating emissions of tropospheric precursors and can be used to supplement reporting on greenhouse gas emissions and removals. Table 7.1 of Chapter 7: Precursors and Indirect Emissions of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories provides a link between the IPCC categories and the corresponding chapters in the EMEP/CORINAIR Handbook. The latest EMEP/EEA Air Pollutant Emission Inventory Handbook from 2023 was used in this report (Table 21). The estimation of precursor and indirect emissions in the Energy sector is carried out using the Tier 1 methodology, i.e. Method 1. The reason for this is that higher methodologies require detailed characteristics of the fuels used in combination with on-site measurements or other detailed parameters, which were not available at the time of preparation of this report. In the transport section, the COPERT model was used to obtain more precise results.

Table 21. Emission factors used to calculate emissions of precursor and indirect gases from the Energy sector

Sector	BTR	Comment
Energy	Emission factors according to Method 1 (Tier 1) EMEP/EEA Air Pollutant Emission Inventory Manual 2023	Method 1 (Tier 1) applied. There are not enough measurement data and detailed parameters for application of higher methodological levels.

9.1.2 Data sources

All activity data for the period 1990-1997, as well as 2003 and 2004 are taken from the International Energy Agency database, while for the remaining period the data are taken from the national energy balances published by the State Statistical Office (Table 22).

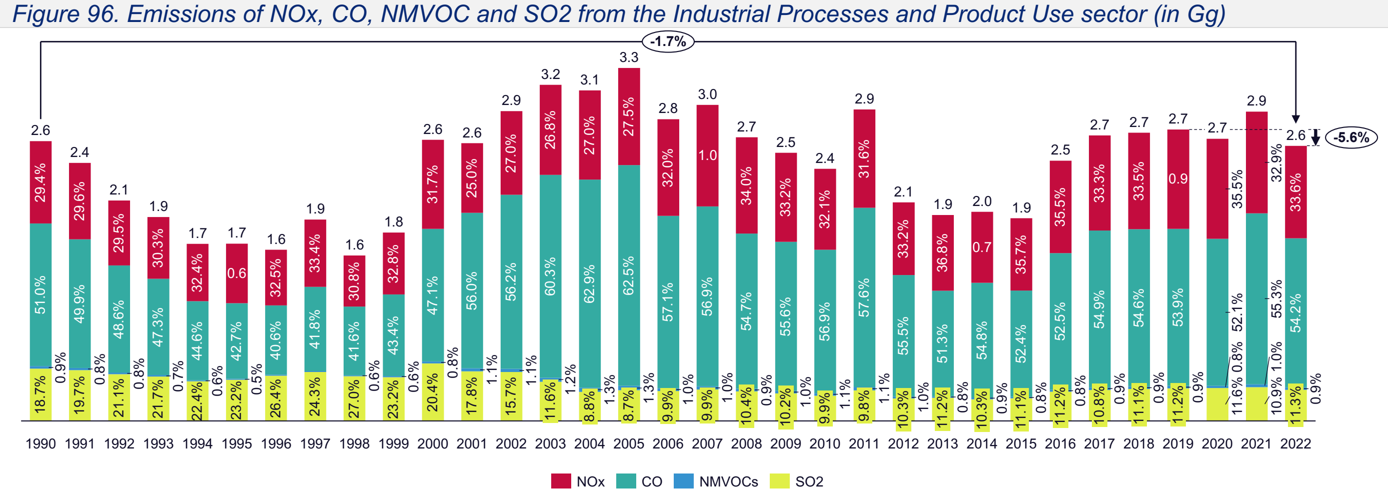
Table 22. Data sources for calculating precursor and indirect gas emissions from the energy sector

Sector	Documents	Data source
Energy	International Energy Agency Database (annual databases from 1990 -1997, 2003 and 2004) Energy balances, Final data, (annual publications 1998-2002, MAKStat database for the period 2005-2022) COPERT transport database 1990-2022	The International Energy Agency, State Statistical Office MOEPP

9.2 Industrial processes and product use

Precursor emissions and indirect emissions from the Industrial Processes and Product Use sector are very small compared to emissions from the Energy Industries sector. Peak emissions occur in 2005 when they reach 3.3 Gg, while in 2022 emissions are 2.6 Gg or 5.6% less than in 2019 (Figure 96). The largest share is CO emissions, which account for 54.2% in 2022, followed by NOx emissions with around 34% and SOx with 11%.

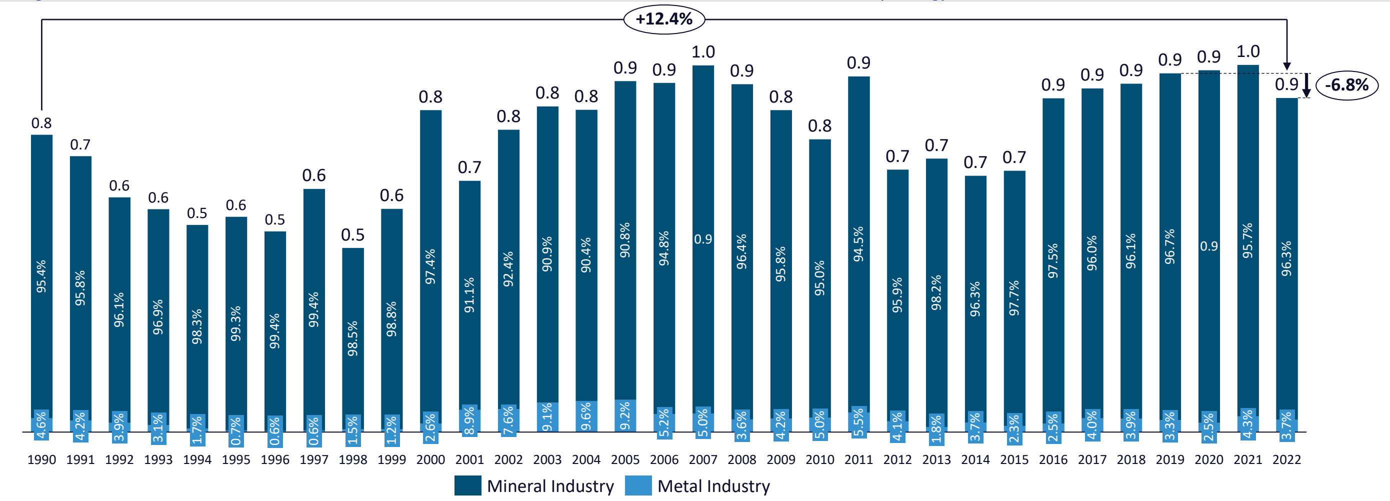
Figure 96. Emissions of NOx, CO, NMVOC and SO2 from the Industrial Processes and Product Use sector (in Gg)



Source: Developed Excel model by the team and team analysis

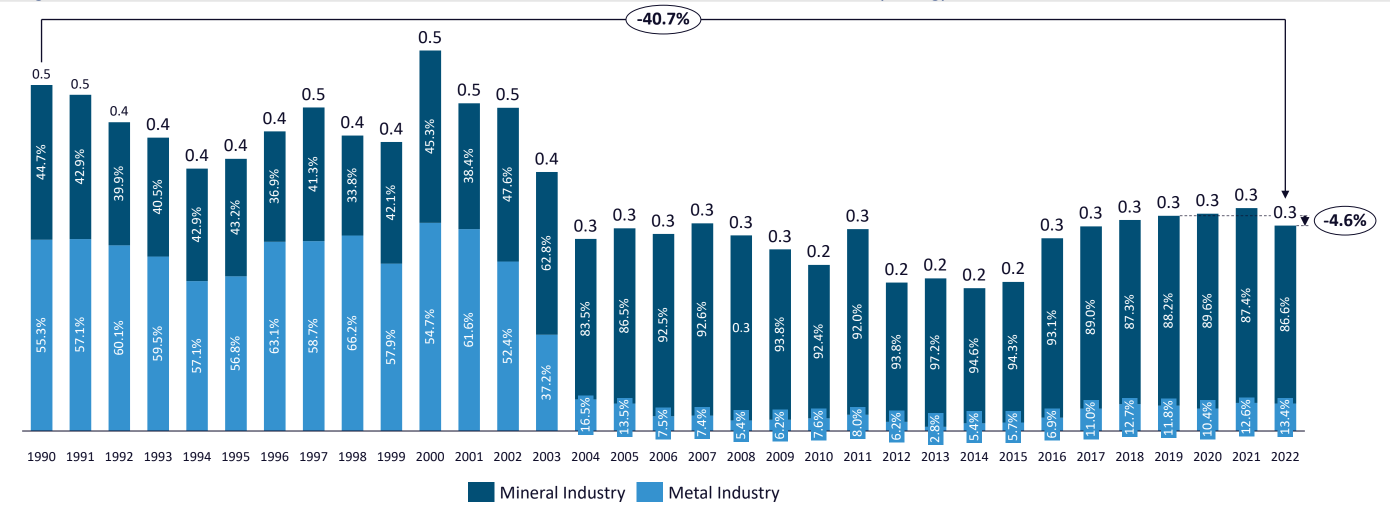
The minerals and metals industries are the only sources of precursor emissions and indirect emissions from the Industrial Processes and Product Use sector. Almost all NOx and SO2 emissions come from cement production in the minerals industry, 96.3% and 86.6% in 2022 (Figure 97andFigure 98The mineral industry's contribution is also dominant in NMVOC and CO emissions, accounting for about 52% and 70%, respectively (Figure 99 and Figure 100). In 2022, NOx emissions decreased by 6.8% and SOx emissions by 4.6%, compared to 2019. The peak production of iron and steel in 2005 led to the highest CO and NMVOC emissions from this subcategory. In that year, the share of the metal industry in CO emissions was 52.9%, while in NMVOC emissions it was about 71.4%.

Figure 97. NOx emissions, from the Industrial Processes and Product Use sector (in Gg)



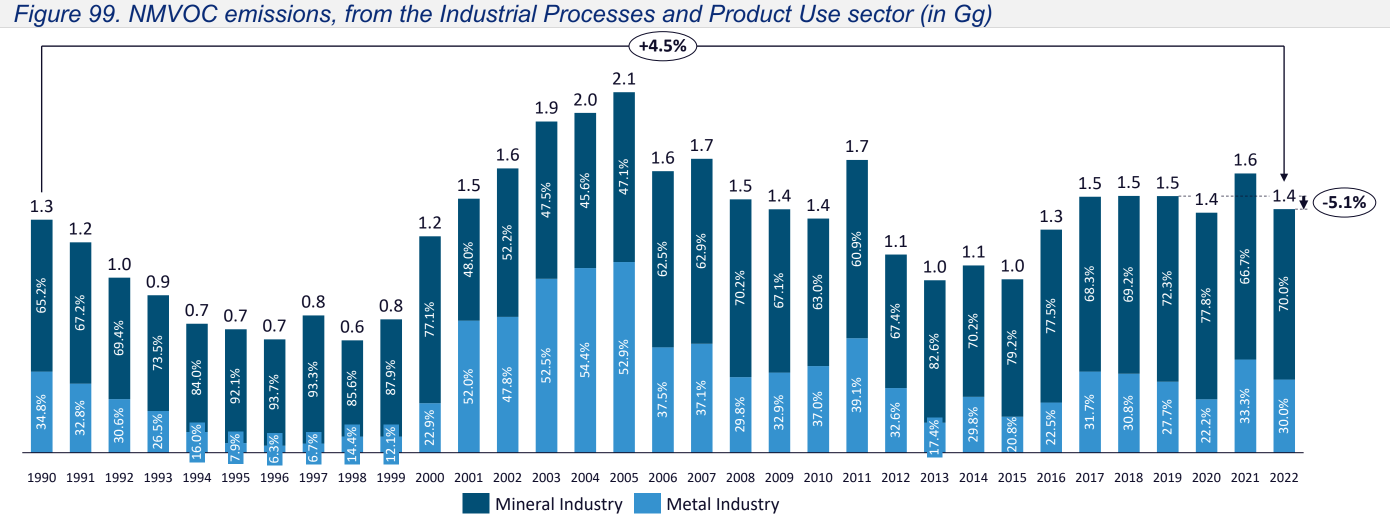
Source: Developed Excel model by the team and team analysis

Figure 98. SO2 emissions, from the Industrial Processes and Product Use sector (in Gg)



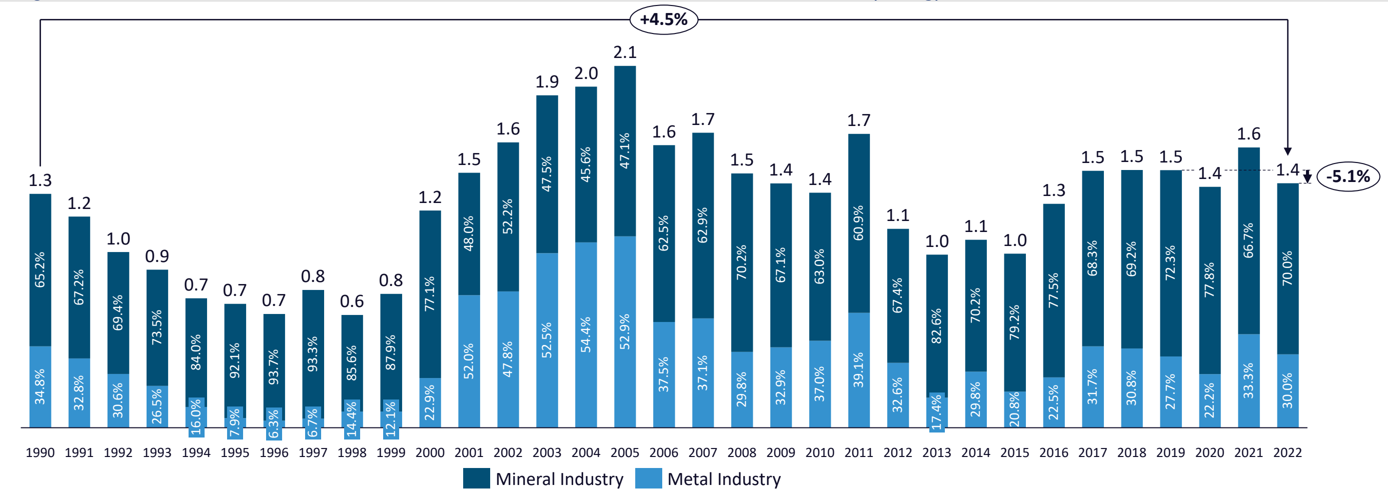
Source: Developed Excel model by the team and team analysis

Figure 99. NMVOC emissions, from the Industrial Processes and Product Use sector (in Gg)



Source: Developed Excel model by the team and team analysis

Figure 100. CO emissions from the Industrial Processes and Product Use sector (in Gg)



Source: Developed Excel model by the team and team analysis

9.2.1 Methodology and emission factors

For the calculation of precursor emissions and indirect emissions from the Industrial Processes and Product Use sector, the Tier 1 approach was used, i.e. Method 1 (Table 23).

Table 23. Emission factors used to calculate emissions of precursors and indirect gases from the Industrial Processes and Product Use sector

Subsector	BTR
Mineral industry	EMEP/EEA Air Pollutant Emission Inventory Manual 2023 Table 3.1 Emission factors according to Method 1 (Tier 1) for category 2.A.1 Cement production. Table 3-25 Emission factors according to Method 2 (Tier 2) for category 1.A.2.fi, Cement production (1.A.2 Manufacturing industries and construction (combustion of fuels)). Table 3.1 Emission factors according to Method 1 (Tier 1) for category 2.A.2 Lime production. Table 3-24 Emission factors according to Method 2 (Tier 2) for category 1.A.2.fi, Lime production (1.A.2 Manufacturing industries and construction (combustion of fuels)). Table 3.1 Emission factors according to Method 1 (Tier 1) for category 2.A.3 Glass production
Metal industry	EMEP/EEA Air Pollutant Emission Inventory Manual 2023 Table 3.18 Emission factors according to Method 2 (Tier 2) for category 2.C.1 Iron and steel production, steel production, steelmaking plant with electric arc furnaces. Table 3.1 Emission factors according to Method (Tier 1) for category 2.C.5 Lead production

9.2.2 Data sources

The annual production (tons/year) given in the reports from the State Statistical Office containing five-year data on industrial production in North Macedonia is used as activity data for each industry.

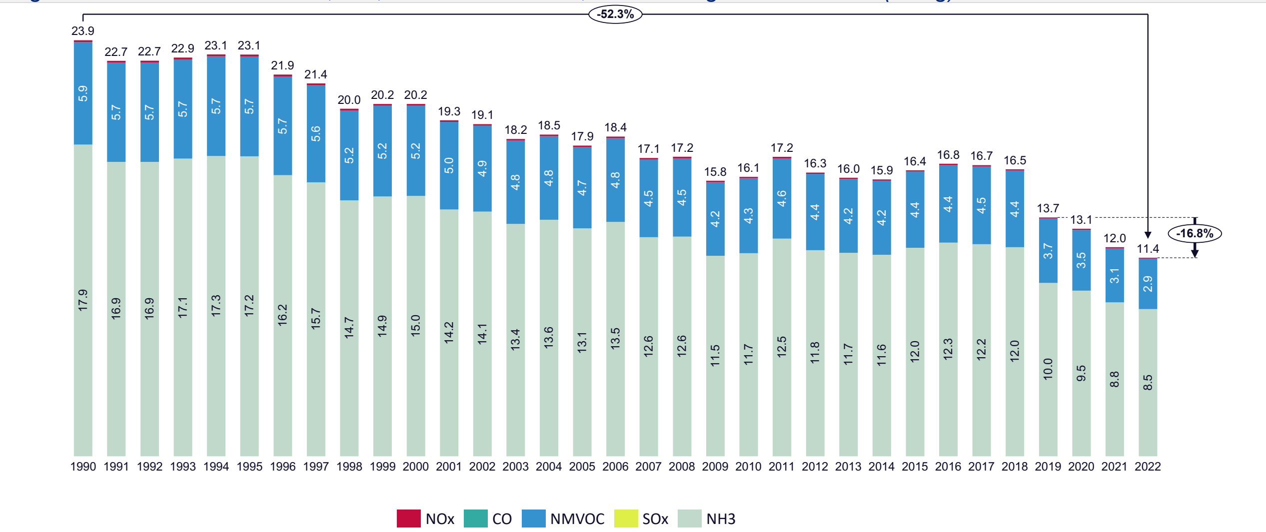
Table 24. Data sources for calculating emissions of precursors and indirect gases from the Industrial Processes and Product Use sector

	Documents	Data source
Mineral industry	Clinker production in the cement industry Industry (1990-1995, 1996-2001, 2002-2006, 2006-2010, 2011-2016), MAXSTAT 2007-2022	Ministry of Environment and Public Works State Statistical Office
Metal industry	Industry (1990-1995, 1996-2001, 2002-2006, 2006-2010, 2011-2016), MAXSTAT 2007-2022	State Statistical Office

9.3 Agriculture

The results for precursor emissions from the Agriculture sector show a significant reduction in all emissions of around 52% (Figure 101) in the period 1990–2022 and depend primarily on the reduction of livestock. Most of these emissions originate from ammonia (NH_3) emissions, which account for about 75% of the total over the period. The second most significant component of precursor emissions in agriculture is NMVOC with about 25%. Although NH_3 and NMVOC dominated, insignificant emissions of CO and NO_X are also observed.

Figure 101. Emissions of NOx, CO, NMVOC and SO2, from the Agriculture sector (in Gg)



Source: Developed Excel model by the team and team analysis

9.3.1 Methodology and emission factors

NMVOC emissions occur from: silage, manure, outdoor manure storage, application of manure to fields, and from animals on pastures. Estimates of emissions associated with silage feeding, outdoor manure storage, application of manure, and from pastures have not been made due to the lack of adequate activity data.

Emissions of NH3, NO and NMVOCs arise from livestock excreta deposited in and around stables and collected as liquid slurry, then from solid manure or from agricultural waste manure. These emissions occur in livestock stables and in open areas, as well as from manure storage, from the use of manure on agricultural land, but also from manure discharged during grazing.

For the calculation of precursor emissions and indirect emissions from the Agriculture sector, the Tier 1 approach was used, i.e. Method 1 (Tier 1) (Table 27).

Table 25. Emission factors used to calculate emissions of precursor and indirect gases from the Agriculture, Forestry and Other Land Use sector

Subsector	BTR
Manure management	EMEP/EEA Air Pollutant Emission Inventory Manual 2023; 3.B Manure Management Table 3.2. Standard emission factors (Tier 1) (EFNH3) for calculating NH3 emissions from manure management Table 3.3 Standard emission factors (Tier 1) for NO (as NO2) from stored manure Table 3.4 Standard emission factors (Tier 1) for NMVOCs Table 3.5 Standard emission factors (Tier 1) particulate emissions from livestock farming (in stables)

9.3.2 Data sources

The activity data used for manure management is the livestock population, provided by the SSO (Table 28).

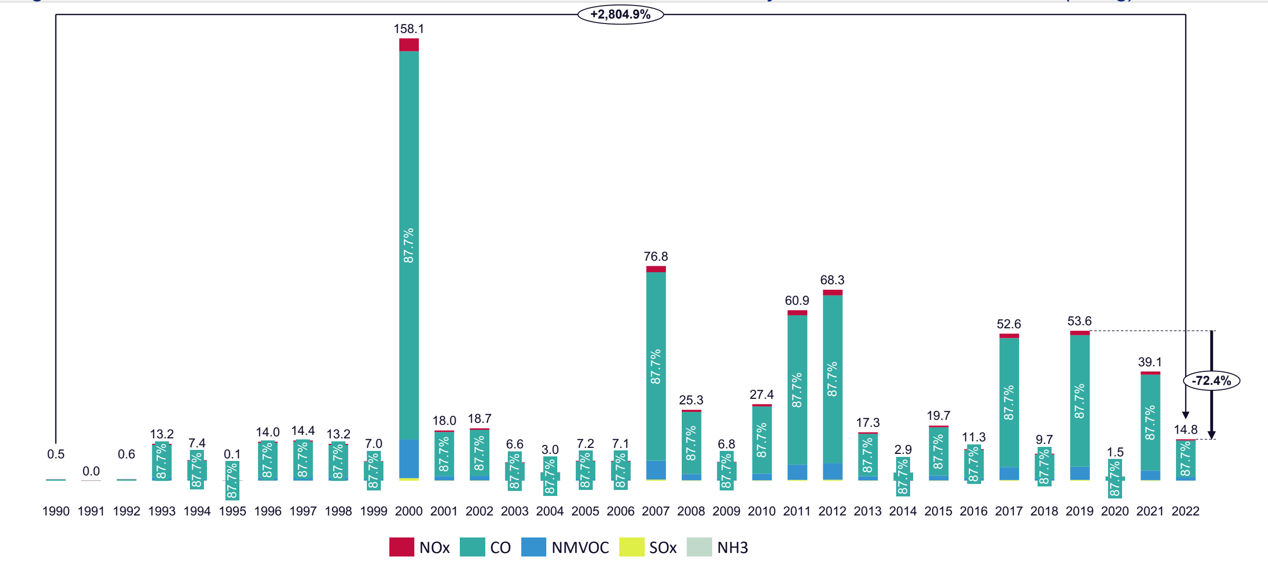
Table 26. Data sources for calculating emissions of precursors and indirect gases from the Agriculture, Forestry and Other Land Use sector

	Documents	Data source
Manure management	Total number of livestock and poultry in Macedonia	SSO – MAXSTAT database

9.4 Forestry and other land uses

In the Forestry and other land use sector, all emissions originate from the subcategory Burning of biomass from forest vegetation (forest fires). Precursor emissions from the Forestry sector show an extremely variable trend, with several pronounced peaks in emissions that are directly related to the occurrence of large forest fires in individual years. The most notable spike occurs in 2000 (Figure 102), which is a direct consequence of a series of extensive fires that affected large forest areas in the country. Similar, but smaller in intensity, peaks are observed in 2007, 2011, 2012, 2017, 2019 and 2021, confirming the clear dependence between forest fires and the increase in precursor emissions, especially carbon monoxide (CO), which accounts for about 88% of total emissions in all years.

Figure 102. Emissions of NOx, CO, NMVOC and SO2, from the Forestry and other land use sector (in Gg)



Source: Developed Excel model by the team and team analysis

9.4.1 Methodology and emission factors

The subcategory Forest Biomass Burning includes emissions from (natural or human-induced) burning of unmanaged and managed forests and other vegetation, excluding agricultural burning of stubble, etc. This includes domestic fires (from burning firewood, crop residues, dung and charcoal), as well as open vegetation fires (burning of forests, shrubs, grass and agricultural crops).

For the calculation of precursor emissions and indirect emissions from the Forestry and other land use sector, the Tier 1 approach was used, i.e. Method 1 (Tier 1) (Table 27).

Table 27. Emission factors used to calculate emissions of precursor and indirect gases from the Agriculture, Forestry and Other Land Use sector

Subsector	BTR
Biomass burning	EMEP/EEA Air Pollutant Emission Inventory Manual 2023; 11.B Forest fires Table 3-1 Emission factors according to Method 1 (Tier 1) for category 11.B Forest fires

9.4.2 Data sources

For biomass burning, the activity data are burned areas (forests). Data on forest fires are obtained from the MAFWE, the State Inspectorate for Forestry and Hunting and the Crisis Management Center (Table 28).

Table 28. Data sources for calculating emissions of precursors and indirect gases from the Agriculture, Forestry and Other Land Use sector

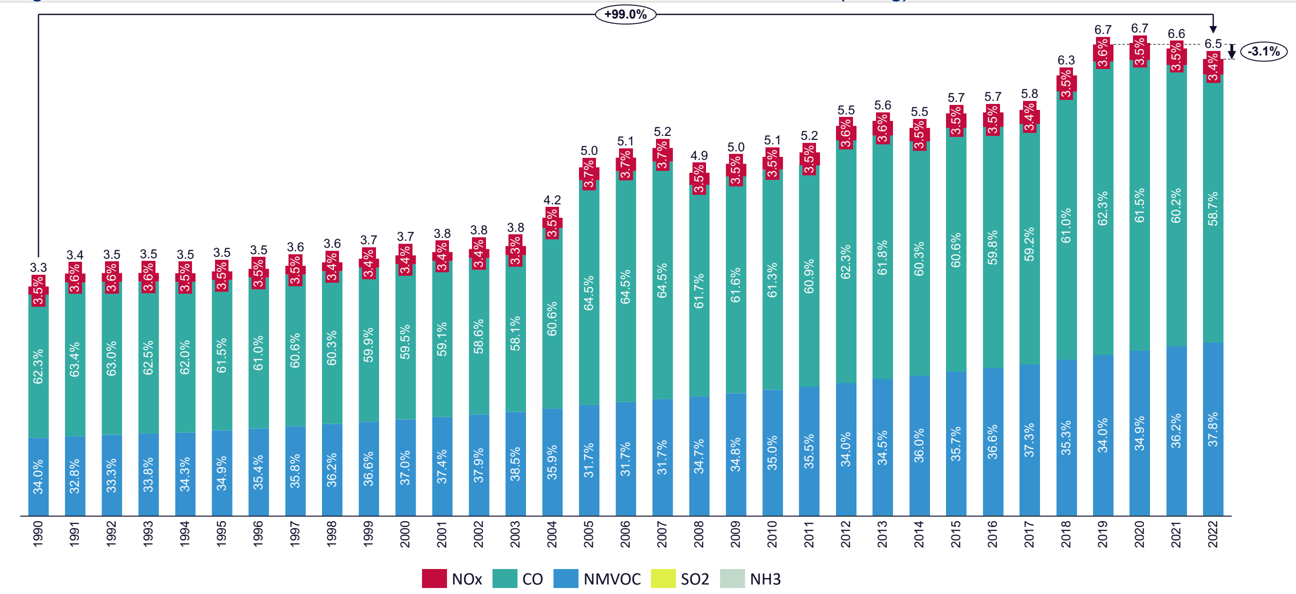
	Documents	Data source
Burning biomass in forests	Statistical yearbooks of the State Statistical Office, Annual reports, internal documents of companies	Forest management companies (PE Macedonian Forests, National Parks, Association of Private Forest Owners), MAFWE, CMC (Crisis Management Center), Fire Fighting Association of Macedonia.

9.5 Waste

In the Waste sector, NOx, CO and SO2 emissions are produced by open burning of waste, by solid waste incineration processes (mainly medical waste), as well as by incineration of sludge from wastewater treatment. NMVOC emissions can originate from wastewater treatment plants and open burning of waste. A revision of the data series for the entire period has been made because, as stated in the waste chapter, a large number of changes have been made, and additionally there are changes in the factors section.

Precursor emissions from the Waste sector in the period 1990–2022 have doubled, indicating increased waste generation and incineration, as well as insufficient application of modern waste management systems. Most of the emissions originate from carbon monoxide (CO), which on average accounts for over 60% of total precursor emissions in this sector, which is mainly due to open burning of waste and landfills. Compared to the Energy and Agriculture sectors, emissions from waste are significantly smaller in volume, but have a growing tendency, which is a worrying signal. It should be particularly emphasized that open burning of waste does not contribute to an increase in precursor gases and at the same time creates toxic compounds and particles harmful to human health.

Figure 103. Emissions of NOx, CO, NMVOC and SO2, from the Waste sector (in Gg)



Source: Developed Excel model by the team and team analysis

9.5.1 Methodology and emission factors

For all categories in the waste sector, standard emission factors from level 1, i.e. Method 1 (Tier 1), are used, except for the category Biological waste treatment - composting, for which emission factors according to Method 2 (Tier 2) are applied.

Table 29. Emission factors used to calculate emissions of precursors and indirect gases from the Waste sector

Subsector	BTR
Incineration of medical waste	Table 3-1 of the 2023 EMEP/EEA Air Pollutant Emission Inventory Manual, Chapter 5.C.1.b.iii Incineration of medical waste
Open burning of waste	Table 3-1 from the 2023 EMEP/EEA Air Pollutant Emission Inventory Manual, Chapter 5.C.2 Open burning of waste
Wastewater treatment	Table 3-1 from the 2023 EMEP/EEA Air Pollutant Emission Inventory Manual, Chapter 5.D.Wastewater treatment

9.5.2 Data sources

The main source of data is the State Statistical Office, as well as relevant reports from institutions, such as the Ministry of Environment and Public Health (Table 30).

Table 30. Data sources for calculating emissions of precursors and indirect gases from the Waste sector

	Documents	Data source
Incineration of medical waste	Data on quantities of incinerated medical waste from the Drisla landfill	Drisla landfill website, environmental reports from the Ministry of Environment and Public Health 2000-2019
Open burning of waste	Report on non-standard waste disposal in the Republic of Macedonia, 2011 Municipal waste	Ministry of Environment, State Statistical Office
Wastewater treatment	Public water supply and sewerage, Water use and protection from pollution in industry, Industrial production	State Statistical Office

10 Uncertainty analysis

In any analysis, the accuracy of the input data is of great importance, as it dictates the precision of the results. Reducing the uncertainty of the input data can significantly increase the reliability of the result. This is the main reason for conducting uncertainty analyses, as they are considered as a means that can help prioritize national-level efforts to reduce the uncertainty of the input data in the future. Therefore, uncertainty analysis is an essential part of the Greenhouse Gas Inventory.

There are two basic methods for determining inventory uncertainty: Approach 1 (Error Propagation Method) and Approach 2 (which is essentially an implementation of the Monte Carlo method). As is well-established practice in previous greenhouse gas inventory reports, both were applied for the purposes of this inventory, and a comparison was made between them.

Approach 1 is based on the Error Propagation Method and is very easy to use, as it is already implemented in the IPCC inventory software. This uncertainty analysis tool calculates the uncertainty of the entire inventory for a given year, as well as the uncertainty in the trend between a given year and a base year. Although the software does not provide disaggregated results at the sectoral level, they can be calculated in separate tables using the well-known equations for Approach 1 - Error Propagation Method. For the purposes of this inventory, this method was implemented in Excel to calculate the uncertainty results by sector.

The second approach that can be used to calculate this is the Monte Carlo method. In this method, random values of the input variables are selected from their probability density function and the corresponding output is calculated. This procedure is repeated multiple times or until the mean and distribution of the output variables do not change. The input variables can include activity data, emission factors, conversion factors, etc., and the output variable is the amount of emissions.

After reviewing several recent greenhouse gas inventories (including those from Annex I countries), it can be concluded that Approach 2 is applied in very few of them, as it is more complex than Approach 1, and on the other hand requires greater knowledge to link Monte Carlo simulation with IPCC inventory software.

Since this approach is not implemented in the IPCC inventory software, a special MATLAB model was developed for the BUR2 inventory. This model directly uses the inventory database (created by the IPCC software), calculates random values for each input variable (according to their probability density function) and calculates emissions as a result.

10.1 Input data

To calculate the uncertainty of emissions for each sector individually, as well as the uncertainty of total annual emissions, uncertainty values for the input data need to be defined first. The IPCC inventory software allows the input of uncertainty for activity data and emission factors. Based on these data, the software automatically calculates the uncertainty using the Error Propagation Method (Approach 1). The disadvantage of this approach is that in certain sectors where activity data and emission factors are composed of multiple input data with different uncertainties, they need to be summed with only two values for activity data and emission factors. Therefore, this introduces additional uncertainty into the calculations. As mentioned earlier, for the Monte Carlo method (Approach 2) a special tool is created that allows the input of uncertainty for each input data separately.

The input data in the energy sector, according to the Guidelines, as well as the reliability of the available resources in Macedonia, are the most reliable. Accordingly, the uncertainty values for activity data and emission factors are set at 5% in both methods (Table 31). Additionally, in the Industrial Processes and Product Use sector the same uncertainty input data are used for both methods (Table 31). In these two sectors, the emission calculations mainly depend only on the two values entered for the activity data and the emission factors, so it was decided to use uncertainty for these two variables only.

Table 31. Input uncertainty data used for the Energy sector (in %)

	Uncertainty of activity data	Uncertainty of emission factors
Energy	5	5
Industrial processes and product use		
Mineral industry		
Cement production	10	3
Glass production	5	30

Other processes using carbonates		
Ceramics	3	5
Other uses of baking soda	3	5
Other	3	5
Chemical industry		
Production of bicarbonate of soda	5	5
Metal industry		
Iron and steel production	10	5 (CO2)
Production of ferroalloys	5	5 (CO2 and CH4)
Aluminium production	2	10 (CO2) and 50 (PFC)
Using products as substitutes for ozone-depleting substances		
Cooling devices		
Refrigerators and stationary refrigeration	5	5 (HFC)

For the remaining two sectors – Agriculture, Forestry and Other Land Use and Waste, because activity data and emission factors are mainly calculated based on multiple inputs, as recommended in the 2006 IPCC Guidelines, in the Monte Carlo method, the uncertainty for each input is entered separately (as shown in Table 32). When entering uncertainty values into the IPCC inventory software for these two sectors, an approximation is made of all these uncertainty values in order to reduce them to only the two required values per subcategory, given in Table 34.

Table 32. Uncertainty input data used for the Agriculture, Forestry and Other Land Use sector (in %)

	Uncertainty
Agriculture, forestry and other land uses	
Livestock farming	
Number of animals	5
Emission factor	30
Land	
Forest land	
Biomass/firewood removal	20
Area	20
Part of biomass lost due to disturbance	15
Biomass conversion and expansion factors	5
Ratio between belowground biomass and aboveground biomass	5
Carbon content in dry matter	5
Cropland, grassland, settlements and other land	
Area	20
Annual increase in carbon in biomass	75
Annual carbon losses in biomass	75
Dead trees/collected biomass waste, which fell under the old land use category	10
Fund change factor for the land use system	20
Fund change factor for management mode	15
Carbon input fund change factor	20

In order to determine the input uncertainty values in each sector, the relevant IPCC Guidelines were followed. In most cases, the standard IPCC values are used, but for the activity data of the subcategory Livestock farming a lower level of uncertainty is used because in the Republic of North Macedonia there are livestock subsidies, so the number of livestock is reported by the owners, thus reducing the level of uncertainty.

Table 33. Input uncertainty data used for the Waste sector (in %)

	Uncertainty
Waste	
Solid waste landfills	
Total municipal solid waste	20
Part of municipal solid waste delivered to solid waste landfills	20
Degradable organic carbon	20
Part of the biodegradable organic carbon that decomposes	20
Correction factor for methane	
= 1.0	10
= 0.8	20
= 0.5	20
= 0.4	30
= 0.6	50
The share of CH4 in the produced landfill gas (F) = 0.5	5
GDP	5

Waste generation rate	10

Table 34. Input uncertainty data used in the IPCC inventory software for the Agriculture, Forestry and Other Land Use and Waste sectors (in %)

	Uncertainty of activity data	Uncertainty of emission factors
Agriculture, forestry and other land uses		
Livestock farming	5	30
Land		
Forest land		
Continuous forest land	20	10
Land converted to forest land	10	10
Cropland, grassland, settlements, and other land		
Land of one type in continuity	20	50
Land converted from one type to another	10	50
Waste	20	20

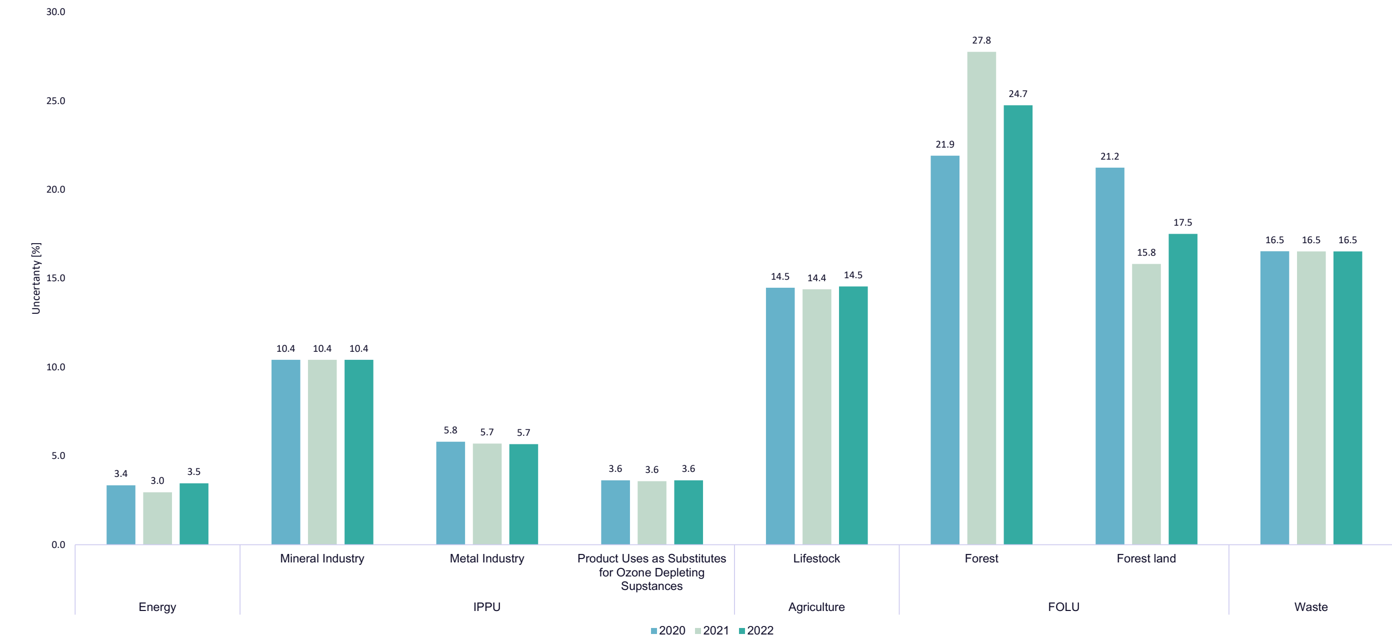
10.2 Results

10.2.1 Error propagation method (Approach 1)

The results of applying the error propagation method for uncertainty calculation show that the Forestry and other land uses sector has the highest uncertainty in the inventory. As shown in Figure 104, the values for this sector are around 21.9% in 2020, reach 27.8% in 2021, and in 2022 they are around 24.7%, making it the sector with the highest variability in estimates. It is immediately followed by the Waste sector, with an uncertainty of around 16.5% in all three years. On the other hand, the Energy sector has the lowest uncertainty, ranging between 3.0% and 3.5%, indicating high reliability of activity data and emission factors. In the Industrial Processes and Product Use sector, the Metal Industry has the highest uncertainty, with values around 5.7–5.8%, while the Mineral Industry has higher values of around 10.4%.

The high uncertainty in the Forestry sector does not mean that the results are incorrect, but that the estimates have a larger range of possible values due to the complexity of the processes, the dependence on natural factors and the limited availability of precise data on biomass, growth and land use change. For example, an uncertainty of 28% means that the actual value of emissions or sinks in this sector may differ by approximately ±28% from the calculated value, which is typical for categories where more modelled or indirect data are used. Thus, if the calculated value of the sink in 2022 is 3,259 Gg CO_2, an uncertainty of ±28% means that the actual value may be lower by about 913 Gg CO_2 or higher by about 913 Gg CO_2. In other words, the true value of the sink is likely to lie in the range between approximately 2,346 Gg CO_2 and 4,172 Gg CO_2.

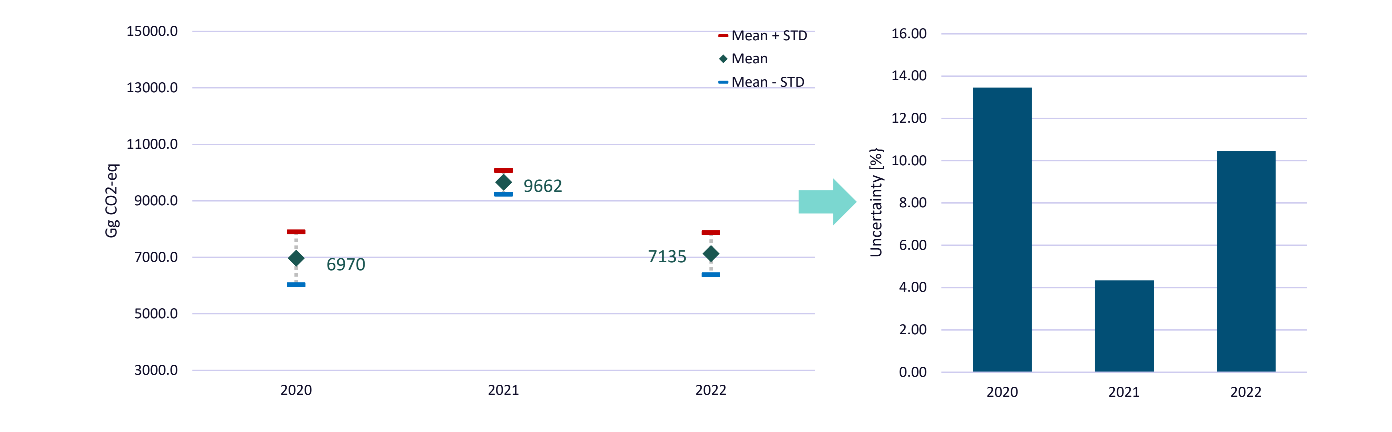
Figure 104. Uncertainty for 2020, 2021 and 2022, using the error propagation method by subcategories



Source: Developed Excel model by the team and team analysis

The results show that the average deviation from total annual emissions for 2020 is around ±937 Gg CO_2-eq, while for 2021 and 2022 it is around ±420 Gg CO_2-eq and ±745 Gg CO_2-eq, respectively (Figure 105). The reduction in total uncertainty is not a result of increased data detail compared to the previous inventory, but primarily of a change in the structure of emissions, i.e. the reduced relative share of the Forestry and other land use sector, which has the highest uncertainty. When a sector with high uncertainty participates less in the total balance, then the total uncertainty at the national level is statistically reduced. This does not mean that uncertainty in the forestry sector itself has decreased. On the contrary, the results of the analysis indicate that forestry remains the sector where the greatest data improvements are needed, especially in the area of data on biomass, growth, land use change, forest fires and forest management, which is indicated as a priority area for further improvement of the inventory in the document. More detailed collection and regular updating of these data in future inventories will contribute to reducing uncertainty and to greater reliability of estimates of carbon sinks.

Figure 105. Total annual emissions (and their standard deviation) and total uncertainty for 2020, 2021 and 2022 using the error propagation method



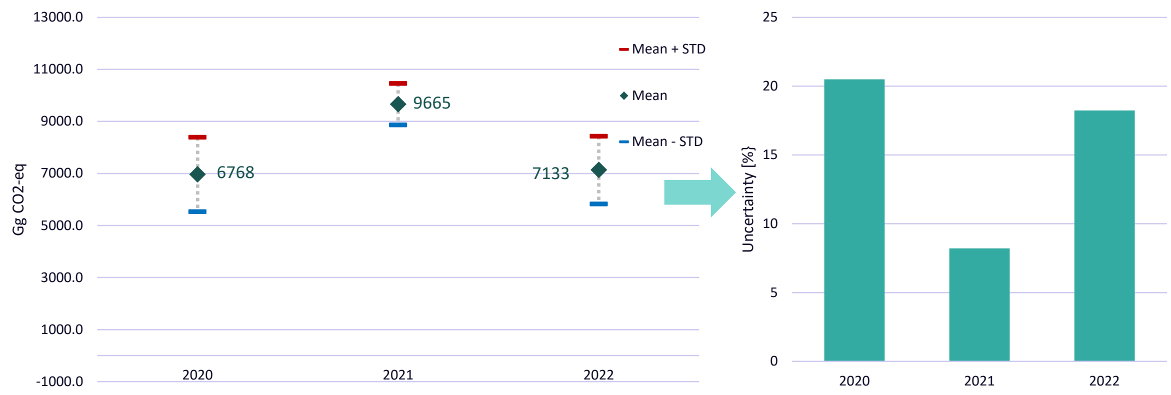
Source: Developed Excel model by the team and team analysis

10.2.2 Monte Carlo method (Approach 2)

The possibility in the Monte Carlo method to introduce uncertainty for each input variable separately, especially in the Agriculture, Forestry and Other Land Use and Waste sectors, changes the results obtained compared to the Error Propagation Method. Using this approach, it is shown that the average deviation of annual emissions, which for 2020 is approximately ± 1428 Gg CO2-eq, while for 2021 and 2022 is approximately ± 794 Gg CO2-eq and ± 1301 Gg CO2-eq

(Figure 106). As with the Error Propagation Method, increasing the share of sectors with higher uncertainty also reduces the total annual uncertainty in 2021 and 2022 relative to 2020.

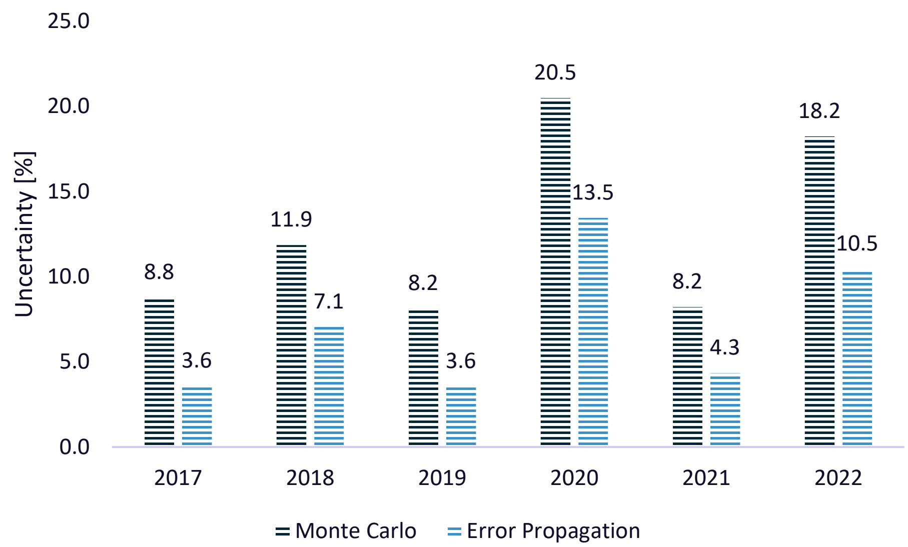
Figure 106. Total annual emissions and total uncertainty for 2020, 2021 and 2022 using the Monte Carlo method



Source: Model developed in MATLAB by the team and analysis by the team

If we compare the results obtained with the two approaches, Monte Carlo and the Error Propagation Method by Years (Figure 107), it can be observed that significant differences occur in the absolute values of the estimated uncertainty. These differences are primarily due to the impossibility of accurately entering the uncertainty of all variables in the IPCC inventory software, i.e. the fact that the uncertainties for all variables must be reduced to only two values (for activity data and emission factors). However, it can be concluded that the trend of uncertainty by year in both methods is the same, i.e. the total uncertainty increases when the share of sectors with higher uncertainty (such as forestry and waste) increases, and decreases when their share in total emissions is smaller. Thus, although the methods give different absolute values, they show the same direction of change in uncertainty over the years.

Figure 107. Comparison of the uncertainty of total annual emissions according to the two approaches, the Monte Carlo method and the error propagation method



Source: Model developed in MATLAB by the team and analysis by the team

11 Quality Assurance and Control (QA/QC) and Verification Activities

The implementation of quality assurance and quality control (QA/QC) procedures is an important part of the development of national greenhouse gas inventories. As described in the IPCC Good Practice Guidance and the latest IPCC Guidelines (since 2006), an appropriate QA/QC program ensures:

- Continuous improvement,
- Transparency,
- Consistency,
- Comparability,
- Completeness,
- Accuracy and
- Timeliness

of national greenhouse gas inventories.

Quality assurance and quality control measures are two different types of activities. The IPCC defines each as follows:

- Quality Assurance (QA) - a planned system of audit procedures conducted by personnel not involved in the inventory development process.
- Quality Control (QC) - a system of routine technical activities carried out by the inventory development team that measures and controls the quality of the inventory during the development process.

An effective QA/QC plan contains the following elements:

- Greenhouse Gas Inventory Team,
- General quality control activities and procedures,
- Source-specific quality control activities and procedures (as an option, depending on resources),
- Quality assurance inspection procedures.

The QA/QC procedures presented in the biennial reports submitted to the UNFCCC (BUR2 and BUR3) are also applied in the first biennial transparency report (BTR1). The QA/QC activities of the national greenhouse gas inventory process are based on in-depth analyses of the country's inventory compilation practices (used in previous BURs) and relevant international best practices.

11.1 Staff involved in QA/QC activities

11.1.1 Chief Technical Advisor

The Chief Technical Advisor (CTA) is a national expert with significant experience in developing greenhouse gas inventories and leadership skills. The CTA is responsible for the following:

- oversees the entire inventory creation process
- provides advice and approves the following elements for the greenhouse gas inventory:
  - mechanisms for collecting input data,
  - time series,
  - emission factors,
  - methodologies for calculating emissions,
  - reporting format,
  - best practices (analysis of key sources, dealing with uncertainty).
- checks, proposes corrections (if any) and approves the National Greenhouse Gas Inventory Report (NIR).

11.1.2 Inventory Development Team

At least one member of the inventory development team should be responsible for each of the sectors covered by the greenhouse gas inventory. At least one member of the inventory development team should be designated as responsible for compiling the entire inventory and at least one member of the team should be responsible for conducting the analyses of key emission sources and uncertainty analyses. The members of the inventory development team shall carry out the following activities:

- collection of input data (activity data and emission factors)

- calculation of sectoral emissions
- implementation of quality control activities and procedures
- recalculation of emissions to introduce corrections suggested by the quality assurance team
- conducting key category analysis and uncertainty analysis
- making corrections suggested by the quality assurance team for the analysis of key categories and the uncertainty analysis
- compiling the entire inventory
- making corrections suggested by the quality assurance team for the entire inventory
- compiling a report on the national greenhouse gas inventory
- making corrections proposed by the Chief Technical Advisor to the national inventory report.

Inventory development team members who collect input data (i.e. identify/verify data sources and document input data) and calculate sectoral emissions are called “Inputters”, while inventory development team members who conduct QC activities and procedures are called “Verifiers”.

11.1.3 Quality Assurance Team

It is preferable that the members of the quality assurance team have previous experience in developing a greenhouse gas inventory (having been involved in the preparation of previous greenhouse gas inventories). At least one member of the quality assurance team should be responsible for each sector covered by the greenhouse gas inventory. At least one member of the quality assurance team should be assigned to review and validate the entire greenhouse gas inventory and at least one member of the quality assurance team to review and validate the key source analysis and uncertainty analysis. The members of the quality assurance team shall carry out the following:

- checking, making suggestions for corrections (if necessary) and confirming sectoral emissions,
- checking, making suggestions for corrections (if necessary) and confirming the entire inventory,
- checking, suggesting corrections (if necessary) and confirming the analyses of key categories and the uncertainty analysis

Table 35. Greenhouse Gas Inventory Team for NC4

Expert (contact information)	Role	Responsibility
prof. Dr. Konstantin Dimitrov kokan@ukim.edu.mk	Chief Technical Advisor (CTA)	Supervision and monitoring of the process Approval of the National Greenhouse Gas Inventory Report (NIR) and other reports QA/QC activities
Academician Ljupcho Kocarev lkocarev@manu.edu.mk	Inventory Development Project Director	Quality control
Dr. Aleksandar Dedinec, Senior Research Associate dedinec@manu.edu.mk	Team leader for the inventory development team Inventory Development Team Member Quality Assurance Team Member Compilation of the full inventory and National Inventory Report (NIR)	Managing the entire process of preparing the greenhouse gas inventory Sectors: Precursors and Indirect Emissions (QC, compilation of sector chapters of the Report), Setting up the AFOLU sector in the new software and data verification Key category and uncertainty analyses QA activities: Energy, Waste, Precursors and Indirect Emissions, Environmental Protection Act
Dr. Verica Taseska-Gjorgievska, Senior Research Associate verica@manu.edu.mk	Inventory Development Team Member Quality Assurance Team Member	Sectors: Energy, Precursors and Indirect Emissions (QC, compilation of the sectoral chapters of the Report) Key category analyses QA activities: Environmental Protection Agency, Industrial production and use of products, Waste

Prof. Dr. Alexandra Dedinec aleksandra.kanevche@finki.ukim.mk	Inventory Development Team Member Quality Assurance Team Member	Sectors: Waste (QC, compilation of sectoral chapters of the Report) Uncertainty analysis Sectors: Energy, ZSHDUZ
Emilia Mihajloska, M.Sc emilija.mihajloska@sdewes.org	Inventory Development Team Member	Sectors: Energy (collection and entry of data, compilation of sectoral chapters of the Report)
Dejan Dimitriev denidimitriev@hotmail.com	Inventory Development Team Member	Sectors: Energy, reference approach (data collection and entry)
Tatyana Dzambazova, research associate tatjana.drangovska@manu.edu.mk	Inventory Development Team Member	Sectors: Industrial production and use of products, Precursors and indirect emissions (collection and entry of data, compilation of sectoral chapters of the Report)
Onur Amet onuramet144@gmail.com	Inventory Development Team Member	Sectors: Energy-transport (collection and entry of data into and from COPERT), Uncertainty analysis (data entry), Precursors - transport calculation, SDUL - entry of surface data into new software and verification of surfaces with old.
Prof. Dr. Afrodita Zendelska afrodita.zendelska@ugd.edu.mk	Inventory Development Team Member	Coordination and coverage of all sectors/QA
Prof. Dr. Dejan Mirakovski dejan.mirakovski@ugd.edu.mk	Inventory Development Team Member	Coordination and coverage of all sectors/QA
Prof. Dr. Ljupco Mihajlov ljupco.mihajlov@ugd.edu.mk		Sector: Agriculture/Cropland and Grassland-Pastures (collection and entry of data for compiling the sectoral chapters of the Report)
Prof. Dr. Dimitar Nakov dimitar.nakov@ugd.edu.mk	Inventory Development Team Member	Sector: Livestock (collection and entry of data for compiling the sectoral chapters of the Report)
Prof. Dr. Ljupco Nestorovski nestorovskil@hotmail.com	Inventory Development Team Member	Sector: FOLU (collection and entry of data on Forestry, compilation of sectoral chapters of the Report)
prof. Dr. Nikola Nikolov nnikolov@sf.ukim.edu.mk	Inventory Development Team Member	Sector: FOLU- Forestry (QC for Forestry, compilation of the sectoral chapters of the Report)
Prof. Dr. Sonja Lepitkova sonja.lepitkova@ugd.edu.mk	Inventory Development Team Member	Sector: FOLU - Other land use, wetlands and settlements (Land use QC, compilation of sectoral chapters of the Report)
Bojan Maksimov, M.A.	Inventory Development Team Member	GIS expert
Prof. Dr. Marija Hadzi-Nikolova	Inventory Development Team Member	Quality control
asst. Anna Mihailovska, MA	Inventory Development Team Member	Greenhouse gas inventory
Vasko Zlatkovski, M.A.	Quality Assurance Team Member	Administration
Aleksandar Jakimov, M.A.	Quality Assurance Team Member	Finance

11.2 Quality control

The Tier 1 approach, which requires a minimum number of quality control activities and procedures, was used by the inventory development team members for all sectors in order to meet basic quality standards. These standards generally focus on:

- Collection, processing, entry and use of data,
- Documentation and data archiving,
- Calculation of emissions.

Table 36. QC activities and procedures according to Method 1 for all sectors in BTR1

Checks on data collection, entry and use	
QC activities	**Procedures**
Check whether the assumptions and criteria for selecting activity data and emission factors are documented	• Cross-check the description of activity data and emission factors with the information entered by category and ensure that they are properly entered and archived.

Checking for transcription errors when entering and referencing data	• Confirmation that bibliographic data for references is properly listed in internal documentation • Cross-check a sample of the input data from each category (or measurements or parameters used in the calculations) for transcription errors. • Using electronic data where possible to minimize transcription errors. • Using IPCC inventory software to minimize errors per user/input.
Checking that emissions/sinks are calculated accurately	• Reproduction of a representative sample of emissions/removals calculations. • If models are used, selectively simulate complex model calculations with abbreviated calculations to assess relative accuracy.
Check that the parameter and emission/sink units are entered correctly and that appropriate conversion factors are used	• Checking whether units are correctly labeled in calculation sheets. • Checking whether units are transferred correctly from the beginning to the end of calculations. • Checking whether the conversion factors are correct. • Checking whether the temporal and spatial adjustment factors have been used correctly.
Checking if the database is complete	• To the extent possible, verify that the appropriate data processing steps have been correctly entered into the database. • As far as possible, verify that the relationships between data are correctly entered into the database. • Ensure that data fields are properly labeled and have accurate design specifications. • Ensure that appropriate documentation is archived for the database and the structure and operation of the model.
Checking data consistency between categories	• Identification of parameters (e.g., activity data, constants) that are common to multiple categories and confirmation that the values entered for these parameters in emission/removal calculations are consistent
Checking whether the movement of inventory data between processing steps is correct	• Checking whether emissions/removals data are correctly aggregated from lower reporting levels to higher reporting levels when preparing summary versions. • Checking whether emissions/removals data are correctly transcribed between different intermediates
QC activities	**Procedures**
Review of internal documentation and data archiving	• Checking whether there is detailed internal documentation to support the estimates and allow for replication of the calculations. • Checking whether each element of the primary data has a reference to the data source (through comments entered into the cells or another note-taking system). • Verify that inventory data, additional supporting data, and inventory versions are archived and stored to facilitate detailed review. • Checking that the archive is closed and kept in a safe place after the inventory is completed. • Checking whether the archiving of data entered by external organizations/experts is confidential.
Checking the emissions calculation	
QC activities	**Procedures**
Checking changes in methodology and data, resulting in recalculations	• Checking changes in methodology and data that result in recalculations • Checking the consistency of the algorithm/method used for calculations over the time series. • Reproduction of a representative sample of emissions calculations to ensure mathematical accuracy.
Checking the consistency of the time series	• Checking the temporal consistency of input data for the entire time series for each category. • Checking the consistency of the algorithm/method used for calculations over the time series. • Checking whether the effect of mitigation measures is adequately reflected in time series calculations
Completeness check	• Confirmation that estimates are reported for all categories and for all years starting from the appropriate base year for the period considered in the current inventory. • For subcategories, confirmation that the entire category is covered. • Determining a clear definition of the type of categories "Other". • Check whether known data gaps resulting in incomplete estimates of emissions/sinks for the category are documented, including a qualitative assessment of the significance of the estimate in relation to total net emissions (e.g. subcategories classified as "not estimated").

Trend check	• For each category, compare the current estimated emissions in the inventory with previous estimates, if available. If there are significant changes or deviations from expected trends, the estimates are re-examined and an explanation for any differences is provided. Significant changes in emissions or dips from previous years may indicate possible errors in the input data or in the calculation. • Check the value of indirect emission factors (aggregate emissions/sinks divided by activity data) over time series. Are there any changes in emissions or sinks? • Checking whether unusual or unexplained trends are observed for activity data or other parameters across the time series.

Source: This list is adapted from the IPCC Good Practice Guidance and the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

11.3 Quality assurance and verification

Quality Assurance (QA) activities are carried out during the inventory evaluation phase, i.e. after the implementation of QC procedures until the final inventory. The quality of the greenhouse gas inventory is ensured through expert review conducted by a quality assurance team. They perform checks, and if necessary, propose corrections and verify the following aspects:

- Appropriateness of selected activity data and emission factors,
- Appropriateness of the applied methodologies,
- Accuracy and consistency of calculated emissions,
- Adequacy of data documentation,
- Accuracy of the analyses conducted on key sources and uncertainty.

As a final step, the Chief Technical Advisor reviews the National Inventory Report, suggests corrections if necessary, and verifies the Report after the members of the Inventory Development Team have made the suggested corrections.

According to the IPCC Guidance on Good Practice and Uncertainty Management in National Greenhouse Gas Inventories, the quality assurance process should prioritize key emission categories, as well as categories where significant changes have been made to methodologies or data.

Quality assurance was implemented in all sectors.Table 37contains information regarding specific sector data that were subject to audit during the implementation of quality assurance procedures.

Table 37. Quality assurance procedures implemented for the Energy, Industrial Production and Use of Products and Waste sectors

Data type	QA activity	Notes/Comments/Examples
Checking activity data	Checks for transcription errors, typos, and switching errors.	Comparison of national data sources with data contained in the IPCC inventory software.
	Comparison with official published data.	Comparison of national energy data (energy balance data published by the SSO and data published by the ESM) and national waste data (waste data published by the SSO and waste generation reports published by the MEPP) with input values for activity data contained in the IPCC inventory software
	Identifying and correcting irregular input data (including checking for sudden changes and peaks occurring in the trend)	Data that does not fall within the real range and is assessed as inaccurate, if necessary, are removed and replaced with data from international sources or with data obtained through expert assessments.
	Comparison with other international data	Comparison of energy data with data published by the International Energy Agency (IEA)
	Checking the documentation of all sources, data format, and assumptions for easy referencing	Maintaining documentation of data sources and assumptions used for each data file in the IPCC inventory software.
	Assurance as to whether the state is able to provide an overview of the overall generation and treatment of waste in the country	Ensuring that an overview of waste generation and treatment is provided, as well as activity data is collected for all types of solid waste (municipal solid waste, sludge, industrial and other waste)
	Ensuring that activity data is provided in appropriate units of measure	Checking the background tables for each category and ensuring the consistency and accuracy of the units of measure for all activity data
	Checking whether the activity data for estimating greenhouse gas emissions are equal to the activity data used for estimating precursor and indirect emissions	Comparison of activity data from each worksheet in the IPCC 2006 database with those provided in the precursor and indirect emissions assessment tables
Emission factors	Checking indirect emission factors (for the time series)	To check the consistency of the use of emission factors
	Double-check against country-specific emission factors published in the International Emission Factor Database (EFDB) and comparison with emission factors of other countries	Ensuring that country-specific emission factors used in the inventory are within the range prescribed by the IPCC Guidelines
	Check whether EFs used to estimate precursor emissions and indirect emissions are consistent, comparable and transparently documented	Check whether the EFs used to estimate precursor emissions and indirect emissions are in accordance with the EMEP/CORINAIR Emission Inventory Guidelines. In case country-specific emission factors are used, a check of the background data, estimation methodology, scope of the EF and comparability with other national reports is required.

Calculations made with IPCC inventory software	Cross-check all steps taken in the calculation	Ensuring that all steps used to determine, estimate and obtain data are accurate, transparent and internally consistent
	Checking the documentation of sources and the correct use of units of measurement	Checking whether the record documentation format is properly completed
	Checking the completeness of data coverage	Ensuring that all relevant gases are covered for all activities
	Check whether other non-energy fuel uses excluded from energy sector activity data are reported in the IPPU sector (in case emissions from these non-energy uses occur)	Ensuring that those excluded from the energy sector are recorded in the IPPU sector
Results (shows)	Checking the differences between the revised/recalculated emission calculations and verifying whether adequate justifications for the revision/recalculation of emissions have been provided	Identification of changes, revisions and transfers in order to improve the accuracy and transparency of estimated emissions
	Identification and correction of irregular result values	Checking whether there is an inconsistency in emission trends and emission levels
	Checking the differences between the sectoral and reference approaches in the Energy sector	Ensuring consistency between calculated emissions and carbon allocation in the sectoral and reference approaches
	Checking completeness, use of symbols for notes and confidential information	Check whether complete estimates have been submitted and whether the annotation symbols have been used where there are no emission estimates.
	Creativity in using annotation symbols	Checking whether the appropriate annotation symbols are used
	Verification of assumptions, corrections, data and sources	Ensuring consistency, transparency, facilitating process repetition and easy data loading
Documentation	Review of the list of improvements and the recommendations and encouragements given (internal and external)	Checking whether the recommendations and encouragements given by the technical assessments/audits conducted have been taken into account and implemented

The process of verifying the quality of the Greenhouse Gas Inventory includes the following steps:

- at the national level (inventory development team – procedures are described above in the text)
- at the international level (through UNFCCC analyses for non-Annex 1 countries).

Recommendations from the Technical Review as part of the UNFCCC International Consultation and Review process have been incorporated into this report to the extent possible. However, some of the recommendations for improvement will be included in subsequent national biennial reports.

11.4 Implementation of QA/QC processes in the ongoing greenhouse gas inventory process

11.4.1 Abridged version of the process

Step 1: Role Assignment (Chief Technical Advisor, Inventory Team Members, Quality Assurance Team Members)

Step 2: Defining the components of the greenhouse gas inventory

For each sector, the appropriate member of the inventory team, in cooperation with the Chief Technical Advisor and the MoEPP, decides on:

- The input data collection mechanism
- Time series
- Emission Factors (National/IPCC Standard)
- Emissions calculation methodologies

The following aspects are taken into account: Current practices for the development of national inventories in the country, country specificities and relevant international good practices.

Step 3: Collecting activity data

For each sector, the appropriate member of the inventory team collects data from official publications and reports and/or contacts identified institutions (data sources) to obtain data. Inventory team members should reference the data sources used and describe the procedures and arrangements undertaken for collecting and archiving data for the preparation of national greenhouse gas inventories.

Step 4: Data entry, documentation and calculation of emissions (QC procedures according to Method 1 (Tier 1) which are carried out in parallel)

Inventory team members use the IPCC Greenhouse Gas Inventory Software to enter activity data and emission factors, to document the data, and to calculate emissions. This IPCC software tool allows for full data documentation, and also includes detailed quality control functions. At the same time, inventory team members carry out quality control activities and procedures according to Method 1 (Tier 1), which is described above.

Step 5: Quality assurance at sector level

The members of the quality assurance team conduct checks and, if necessary, propose corrections and verify the adequacy of the selected activity data and emission factors, the adequacy of the applied methodologies, the accuracy and consistency of the calculated emissions and the adequacy of the data documentation.

Step 6: Compiling the entire inventory

This activity is taken over by one of the members ofthe inventory development team.

Step 7: Quality assurance of the summary for the entire inventory

One of the members of the quality assurance team reviews, suggests corrections, and verifies the accuracy and consistency of the entire inventory.

Step 8: Conduct key category analyses

This activity is undertaken by the member(s) of the inventory team. Analysis of key categories is carried out using the methodology of the 2006 IPCC Guidelines. A separate chapter is also included in the National Greenhouse Gas Inventory Report.

Step 9: Managing uncertainty (as decided)

The Chief Technical Advisor and the member(s) of the inventory team decide on the target sector(s) for conducting the uncertainty analysis, taking into account the results of the key category analysis and other national specificities. The appropriate member(s) of the inventory team conducts an uncertainty management analysis using the methodology of the 2006 IPCC Guidelines. A separate chapter is also included in the National Greenhouse Gas Inventory Report.

Step 10: Quality assurance of key category analysis and uncertainty analysis

A member of the quality assurance team reviews, suggests corrections, and verifies the accuracy and consistency of the key category analysis and uncertainty analysis.

Step 11: Preparation of sectoral chapters of the National Greenhouse Gas Inventory Report

For each sector, this activity is undertaken by the appropriate members of the inventory team responsible for the sector.

Step 12: Creating a chapter with a summary of the inventory

This activity is carried out by the members of the inventory team (same as in Step 6).

Step 13: Quality Assurance of the National Greenhouse Gas Inventory Report

The Chief Technical Advisor reviews, proposes corrections and approves the National Greenhouse Gas Inventory Report.

Step 14: Notification

The Ministry of Environment and Public Health is the institution responsible for reporting national greenhouse gas emissions. In accordance with its international (including European) and national obligations, the Ministry of Environment and Public Health should prescribe a reporting format to be followed by the members of the inventory team. All reports should be approved by the Chief Technical Advisor.

11.4.2 Reporting, documentation and archiving procedures

Documentation of the data source, the selection of emission factors, and other information relevant to the greenhouse gas estimates are documented in the IPCC 2006 Inventory Database (as notes to the Worksheet).

All documents relevant to the greenhouse gas inventory are stored electronically on the server of the Ministry of Environment and Physical Planning and in the database of the Macedonian Academy of Sciences and Arts. This includes quality system documents, reports, original data from data sources, software files of the IPCC inventory preparation software, CRT data files for the ETF inventory reporting tool, data submitted to the UNFCCC and greenhouse gas inventory spreadsheets. The database also documents and archives decisions made by the coordination team, the results of the key category analysis and uncertainty analysis, internal and external audit documents, as well as the inventory preparation processes and relevant guidelines.

After each submission of the national inventory to the UNFCCC, a complete copy of the full database is submitted by the inventory team to the UNPD project coordinator, who forwards it to the Ministry of Environment and Physical Planning.

11.4.3 Ensuring sustainability

In summary, the process of preparing Macedonia's greenhouse gas inventory organized in the manner shown in the previous text meets the necessary technical conditions for ensuring sustainability, because:

- Special emphasis is placed on documenting key information in a concise format;
- Activities and tasks are standardized and procedures are clearly outlined;
- The roles and responsibilities of all parties involved are clearly defined.

Finally, it is worth mentioning that training materials on GHG inventory preparation have been developed by the GHG inventory preparation team. These materials are quite country-specific, both in that they are based on personal experience and lessons learned during the preparation of the GHG inventory in Macedonian conditions and will provide clear guidance for new participants in the process. In addition, activities were implemented to strengthen national capacities for inventory preparation and two new individuals were trained in inventory preparation and actively involved in the process.

12 Recalculations, improvements and capacity building

12.1 Explanations and justifications for recalculations

In the framework of the preparation of this report, a detailed review of the methodologies and data used in previous cycles was carried out, which necessitated recalculations for several categories. One of the main reasons for the recalculations is the alignment with the latest global warming potentials (GWP) according to AR5. Previous inventories used AR4 values, which led to the need to revise the CO_2-equivalents for all categories dominated by CH_4 and N_2O, especially in livestock and waste. The calculations with AR5 introduce significant differences, so the entire time series had to be adapted.

In the area of cropland, recalculations were necessary due to previous errors in the calculation of sinks in perennial crops, but also in the entire Forestry and Other Land Use sector, there were certain inconsistencies due to the use of different values for the same parameters, which to a certain extent can be attributed to a shortcoming of the 2020 version of the IPCC software. In forestry, certain data related to deforestation were corrected because it had values twice as high as the entire series.

In addition to AFOLU, significant recalculations were also made in the Waste sector, where new and significantly more detailed input data were introduced during this cycle. First, for the first time, wastewater treatment plants were integrated, as well as information on whether households are connected to a sewage system or not. In addition, a regional breakdown of waste data was established, which did not exist in previous inventories. The introduction of a regional structure required a revision of the calculations for all years for which data were provided. A key element that directly affects the methodology in the waste sector is the population, which is a basic input for several categories. With the publication of the new 2021 Census, a complete revision of the national population data was carried out. In parallel, the State Statistical Office made a complete reassessment and correction of the time series for the population for the period 2002–2021. These changes significantly affect the calculations for wastewater, solid waste, and emissions dependent on urban and rural structure, so a complete recalculation of the series for these categories was necessary.

12.2 Impact on trends in emissions and removals, including consistency of time series

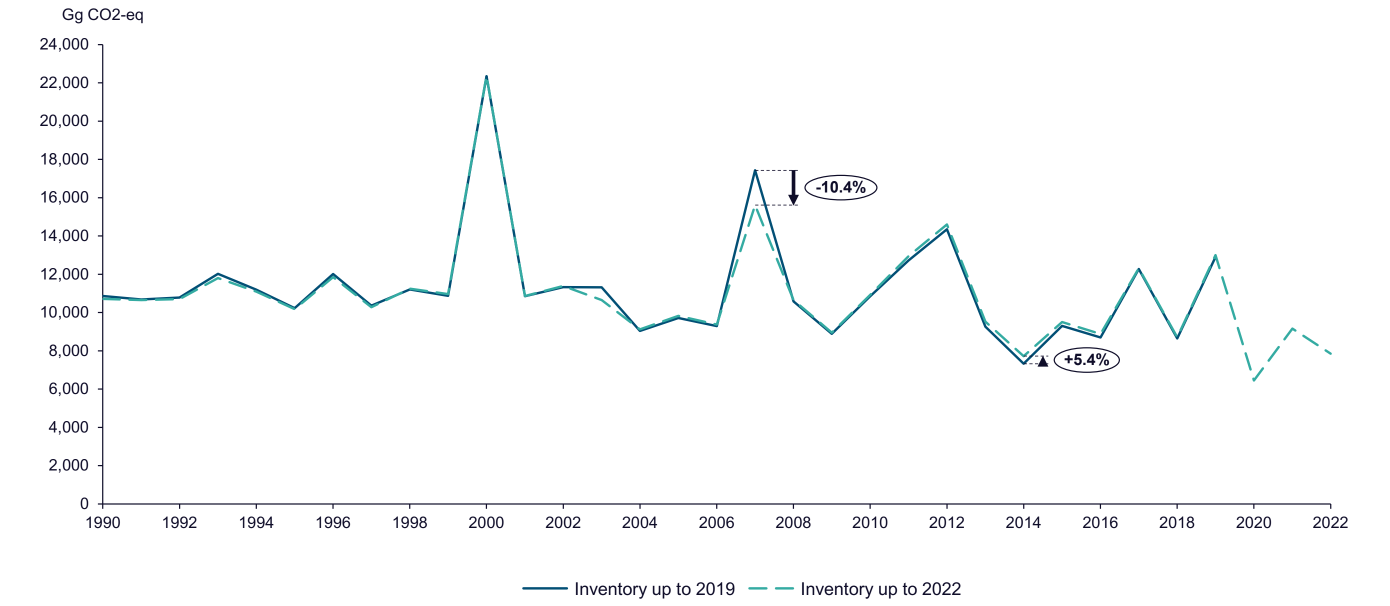
To ensure consistency of the time series and to integrate new data and methodological improvements, a comparison was made between the trends in greenhouse gas emissions in the previous inventory (with a time series up to 2019) and the new inventory (with a time series up to 2022). The comparison was made for two aggregated categories: (i) total greenhouse gas emissions and sinks and (ii) total emissions excluding the LULUCF sector.

The analysis of total emissions and sinks shows that the new inventory generally follows the same time series dynamics as the previous inventory, but with some differences in individual years as a result of recalculations and data improvements. The most significant difference is observed around 2007, where the new inventory shows a decrease of approximately 10.4% compared to the values in the previous inventory (Figure 108). This difference is related to revised data and improved methodology for estimating emissions in certain sectors. On the other hand, in the period around 2014–2015, a small increase of around 5.4% is observed.

When analyzing total emissions excluding the LULUCF sector, the differences between the two inventories are relatively small and the time series show a high level of consistency. For most of the period, the differences are in the range of a few percent. For example, around 2007 the new inventory shows an increase of approximately 2.2%, while around 2016 the difference reaches about 3.5% (Figure 109). These differences mainly arise from updating activity data, recalculations in the energy sector and improvement of data in the waste sector.

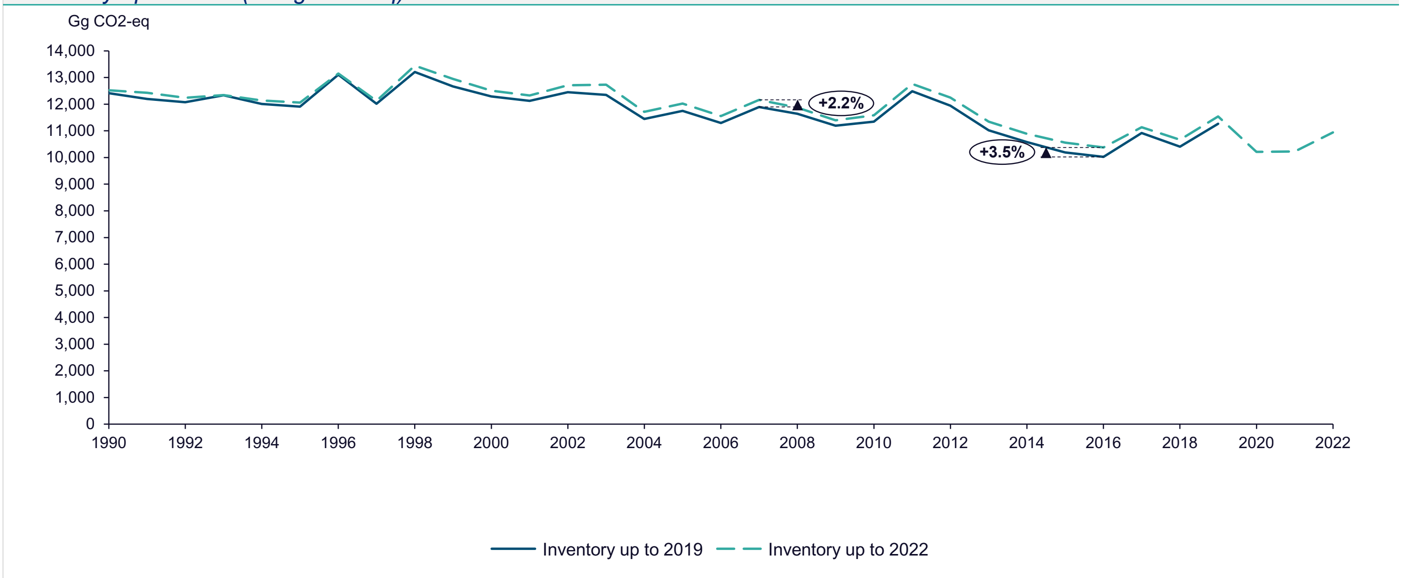
Overall, the results show that the trend in national emissions remains consistent between the two inventories, while the observed differences are the result of methodological improvements, improved activity data and updated time series in line with IPCC guidelines. The new inventory provides a more complete and better aligned time series for the period 1990–2022, which is the basis for improved transparency and accuracy of the national greenhouse gas inventory system.

Figure 108. Comparison of greenhouse gas emissions and sinks in the greenhouse gas inventory by 2019 with the greenhouse gas inventory by 2022 (in Gg CO2-eq)



Source: Team Analysis

Figure 109. Comparison of greenhouse gas emissions in the greenhouse gas inventory up to 2019 with the greenhouse gas inventory up to 2022 (in Gg CO2-eq)



Source: Team Analysis

12.3 Key improvements over the previous inventory

In the process of preparing this National Greenhouse Gas Inventory (NID) report, several methodological and technical improvements were made compared to the previous inventory. These improvements relate to improving the quality of activity data, advancing quality assurance and control (QA/QC) procedures, improving time series, and using additional data sources. In Table **38** the main improvements made to this inventory by sector are shown.

Table 38. Improvements made in this inventory compared to the previous one

Sector	Improvement introduced in this inventory	Description of the improvement	Expected impact
Energy	Standardization of input data and conversion factors	Additional QC checks were conducted to ensure consistency of net calorific values and conversion factors used in the IPCC Inventory Software (version 2025).	Improved consistency of calculations and reduction of methodological inconsistencies
Energy	Audit of fuel consumption data	The fuel consumption data were additionally checked and aligned with the breakdown in the national energy balances.	Improved consistency of activity data and time series
Energy	Improved QA/QC procedures	Additional data quality checks have been introduced to identify inconsistencies in the nomenclature of energy sources and conversion factors.	Increased transparency and reliability of emissions estimates
Industrial processes and product use	Updated data on F-gases	Updated data on imports of fluorinated gases provided by the Ozone Department of the MoEPP were used.	Improved accuracy of emissions estimates
Industrial processes and product use	Improved time series consistency	An additional check of the activity data was conducted in order to improve the consistency of the emission estimates in the time series.	Improved reliability of emissions trends
Agriculture – livestock farming	Application of Tier 2 methodology for key categories	Additional data on farm structure, feeding systems and manure management were used in order to continue the application of the Tier 2 methodology for dairy cattle and pigs.	Improved accuracy of emissions estimates
Agriculture	Improving calculations of direct and indirect N2O emissions from agriculture	IPCC Inventory Software (version 2025) allows the inclusion of all animal categories	More realistic emissions estimates
Land and land use changes	Improved spatial data analysis	A combination of national statistical data and satellite imagery (Landsat and Sentinel) was used to assess land use changes.	Improved representativeness of activity data
Land and land use changes	Application of Object-Based Analysis (OBIA)	Satellite images were classified using the OBIA methodology, which allowed for better identification of land use categories.	Improved spatial accuracy of data
Land and land use changes	Inclusion of perennial plants in the category of fruit plantations	Included are sinkh from the category of fruit plantations for perennial plants (orchards and other permanent plantations).	Improved completeness and representativeness of carbon removal estimates
Waste	Including regional data distribution	Waste generation and treatment estimates were further disaggregated by statistical regions, allowing for better spatial representativeness of activity data.	Improved spatial detail and transparency of assessments
Waste	Recalculation of emissions from medical waste incineration	Emissions from medical waste incineration were recalculated based on updated activity data.	Improved accuracy of emissions estimates
Waste	Inclusion of data from wastewater treatment plants	The inventory includes data on wastewater treatment and sludge generation from wastewater treatment plants, improving the completeness of the wastewater category.	Improved inventory completeness
Waste	Improved classification of industrial wastewater	Industrial wastewater data was revised because some industry categories were not included in the calculations.	Improved inventory completeness

12.3.1 Implementation of recommendations from the previous inventory by 2019

In the process of preparing this inventory, the recommendations identified in the previous report were reviewed and activities were undertaken for their gradual implementation. The improvements relate to improving the quality of activity data, improving institutional cooperation with data providers and improving the applied methodologies. The main activities undertaken in this inventory are summarized below.

In the Energy sector, activities were undertaken to establish better cooperation with institutions that have data on the composition and carbon content of fuels. In this regard, data were requested from the companies Nomagas and ESM, in order to improve the national emission factors. By the time of finalization of the inventory, adequate data for updating the emission factors were not provided, which is why it is planned to organize additional meetings with the relevant institutions to define a permanent mechanism for submitting the necessary data in future inventories. In the Transport sub-sector, a significant methodological improvement was made by recalculating the entire time series of emissions for the period 1990–2022 using the Tier 3 methodology with the COPERT tool, which represents a significant improvement compared to previous estimates.

In the Industrial Processes and Product Use (IPPU) sector, improvements were made in the use of available data and their consistency with other national sources. In the categories related to the mineral and metal industry, a discrepancy was identified between the data used in the inventory and the data available in the national pollutant inventory of the Ministry of Environment and Physical Planning. Therefore, it is planned to organize meetings with the relevant industrial companies and the State Statistical Office in the next inventory, in order to harmonize the input data for the entire time series. In the F-gases category, the inventory was updated with new data provided by the POPs office in the MoEPP for the period 2012–2022, although the data are still only available at an aggregated level. The need for detailed data by type of equipment remains open and is a priority for further improvement. Additionally, an analysis of potential sources of N_2O emissions from medical devices and SF_6 from electrical equipment has been conducted, but due to limited data availability, these categories are currently reported as "NE", with more detailed analyses planned in the next inventory.

In the Agriculture, Forestry and Other Land Use (AFOLU) sector, improvements were made in the availability of activity data. In the Livestock sub-sector, additional data from the Food and Veterinary Agency (FVA) were used, improving the basis for the application of higher-level methodologies. In the Land sub-sector, activities continued to use remote sensing and satellite imagery data to improve land use change assessments and their spatial representativeness. In addition, the need to improve data on mineral fertilizer use, organic residue management and other relevant data on activities that affect greenhouse gas emissions from land was identified. In the Forestry sub-sector, the need to establish systematic data collection remains, including a national forest inventory, the development of local growth tables and a system for monitoring natural disturbances.

In the Waste sector, specific improvements were made to the methodology and input data. The inventory was improved by disaggregating emissions by region and recalculating the entire time series, which allows for better spatial representation of waste generation and management data. In addition, input data on the composition of municipal waste were improved, which contributes to a more accurate assessment of emissions from landfills. In the area of wastewater treatment plants, initial data were collected in order to include emissions from sludge generation. However, due to insufficiently clarified conversion factors, this improvement will be further developed in the next inventory.

The activities undertaken show that the recommendations from the previous report are gradually being implemented, although some of the improvements require further strengthening of institutional cooperation and improvement of data collection systems. Further improvement of the national greenhouse gas inventory system will focus on establishing continuous data flows with relevant institutions, developing national emission factors and gradually moving towards higher-level methodologies in line with the IPCC guidelines.

12.4 Improvements in data and methodologies

The analysis of available data, QC reports and findings from sectoral documentation indicates that the existing system for the preparation of the national greenhouse gas inventory has solid foundations, but visible shortcomings remain that must be overcome in order to achieve higher precision, transparency and compliance with the requirements of the Framework Convention and the ETF framework. In several areas, it is necessary to improve the methodology, data collection systems and institutional coordination, in order to ensure consistent and reliable time series for all categories.

One of the most significant conclusions concerns the need for standardization and improved organization of input data used in particular for the calculation of emissions, and for all sectors. It is necessary to establish a single, central and official database of input data for all AFOLU categories, with clearly defined procedures for approval, revision and monitoring of changes. In the IPCP, it is necessary to additionally revise the series up to 1990 through cooperation with the companies due to differences that arise from different data sources. Also, QC in the Waste sector noted that the same company publishes different data in different places and as a result, it is necessary to delimit with the company which data is correct and if there is a need to make a change in the waste sector.

Quality control (QC) also pointed out methodological inconsistencies, such as the different number of decimals in the conversion factors and the inconsistency in the nomenclature of energy sources, which in the IPCC software from 2025 causes additional confusion, resulting in significant differences in net calorific values and calculations for certain years. It is necessary to establish a single set of conversion factors, with the mandatory use of a standardized number of decimals and automated QC algorithms that will warn of any deviation. For better traceability, it is recommended to maintain Excel matrices with input data for each year, which has already proven to be a good practice.

In livestock farming, the key recommendation is to move towards a wider application of the Tier 2 methodology, especially for dairy cattle and pigs, and to examine how to reconcile the entire time series, as there are now different methods that have yielded significant differences in results. The recommendation stems from the fact that detailed national data on farming systems, farm structures, feeding regimes and manure management are currently lacking. According to the sector report, “Tier 2 methodology should be used to estimate emissions for dairy cattle and pigs”, but this is only possible if additional data are provided. Therefore, the potential of the surveys that the AHV conducts to categorize dairy cattle and pig farms should be exploited, and if they do not provide sufficient information, it is advisable to organize a new field survey. Such a survey would allow the definition of typical farming systems, the technologies used and manure management practices, which is a basic prerequisite for calculating emissions under the Tier 2 methodology. Additionally, it is recommended that emissions from waste management be reduced by the quantities discharged to biogas plants, which will ensure greater reality of the calculations.

In forestry, significant improvements in spatial data and methods for monitoring changes are needed. Current variations in area, biomass and growth are a result of the lack of a modern national forest inventory and the reliance on data collected over long time intervals. To avoid anomalies such as abrupt changes in the category of "unmanaged forest land", it is necessary to establish a methodology that combines spatial data with field verifications, using modern GIS and remote-sensing tools (Sentinel, LandSAT, Lidar), and to develop national growth and biomass factors. In addition, for cropland and grassland, although the combination of SSO data with CORINE/CLC+Backbone has created a solid foundation, gaps remain in national emission factors, especially for soil carbon stocks. Therefore, it is recommended to establish a soil monitoring program to develop nationally adapted SOC factors, which would improve the quality of calculations for conversions between land categories. It is also necessary to standardize data on agrotechnical practices, which are currently not part of official statistics, but directly affect emissions.

In the categories of settlements, wetlands and other land, the establishment of a continuous system for monitoring transitions is of utmost importance. Regular use of CLC+Backbone is required and interpolations in years where spatial data are missing should be avoided, as they create potential systematic errors. Establishing a national geospatial database with annual updates would allow for much more precise assessments of changes in land categories.

The implementation of these measures will enable a significant improvement in the quality of the national inventory, reduction of uncertainties and achievement of a higher level of transparency and compliance with international requirements. InTable 39A plan for improvement is shown and who is responsible for doing it.

Table 39. Improvement plan

Area / sector	Recommendation	Responsible institution	Priority	Time frame	Expected improvement/impact
National Inventory System	Improving institutional coordination and data collection systems for all sectors	MoEPP (inventory coordinator) and the national inventory development team	Tall	Short-term – medium-term	Better time series consistency and improved transparency
Input data (all sectors)	Establishing a centralized national database of input data with procedures for auditing and monitoring changes	MoEPP and the national inventory development team	Tall	Medium term	Better data traceability and error reduction
IPPU sector	Revision of the time series up to 1990 due to differences in data from different sources	The National Inventory Team, the Ministry of Environment, the relevant industrial companies and the State Statistical Office	Medium	Short-term	Improving data consistency
Waste sector	Harmonization of data submitted by companies and definition of a final data source	National Inventory Team and MoEPP and landfill operators/utilities	Tall	Short-term	Reducing uncertainty in calculations
Energy	Standardization of conversion factors and nomenclature of energy sources	The National Inventory Team	Tall	Short-term	Reducing methodological inconsistencies
Data management	Maintaining Excel matrices with input data	The National Inventory Team	Medium	Short-term	Better QA/QC control and traceability
Livestock farming	Greater application of Tier 2 methodology for dairy cattle and pigs and development of methodology for 1990-2016 data where Tier 1 is used	National Inventory and AHV Team	Tall	Medium term	Greater accuracy of emissions estimates
Livestock farming	Using AHV survey data for farm categorization	National Inventory and AHV Team	Medium	Short-term	Better national parameters
Livestock farming	Organizing additional field research on farming systems	MoEPP, AHV and scientific institutions	Medium	Medium term	Improving national factors

Biogas plants	Correction of emissions from waste management by subtracting the quantities used for biogas	The National Inventory Team	Medium	Short-term	More realistic emissions estimates
Forestry	Improving spatial data on forest areas	The National Inventory Team in cooperation with the PE "National Forests" and the Ministry of Environment and Public Protection	Tall	Medium term	Reducing uncertainty in the AFOLU sector
Forestry	Using GIS and remote sensing data (Sentinel, Landsat, LiDAR)	The National Inventory Team in cooperation with the PE "National Forests" and the Ministry of Environment and Public Protection	Medium	Medium term	Better estimation of biomass and growth
Soils	Establishing a national soil monitoring system for SOC factors	Ministry of Agriculture and Scientific Institutions	Medium	Long term	Reducing uncertainty in calculations
Agricultural practices	Improving statistical data on agrotechnical practices	The National Inventory Team in cooperation with the Ministry of Agriculture, Forestry and Water Management	Medium	Medium term	Better data activities
Land categories	Establishing a system for continuous monitoring of land transitions	National Inventory Team, MoEPP and Geospatial Institutions	Medium	Medium term	Better spatial data consistency
Spatial data	Regularly using CLC+Backbone and avoiding interpolations	National Inventory Team	Medium	Short-term	Reducing systematic errors
Geospatial database	Development of a national geospatial database with annual updates	National Inventory Team and MoEPP	Medium	Medium term	Better accuracy of land category assessments

As stated in the introduction to this inventory, the structure of this National Inventory is largely aligned with the outline for a National Inventory Document defined under the Enhanced Transparency Framework of the Paris Agreement, as established by Decision 5/CMA.3. The inventory contains all the main elements foreseen in this structure, including an overview of national emissions and sinks, detailed sectoral chapters, analysis of key categories, uncertainty analysis, quality assurance and control (QA/QC) activities, explanations for recalculations, and identification of areas for further improvement. However, in certain parts the way in which the information is structured differs from the proposed format of the outline, in particular with regard to certain information that, according to the recommended structure, should be integrated into each sectoral or sub-categorical chapter. These differences relate primarily to the presentation of uncertainty analysis, QA/QC procedures, recalculations and planned improvements, which have been retained as separate chapters in order to ensure comparability with the previous inventory until 2019.

In this sense, this inventory can be considered as a transitional document in the process of aligning with the reporting structure provided for in the Enhanced Transparency Framework. All information required by the guidelines is included in the report, but in some cases is organized in separate chapters. In the next inventory cycle, the inventory team plans to fully align the structure of the document with the outline of Decision 5/CMA.3, which will include integrating information on uncertainty, QA/QC activities, recalculations and planned improvements directly into the sectoral and sub-categorical chapters.

12.5 Areas for further capacity building

The experiences from the preparation of the last inventory indicate the need for further strengthening of capacities in the area of working with the IPCC Inventory Software, managing input data and internal coordination processes. During the preparation period of BTR1, experts from the AFOLU sector entered the data directly into the 2020 version of the software, and then the MANU team was responsible for transferring them and harmonizing them with the latest 2025 version of the software. This process was necessary because in the previous period some of the experts were new to the inventory preparation system, and the available time for preparation was limited. In addition, the new version of the software is significantly more complex, with a larger number of sheets and modified data entry formats. These circumstances emphasized the need for more organized and systematic training in the use of the IPCC software, especially for the AFOLU sector, where the detail and number of categories require full knowledge of the structure of each part of the tool.

In the future, it is recommended:

- Developing a structured training program for all experts working with the IPCC software, with a special focus on the AFOLU sector, which is methodologically the most complex and error-prone.
- Regular practical workshops on new versions of the IPCC software, with demonstrations on data entry, use of QC systems, and consistency checking of time series.
- Creating guidelines and checklists specific to national circumstances, which will serve as reference documents for new team members and reduce the risk of errors in data entry and processing.

In parallel with this, the work process has shown that even the IPCC Inventory Software itself has certain inconsistencies, limitations and technical challenges that sometimes complicate the input or create the need for additional corrections. Therefore, in the future, the possibility of developing a national Macedonian inventory support software can be seriously considered, following the example of several countries that already use their own tools integrated with the IPCC methodology. Such a solution would allow for greater flexibility, better automation of calculations, better permanent archiving of data and significantly more efficient time series management, as well as the incorporation of QC methods.

The migration from the old to the new version of the IPCC software has shown that continuous capacity building is essential for maintaining the quality and stability of the national inventory system. Investment in human capital, regular training and transparent inter-institutional cooperation will be key to further strengthening domestic capacities and successfully fulfilling the obligations under the transparency framework under the Paris Agreement.

12.6 Gender issue

Gender mainstreaming is an important principle in the implementation of climate policies and in reporting processes to the United Nations Framework Convention on Climate Change (UNFCCC). The Paris Agreement and the adopted Gender Action Plan (GAP) emphasize the need for climate policies and transparency systems to ensure inclusive and equal participation of women and men in decision-making processes, technical expertise and capacity building. This approach aims to ensure that different social groups are included in the processes of creating and implementing climate policies. In this context, the Republic of North Macedonia strives to integrate a gender perspective in the processes related to the preparation and continuous improvement of the national greenhouse gas inventory.

The National Greenhouse Gas Inventory is a key component of the national monitoring, reporting and verification (MRV) system under the Enhanced Transparency Framework (ETF) established by the Paris Agreement. The inventory preparation is based on broad institutional cooperation between state institutions, academic organizations and sector experts who provide activity data and technical information for the different sectors. Within these processes, an inclusive approach is promoted that ensures equal participation of women and men in expert teams, technical consultations and quality assurance and control (QA/QC) activities. Such an approach contributes to improving the transparency, quality and reliability of the national inventory system. The institutional structure for the preparation of the national inventory includes experts from different scientific disciplines and institutions, ensuring the participation of experts from the academic sector, state institutions and relevant stakeholders. Workshops, technical meetings and consultations with data-providing institutions allow for the active participation of a wide range of experts and representatives of institutions. These activities contribute to improving the quality of data, methodologies and institutional coordination related to the preparation of the inventory. In addition, this approach contributes to strengthening the expert capacities of the institutions participating in the national reporting system.

The analysis of the composition of the expert team engaged in the preparation of the national greenhouse gas inventory shows a relatively balanced gender structure. Out of a total of 15 experts involved in the inventory preparation process, 6 are women, representing about 40 percent of the total team. The remaining 9 experts are men, representing about 60 percent of the team. Women actively participate in several technical areas related to the inventory preparation, including data analysis, sectoral calculations and scientific expertise. This indicates a significant participation of women in the scientific and technical activities related to the national greenhouse gas inventory system. In addition, the analysis of the attendance lists from the workshops organized within the framework of the preparation of the national greenhouse gas inventory and the process of preparing the climate change mitigation document organized at MANU also shows a relatively balanced participation of men and women. Out of a total of about 120 participants in these workshops, approximately 52 are women, representing about 43 percent of the participants. The remaining 68 or so participants are men, or about 57 percent of the total number of participants. Women actively participate in the consultation and capacity-building process related to the preparation of the inventory. They represent institutions such as ministries, scientific institutions, international organizations and other relevant stakeholders. Such participation indicates significant involvement of women in the technical and institutional activities related to the national greenhouse gas inventory system.

Such a gender structure contributes to an inclusive approach in the process of preparing and improving the national greenhouse gas inventory. At the same time, it contributes to strengthening transparency, expert cooperation and institutional coordination within the national monitoring, reporting and verification system. The inclusive participation of experts from different institutions enables a better exchange of knowledge and experiences in the inventory preparation process. In line with the principles of the UNFCCC Gender Action Plan, further strengthening of gender-sensitive approaches in capacity-building processes and institutional coordination is expected in the future. This will contribute to further improving the participation of experts in the preparation of national greenhouse gas reports and inventories.

Annex I

A I.1 Applied methods

Table 40. Methods applied in the preparation of the greenhouse gas inventory (for 2022)

Categories	CO2		CH4		N2O		HFCs		PFCs		SF6	
	Method used	Emission factors	Method used	Emission factors	Method used	Emission factors	Method used	Emission factors	Method used	Emission factors	Method used	Emission factors
1 - Energy	**T1, T2**	**CS, DF**	**T1**	**DF**	**T1**	**DF**						
1.A – Activities involving the combustion of fuel	T1, T2	CS, DF	T1	DF	T1	DF						
1.A.1 – Energy industries	T2	CS	T1	DF	T1	DF						
1.A.2 – Manufacturing Industries and Construction	T1, T2	CS, DF	T1	DF	T1	DF						
1.A.3 - Transport	T2	CS, DF	T2	DF	T2	DF						
1.A.4 – Other sectors	T1, T2	CS, DF	T1	DF	T1	DF						
1.A.5 – Non-Specified	T1, T2	CS, DF	T1	DF	T1	DF						
1.B – Fugitive emissions from fuels	T1	DF	T1	DF								
1.B.1 – Solid fuels			T1	DF								
1.B.2 – Oil and natural gas	T1	DF	T1	DF								
2 – Industrial Processes and Product Use	**T1, T2**	**CS, DF**					**T1**	**DF**	**T1**	**DF**	**NO, NE**	**NO, NE**
2.A – Mineral Industry	T1, T2	CS, DF										
2.A.1 – Cement production	T2	CS										
2.A.2 – Lime production	T1	DF										
2.A.3 – Glass production	T1	DF										
2.A.4 – Other processes uses of carbonates	T1	DF										
2.A.5 - Other	NO	NO	NO	NO								
2.B – Chemical industry	T1	DF										
2.B.1 – Ammonia Production	NO	NO										
2.B.2 – Nitric Acid Production					NO	NO						
2.B.3 – Adipic Acid Production					NO	NO						
2.B.4 - Caprolactam, Glyoxal and Glyoxylic acid Production					NO	NO						
2.B.5 - Carbide Production	NO	NO	NO	NO								
2.B.6 - Titanium Dioxide production	NO	NO										
2.B.7 – Soda Ash Production	NO	NO										
2.B.8 – Petrochemical and Carbon Black production	NO	NO										
2.B.9 – Fluorochemical production												
2.B.10 - Other												
2.C – Metal Industry	T2	CS	T1	DF					NO	NO		
2.C.1 – Iron and steel production	T2	CS	NO	NO								
2.C.2 - Ferroalloys production	T2	CS	T1	DF								
2.C.3 - Aluminum production	NO	NO							NO	NO		
2.C.4 - Magnesium production	NO	NO										
2.C.5 - Lead production	T1	DF										
2.C.6 - Zinc production	NO	NO										
2.C.7 - Other												
2.D – Non-energy products from fuel and solvent use												
2.D.1 – Lubricants use	NE	NE										
2.D.2 – Paraffin wax use	NE	NE										
2.D.3 – Solvent use												
2.D.4 - Other	NO	NO										
2.E – Electronics industry							NO	NO	NO	NO	NO	NO
2.E.1 – Integrated circuit or semiconductor							NO	NO	NO	NO	NO	NO
2.E.2 - TFT flat panel display									NO	NO	NO	NO
2.E.3 - Photovoltaics									NO			
2.E.4 – Heat transfer fluid									NO			
2.E.5 - Other							NO	NO	NO	NO	NO	NO
2.F – Products uses as substitutes for ozone depleting substances							**T1**	**DF**				

2.F.1 – Refrigeration and Air Conditioning							T1	DF				
2.F.2 – Foam Blowing Agents							NO	NO				
2.F.3 – Fire protection							NO	NO	NO	NO		
2.F.4 - Aerosols							NO	NO				
2.F.5 – Solvents							NO	NO	NO	NO		
2.F.6 – Other applications												
2.G – Other Product Manufacture and Use	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		
2.G.1 – Electrical equipment									NE	NE		
2.G.2 - SF6 and PFCs from other product uses									NO	NO	NE	NE
2.G.3 - N2O from product uses					NE	NE						
2.G.4 - Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		
2.H - Other												
2.H.1 – Pulp and paper industry												
2.H.2 – Food and Beverage Industry												
2.H.3 - Other												
3 – Agriculture, forestry and other land use	**T1**	**DF**	**T1**	**DF**	**T1**	**DF**						
3.A - Livestock	NO	NO	T1, T2	DF	T1, T2	DF						
3.A.1 – Enteric fermentation			T1, T2	DF								
3.A.2 – Manure management			T1, T2	DF	T1, T2	DF						
3.B - Land	T1	DF										
3.B.1 – Forest land	T1	DF										
3.B.2 – Cropland	T1	DF										
3.B.3 - Grassland	T1	DF										
3.B.4 - Wetlands	NE	NE			NE	NE						
3.B.5 – Settlements	T1	DF										
3.B.6 – Other land	T1	DF										
3.C – Aggregate sources and non-CO2 emissions sources on land	T1	DF	T1	DF	T1	DF						
3.C.1 – Burning			NE	NE	NE	NE						
3.C.2 - Liming	NE	NE										
3.C.3 – Urea Application	T1	DF										
3.C.4 - Direct N2O emissions from managed soils					T1	DF						
3.C.5 - Indirect N2O emissions from managed soils					T1	DF						
3.C.6 – Indirect N2O emissions from manure management					T1	DF						
3.C.7 – Rice cultivation			T1	DF								
3.C.8 - Other												
3.D - Other	T1	DF										
3.D.1 – Harvested Wood Products	T1	DF										
3.D.2 - Other												
4 - Waste	**T1**	**DF**	**T1, T2**	**DF**	**T1**	**DF**						
4.A – Solid waste disposal			T2/T3	DF								
4.B – Biological treatment of solid waste			T1	DF								
4.C – Incineration and open burning of waste	T1	DF	T1	DF	T1	DF						
4.D – Wastewater treatment and discharge			T2	DF	T1	DF						
4.E - Other												
5 - Other												
5.A – Indirect N2O emissions from atmospheric deposition of nitrogen in NOx and NH3					NE	NE						
5.B - Other												
Memo items												
International bunkers												
1.A.3.ai – International Aviation (International Bunkers)	T1	DF	T1	DF	T1	DF						
1.A.3.di – International water-borne navigation (international bunkers)	NO	NO	NO	NO	NO	NO						

Annex II Detailed tables from the Greenhouse Gas Inventory

Table 41. Greenhouse gas inventory for 2019

Categories	Emissions (Gg)			Emissions CO2 equivalents (Gg)			
	Net CO2*	CH4	N2O	HFCs	PFCs	SF6	Other halogenated gases with conversion factors equivalent to CO2
Total National Emissions and Removals	10,182.21	65.11	2.45	348.74	NO, NO	NO, NO	NO, NO
1 - Energy	8,228.90	9.23	0.23	NA	NA	NA	NA
1.A - Fuel Combustion Activities	8,224.49	3.35	0.23	NA	NA	NA	NA
1.A.1 - Energy Industries	4,573.95	0.05	0.06	NA	NA	NA	NA
1.A.2 - Manufacturing Industries and Construction	1,063.41	0.08	0.01	NA	NA	NA	NA
1.A.3 - Transport	2,319.28	0.70	0.13	NA	NA	NA	NA
1.A.4 - Other Sectors	76.51	2.44	0.03	NA	NA	NA	NA
1.A.5 - Non-Specified	191.34	0.08	0.00	NA	NA	NA	NA
1.B - Fugitive emissions from fuels	4.41	5.87	NA	NA	NA	NA	NA
1.B.1 - Solid Fuels	4.41	5.87	NA	NA	NA	NA	NA
1.B.2 - Oil and Natural Gas	0.00	0.00	NA	NA	NA	NA	NA
1.B.3 - Other emissions from Energy Production	NO	NO	NA	NA	NA	NA	NA
1.C - Carbon dioxide Transport and Storage	NO	NA	NA	NA	NA	NA	NA
1.C.1 - Transport of CO2	NO	NA	NA	NA	NA	NA	NA
1.C.2 - Injection and Storage	NO	NA	NA	NA	NA	NA	NA
1.C.3 - Other	NO	NA	NA	NA	NA	NA	NA
2 - Industrial Processes and Product Use	484.12	0.00	NO, NO	348.74	NO, NO	NO, NO	NO, NO
2.A - Mineral Industry	395.17	NO, NO	NO, NO	NA	NA	NA	NA
2.A.1 - Cement production	376.89	NA	NA	NA	NA	NA	NA
2.A.2 - Lime production	17.25	NA	NA	NA	NA	NA	NA
2.A.3 - Glass Production	0.07	NA	NA	NA	NA	NA	NA
2.A.4 - Other Process Uses of Carbonates	0.96	NA	NA	NA	NA	NA	NA
2.A.5 - Other (please specify)	NO	NO	NO	NA	NA	NA	NA
2.B - Chemical Industry	NA..NO	NA..NO	NO, NO	NA..NO	NO, NO	NO, NO	NO, NO
2.B.1 - Ammonia Production	NO.	NA	NA	NA	NA	NA	NA
2.B.2 - Nitric Acid Production	NA	NA	NO	NA	NA	NA	NA
2.B.3 - Adipic Acid Production	NA	NA	NO	NA	NA	NA	NA
2.B.4 - Caprolactam, Glyoxal and Glyoxylic Acid Production	NA	NA	NO	NA	NA	NA	NA
2.B.5 - Carbide Production	NO	NO	NA	NA	NA	NA	NA
2.B.6 - Titanium Dioxide Production	NO	NA	NA	NA	NA	NA	NA
2.B.7 - Soda Ash Production	NO	NA	NA	NA	NA	NA	NA
2.B.8 - Petrochemical and Carbon Black Production	NO	NO.	NA	NA	NA	NA	NA
2.B.9 - Fluorochemical Production	NA	NA	NA	NO	NO	NO	NO
2.B.10 - Other (Please specify)	NO	NO	NO	NO	NO	NO	NO
2.C - Metal Industry	88.95	0.00	NO, NO	NA..NO	NO, NO	NO, NO	NO, NO
2.C.1 - Iron and Steel Production	21.71	NO	NA	NA	NA	NA	NA
2.C.2 - Ferroalloys Production	61.54	0.00	NA	NA	NA	NA	NA
2.C.3 - Aluminium production	NO	NA	NA	NA	NO	NA	NA
2.C.4 - Magnesium production	NO	NA	NA	NA	NA	NO	NA
2.C.5 - Lead Production	5.70	NA	NA	NA	NA	NA	NA
2.C.6 - Zinc Production	NO	NA	NA	NA	NA	NA	NA
2.C.7 - Other (please specify)	NO	NO	NO	NO	NO	NO	NO
2.D - Non-Energy Products from Fuels and Solvent Use	0.00	NA..NO	NO, NO	NA	NA	NA	NA
2.D.1 - Lubricant Use	NO	NA	NA	NA	NA	NA	NA
2.D.2 - Paraffin Wax Use	NO	NA	NA	NA	NA	NA	NA
2.D.3 - Solvent Use	NA.	NA	NA	NA	NA	NA	NA
2.D.4 - Other (please specify)	0.00	NO	NO	NA	NA	NA	NA
2.E - Electronics Industry	NO, NO	NO, NO	NO, NO	NA..NO	NO, NO	NO, NO	NO, NO
2.E.1 - Integrated Circuit or Semiconductor	NA	NA	NA	NO	NO	NO	NO
2.E.2 - TFT Flat Panel Display	NA	NA	NA	NA	NO	NO	NO
2.E.3 - Photovoltaics	NA	NA	NA	NA	NO	NA	NA
2.E.4 - Heat Transfer Fluid	NA	NA	NA	NA	NO	NA	NA
2.E.5 - Other (please specify)	NO	NO	NO	NO	NO	NO	NO
2.F - Product Uses as Substitutes for Ozone Depleting Substances	NA	NA	NA	348.74	YES, NO, NO	NA	NA
2.F.1 - Refrigeration and Air Conditioning	NA	NA	NA	348.74	NA	NA	NA
2.F.2 - Foam Blowing Agents	NA	NA	NA	NO	NA	NA	NA
2.F.3 - Fire Protection	NA	NA	NA	NO	NO	NA	NA

2.F.4 - Aerosols	NA	NA	NA	NO	NA	NA	NA
2.F.5 - Solvents	NA	NA	NA	NO	NO	NA	NA
2.F.6 - Other Applications (please specify)	NA	NA	NA	NO	NO	NA	NA
2.G - Other Product Manufacture and Use	NO, NO	NO, NO	YES, NO, NO	NO, NO	NO, NO, NO	NO, NO, NO	NO, NO
2.G.1 - Electrical Equipment	NA	NA	NA	NA	NO	NO	NA
2.G.2 - SF6 and PFCs from Other Product Uses	NA	NA	NA	NA	NO	NO	NA
2.G.3 - N2O from Product Uses	NA	NA	NO	NA	NA	NA	NA
2.G.4 - Other (Please specify)	NO	NO	NO	NO	NO	NO	NO
2.H - Other	NO	NO	NA	NA	NA	NA	NA
2.H.1 - Pulp and Paper Industry	NO	NO	NA	NA	NA	NA	NA
2.H.2 - Food and Beverages Industry	NO	NO	NA	NA	NA	NA	NA
2.H.3 - Other (please specify)	NO	NO	NO.	NA	NA	NA	NA
3 - Agriculture, Forestry, and Other Land Use	1,462.75	29.28	2.07	NA	NA	NA	NA
3.A - Livestock	NA	28.62	0.36	NA	NA	NA	NA
3.A.1 - Enteric Fermentation	NA	25.08	NA	NA	NA	NA	NA
3.A.2 - Manure Management	NA	3.54	0.36	NA	NA	NA	NA
3.B - Land	1,460.04	NA	YES, NO	NA	NA	NA	NA
3.B.1 - Forest land	1,046.90	NA	NA	NA	NA	NA	NA
3.B.2 - Cropland	26.74	NA	NA	NA	NA	NA	NA
3.B.3 - Grassland	195.42	NA	NA	NA	NA	NA	NA
3.B.4 - Wetlands	NO	NA,	NO	NA	NA	NA	NA
3.B.5 - Settlements	11.32	NA	NA	NA	NA	NA	NA
3.B.6 - Other Land	179.66	NA	NA	NA	NA	NA	NA
3.C - Aggregate sources and non-CO2 emissions sources on land	2.71	0.66	1.71	NA	NA	NA	NA
3.C.1 - Emissions from biomass burning	NA	NO	NO	NA	NA	NA	NA
3.C.2 - Liming	NO	NA	NA	NA	NA	NA	NA
3.C.3 - Urea application	2.71	NA	NA	NA	NA	NA	NA
3.C.4 - Direct N2O Emissions from managed soils	NA	NA	1.15	NA	NA	NA	NA
3.C.5 - Indirect N2O Emissions from managed soils	NA	NA	0.34	NA	NA	NA	NA
3.C.6 - Indirect N2O Emissions from manure management	NA	NA	0.22	NA	NA	NA	NA
3.C.7 - Rice cultivation	NA	0.66	NA	NA	NA	NA	NA
3.C.8 - Other (please specify)	NA	NO	NO	NA	NA	NA	NA
3.D - Other	NO	NO, NO	NO, NO	NA	NA	NA	NA
3.D.1 - Harvested Wood Products	NO	NA	NA	NA	NA	NA	NA
3.D.2 - Other (please specify)	NO	NO	NO	NA	NA	NA	NA
4 - Waste	6.44	26.60	0.14	NA	NA	NA	NA
4.A - Solid Waste Disposal	NA	21.69	NA	NA	NA	NA	NA
4.B - Biological Treatment of Solid Waste	NA	0.00	0.00	NA	NA	NA	NA
4.C - Incineration and Open Burning of Waste	6.44	0.49	0.01	NA	NA	NA	NA
4.D - Wastewater Treatment and Discharge		4.43	0.13	NA	NA	NA	NA
4.E - Other (please specify)	NO	NO	NO	NA	NA	NA	NA
5 - Other	NO	NO	NO	NA	NA	NA	NA
5.A - Indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3	NO	NO	NO	NA	NA	NA	NA
5.B - Other (please specify)	NO	NO	NO	NA	NA	NA	NA
				.			
Memo Items (5)				.			
International Bunkers	83.66	0.00	0.00	NA	NA	NA	NA
1.A.3.a.i - International Aviation (International Bunkers)	83.66	0.00	0.00	NA	NA	NA	NA
1.A.3.d.i - International water-borne navigation (International bunkers)	NO	NO	NO	NA	NA	NA	NA
1.A.5.c - Multilateral Operations	NO	NO	NO	NA	NA	NA	NA

NO - Not occurring; NA – Not Applicable; NE – Not Estimated

**Net CO2 emissions (emissions minus sinks)*

Table 42. Greenhouse gas inventory for 2020

Categories	Emissions (Gg)			Emissions CO2 equivalents (Gg)			
	Net CO2*	CH4	N2O	HFCs	PFCs	SF6	Other halogenated gases with conversion factors equivalent to CO2
Total National Emissions and Removals	3,733.13	62.93	2.49	295.95	NO, NO	NO, NO	NO, NO
1 - Energy	6,987.17	8.56	0.20	NA	NA	NA	NA
1.A - Fuel Combustion Activities	6,983.12	3.17	0.20	NA	NA	NA	NA
1.A.1 - Energy Industries	3,737.98	0.04	0.04	NA	NA	NA	NA
1.A.2 - Manufacturing Industries and Construction	1,066.39	0.07	0.01	NA	NA	NA	NA
1.A.3 - Transport	1,956.57	0.57	0.11	NA	NA	NA	NA
1.A.4 - Other Sectors	62.68	2.40	0.03	NA	NA	NA	NA
1.A.5 - Non-Specified	159.51	0.08	0.00	NA	NA	NA	NA
1.B - Fugitive emissions from fuels	4.05	5.39	NA	NA	NA	NA	NA
1.B.1 - Solid Fuels	4.05	5.39	NA	NA	NA	NA	NA
1.B.2 - Oil and Natural Gas	0.00	0.00	NA	NA	NA	NA	NA
1.B.3 - Other emissions from Energy Production	NO	NO	NA	NA	NA	NA	NA
1.C - Carbon dioxide Transport and Storage	NO	NA	NA	NA	NA	NA	NA
1.C.1 - Transport of CO2	NO	NA	NA	NA	NA	NA	NA
1.C.2 - Injection and Storage	NO	NA	NA	NA	NA	NA	NA
1.C.3 - Other	NO	NA	NA	NA	NA	NA	NA
2 - Industrial Processes and Product Use	494.73	0.00	NO, NO	295.95	NO, NO	NO, NO	NO, NO
2.A - Mineral Industry	401.77	NO, NO	NO, NO	NA	NA	NA	NA
2.A.1 - Cement production	400.78	NA	NA	NA	NA	NA	NA
2.A.2 - Lime production	NO	NA	NA	NA	NA	NA	NA
2.A.3 - Glass Production	0.04	NA	NA	NA	NA	NA	NA
2.A.4 - Other Process Uses of Carbonates	0.94	NA	NA	NA	NA	NA	NA
2.A.5 - Other (please specify)	NO	NO	NO	NA	NA	NA	NA
2.B - Chemical Industry	NO, NO	NO, NO	NO, NO	NO, NO	NO, NO	NO, NO	NO, NO
2.B.1 - Ammonia Production	NO	NA	NA	NA	NA	NA	NA
2.B.2 - Nitric Acid Production	NA	NA	NO	NA	NA	NA	NA
2.B.3 - Adipic Acid Production	NA	NA	NO	NA	NA	NA	NA
2.B.4 - Caprolactam, Glyoxal and Glyoxylic Acid Production	NA	NA	NO	NA	NA	NA	NA
2.B.5 - Carbide Production	NO	NO	NA	NA	NA	NA	NA
2.B.6 - Titanium Dioxide Production	NO	NA	NA	NA	NA	NA	NA
2.B.7 - Soda Ash Production	NO	NA	NA	NA	NA	NA	NA
2.B.8 - Petrochemical and Carbon Black Production	NO	NO	NA	NA	NA	NA	NA
2.B.9 - Fluorochemical Production	NA	NA	NA	NO	NO	NO	NO
2.B.10 - Other (Please specify)	NO	NO	NO	NO	NO	NO	NO
2.C - Metal Industry	92.96	0.00	NO, NO	NO, NO	NO, NO	NO, NO	NO, NO
2.C.1 - Iron and Steel Production	16.32	NO	NA	NA	NA	NA	NA
2.C.2 - Ferroalloys Production	71.27	0.00	NA	NA	NA	NA	NA
2.C.3 - Aluminium production	NO	NA	NA	NA	NO	NA	NA
2.C.4 - Magnesium production	NO	NA	NA	NA	NA	NO	NA
2.C.5 - Lead Production	5.38	NA	NA	NA	NA	NA	NA
2.C.6 - Zinc Production	NO	NA	NA	NA	NA	NA	NA
2.C.7 - Other (please specify)	NO	NO	NO	NO	NO	NO	NO
2.D - Non-Energy Products from Fuels and Solvent Use	0.00	NO, NO	NO, NO	NA	NA	NA	NA
2.D.1 - Lubricant Use	NO	NA	NA	NA	NA	NA	NA
2.D.2 - Paraffin Wax Use	NO	NA	NA	NA	NA	NA	NA
2.D.3 - Solvent Use	NA	NA	NA	NA	NA	NA	NA
2.D.4 - Other (please specify)	0.00	NO	NO	NA	NA	NA	NA
2.E - Electronics Industry	NO, NO	NO, NO	NO, NO	NO, NO	NO, NO	NO, NO	NO, NO
2.E.1 - Integrated Circuit or Semiconductor	NA	NA	NA	NO	NO	NO	NO
2.E.2 - TFT Flat Panel Display	NA	NA	NA	NA	NO	NO	NO
2.E.3 - Photovoltaics	NA	NA	NA	NA	NO	NA	NA
2.E.4 - Heat Transfer Fluid	NA	NA	NA	NA	NO	NA	NA
2.E.5 - Other (please specify)	NO	NO	NO	NO	NO	NO	NO
2.F - Product Uses as Substitutes for Ozone Depleting Substances	NA	NA	NA	295.95	YES, NO, NO	NA	NA
2.F.1 - Refrigeration and Air Conditioning	NA	NA	NA	295.95	NA	NA	NA
2.F.2 - Foam Blowing Agents	NA	NA	NA	NO	NA	NA	NA
2.F.3 - Fire Protection	NA	NA	NA	NO	NO	NA	NA
2.F.4 - Aerosols	NA	NA	NA	NO	NA	NA	NA
2.F.5 - Solvents	NA	NA	NA	NO	NO	NA	NA
2.F.6 - Other Applications (please specify)	NA	NA	NA	NO	NO	NA	NA
2.G - Other Product Manufacture and Use	NO, NO	NO, NO	YES, NO, NO	NO, NO	NO, NO, NO	NO, NO, NO	NO, NO
2.G.1 - Electrical Equipment	NA	NA	NA	NA	NO	NO	NA
2.G.2 - SF6 and PFCs from Other Product Uses	NA	NA	NA	NA	NO	NO	NA
2.G.3 - N2O from Product Uses	NA	NA	NO	NA	NA	NA	NA

2.G.4 - Other (Please specify)	NO	NO	NO	NO	NO	NO	NO
2.H - Other	NO	NO	NA	NA	NA	NA	NA
2.H.1 - Pulp and Paper Industry	NO	NO	NA	NA	NA	NA	NA
2.H.2 - Food and Beverages Industry	NO	NO	NA	NA	NA	NA	NA
2.H.3 - Other (please specify)	NO	NO	NO	NA	NA	NA	NA
3 - Agriculture, Forestry, and Other Land Use	-3,755.19	27.30	2.15	NA	NA	NA	NA
3.A - Livestock	NA	26.71	0.42	NA	NA	NA	NA
3.A.1 - Enteric Fermentation	NA	22.92	NA	NA	NA	NA	NA
3.A.2 - Manure Management	NA	3.79	0.42	NA	NA	NA	NA
3.B - Land	-3,758.41	NA	YES, NO	NA	NA	NA	NA
3.B.1 - Forest land	-3,745.88	NA	NA	NA	NA	NA	NA
3.B.2 - Cropland	-104.65	NA	NA	NA	NA	NA	NA
3.B.3 - Grassland	-193.42	NA	NA	NA	NA	NA	NA
3.B.4 - Wetlands	NO	NA	NO	NA	NA	NA	NA
3.B.5 - Settlements	32.53	NA	NA	NA	NA	NA	NA
3.B.6 - Other Land	253.01	NA	NA	NA	NA	NA	NA
3.C - Aggregate sources and non-CO2 emissions sources on land	3.23	0.59	1.73	NA	NA	NA	NA
3.C.1 - Emissions from biomass burning	NA	NO	NO	NA	NA	NA	NA
3.C.2 - Liming	NO	NA	NA	NA	NA	NA	NA
3.C.3 - Urea application	3.23	NA	NA	NA	NA	NA	NA
3.C.4 - Direct N2O Emissions from managed soils	NA	NA	1.13	NA	NA	NA	NA
3.C.5 - Indirect N2O Emissions from managed soils	NA	NA	0.35	NA	NA	NA	NA
3.C.6 - Indirect N2O Emissions from manure management	NA	NA	0.25	NA	NA	NA	NA
3.C.7 - Rice cultivation	NA	0.59	NA	NA	NA	NA	NA
3.C.8 - Other (please specify)	NA	NO	NO	NA	NA	NA	NA
3.D - Other	NO	NO, NO	NO, NO	NA	NA	NA	NA
3.D.1 - Harvested Wood Products	NO	NA	NA	NA	NA	NA	NA
3.D.2 - Other (please specify)	NO	NO	NO	NA	NA	NA	NA
4 - Waste	6.42	27.07	0.14	NA	NA	NA	NA
4.A - Solid Waste Disposal	NA	22.35	NA	NA	NA	NA	NA
4.B - Biological Treatment of Solid Waste	NA	0.00	0.00	NA	NA	NA	NA
4.C - Incineration and Open Burning of Waste	6.42	0.48	0.01	NA	NA	NA	NA
4.D - Wastewater Treatment and Discharge		4.24	0.13	NA	NA	NA	NA
4.E - Other (please specify)	NO	NO	NO	NA	NA	NA	NA
5 - Other	NO	NO	NO	NA	NA	NA	NA
5.A - Indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3	NO	NO	NO	NA	NA	NA	NA
5.B - Other (please specify)	NO	NO	NO	NA	NA	NA	NA
Memo Items (5)							
International Bunkers	46.85	0.00	0.00	NA	NA	NA	NA
1.A.3.a.i - International Aviation (International Bunkers)	46.85	0.00	0.00	NA	NA	NA	NA
1.A.3.d.i - International water-borne navigation (International bunkers)	NO	NO	NO	NA	NA	NA	NA
1.A.5.c - Multilateral Operations	NO	NO	NO	NA	NA	NA	NA

NO - Not occurring; NA – Not Applicable; NE – Not Estimated

**Net CO2 emissions (emissions minus sinks)*

Table 43. Greenhouse gas inventory for 2021

Categories	Emissions (Gg)			Emissions CO2 equivalents (Gg)			
	Net CO2*	CH4	N2O	HFCs	PFCs	SF6	Other halogenated gases with conversion factors equivalent to CO2
Total National Emissions and Removals	6,472.68	60.84	2.57	302.45	NO, NO	NO, NO	NO, NO
1 - Energy	7,025.01	8.41	0.23	NA	NA	NA	NA
1.A - Fuel Combustion Activities	7,021.70	4.00	0.23	NA	NA	NA	NA
1.A.1 - Energy Industries	3,420.31	0.04	0.04	NA	NA	NA	NA
1.A.2 - Manufacturing Industries and Construction	1,135.36	0.08	0.01	NA	NA	NA	NA
1.A.3 - Transport	2,251.49	1.36	0.15	NA	NA	NA	NA
1.A.4 - Other Sectors	67.86	2.41	0.03	NA	NA	NA	NA
1.A.5 - Non-Specified	146.67	0.10	0.00	NA	NA	NA	NA
1.B - Fugitive emissions from fuels	3.32	4.42	NA	NA	NA	NA	NA
1.B.1 - Solid Fuels	3.32	4.42	NA	NA	NA	NA	NA
1.B.2 - Oil and Natural Gas	0.00	0.00	NA	NA	NA	NA	NA
1.B.3 - Other emissions from Energy Production	NO	NO	NA	NA	NA	NA	NA
1.C - Carbon dioxide Transport and Storage	NO	NA	NA	NA	NA	NA	NA
1.C.1 - Transport of CO2	NO	NA	NA	NA	NA	NA	NA
1.C.2 - Injection and Storage	NO	NA	NA	NA	NA	NA	NA
1.C.3 - Other	NO	NA	NA	NA	NA	NA	NA
2 - Industrial Processes and Product Use	505.65	0.00	NO, NO	302.45	NO, NO	NO, NO	NO, NO
2.A - Mineral Industry	400.70	NO, NO	NO, NO	NA	NA	NA	NA
2.A.1 - Cement production	399.71	NA	NA	NA	NA	NA	NA
2.A.2 - Lime production	NO	NA	NA	NA	NA	NA	NA
2.A.3 - Glass Production	0.07	NA	NA	NA	NA	NA	NA
2.A.4 - Other Process Uses of Carbonates	0.93	NA	NA	NA	NA	NA	NA
2.A.5 - Other (please specify)	NO	NO	NO	NA	NA	NA	NA
2.B - Chemical Industry	NA..NO	NA..NO	NO, NO	NA..NO	NO, NO	NO, NO	NO, NO
2.B.1 - Ammonia Production	NO.	NA	NA	NA	NA	NA	NA
2.B.2 - Nitric Acid Production	NA	NA	NO	NA	NA	NA	NA
2.B.3 - Adipic Acid Production	NA	NA	NO	NA	NA	NA	NA
2.B.4 - Caprolactam, Glyoxal and Glyoxylic Acid Production	NA	NA	NO	NA	NA	NA	NA
2.B.5 - Carbide Production	NO	NO	NA	NA	NA	NA	NA
2.B.6 - Titanium Dioxide Production	NO	NA	NA	NA	NA	NA	NA
2.B.7 - Soda Ash Production	NO	NA	NA	NA	NA	NA	NA
2.B.8 - Petrochemical and Carbon Black Production	NO	NO.	NA	NA	NA	NA	NA
2.B.9 - Fluorochemical Production	NA	NA	NA	NO	NO	NO	NO
2.B.10 - Other (Please specify)	NO	NO	NO	NO	NO	NO	NO
2.C - Metal Industry	104.95	0.00	NO, NO	NA..NO	NO, NO	NO, NO	NO, NO
2.C.1 - Iron and Steel Production	28.44	NO	NA	NA	NA	NA	NA
2.C.2 - Ferroalloys Production	71.14	0.00	NA	NA	NA	NA	NA
2.C.3 - Aluminium production	NO	NA	NA	NA	NO	NA	NA
2.C.4 - Magnesium production	NO	NA	NA	NA	NA	NO	NA
2.C.5 - Lead Production	5.38	NA	NA	NA	NA	NA	NA
2.C.6 - Zinc Production	NO	NA	NA	NA	NA	NA	NA
2.C.7 - Other (please specify)	NO	NO	NO	NO	NO	NO	NO
2.D - Non-Energy Products from Fuels and Solvent Use	0.00	NA..NO	NO, NO	NA	NA	NA	NA
2.D.1 - Lubricant Use	NO	NA	NA	NA	NA	NA	NA
2.D.2 - Paraffin Wax Use	NO	NA	NA	NA	NA	NA	NA
2.D.3 - Solvent Use	NA.	NA	NA	NA	NA	NA	NA
2.D.4 - Other (please specify)	0.00	NO	NO	NA	NA	NA	NA
2.E - Electronics Industry	NO, NO	NO, NO	NO, NO	NA..NO	NO, NO	NO, NO	NO, NO
2.E.1 - Integrated Circuit or Semiconductor	NA	NA	NA	NO	NO	NO	NO
2.E.2 - TFT Flat Panel Display	NA	NA	NA	NA	NO	NO	NO
2.E.3 - Photovoltaics	NA	NA	NA	NA	NO	NA	NA
2.E.4 - Heat Transfer Fluid	NA	NA	NA	NA	NO	NA	NA
2.E.5 - Other (please specify)	NO	NO	NO	NO	NO	NO	NO
2.F - Product Uses as Substitutes for Ozone Depleting Substances	NA	NA	NA	302.45	YES, NO, NO	NA	NA
2.F.1 - Refrigeration and Air Conditioning	NA	NA	NA	302.45	NA	NA	NA
2.F.2 - Foam Blowing Agents	NA	NA	NA	NO	NA	NA	NA
2.F.3 - Fire Protection	NA	NA	NA	NO	NO	NA	NA
2.F.4 - Aerosols	NA	NA	NA	NO	NA	NA	NA
2.F.5 - Solvents	NA	NA	NA	NO	NO	NA	NA
2.F.6 - Other Applications (please specify)	NA	NA	NA	NO	NO	NA	NA
2.G - Other Product Manufacture and Use	NO, NO	NO, NO	YES, NO, NO	NO, NO	NO, NO, NO	NO, NO, NO	NO, NO
2.G.1 - Electrical Equipment	NA	NA	NA	NA	NO	NO	NA
2.G.2 - SF6 and PFCs from Other Product Uses	NA	NA	NA	NA	NO	NO	NA
2.G.3 - N2O from Product Uses	NA	NA	NO	NA	NA	NA	NA

2.G.4 - Other (Please specify)	NO	NO	NO	NO	NO	NO	NO
2.H - Other	NO	NO	NA	NA	NA	NA	NA
2.H.1 - Pulp and Paper Industry	NO	NO	NA	NA	NA	NA	NA
2.H.2 - Food and Beverages Industry	NO	NO	NA	NA	NA	NA	NA
2.H.3 - Other (please specify)	NO	NO	NO.	NA	NA	NA	NA
3 - Agriculture, Forestry, and Other Land Use	-1,064.27	24.76	2.20	NA	NA	NA	NA
3.A - Livestock	NA	24.18	0.45	NA	NA	NA	NA
3.A.1 - Enteric Fermentation	NA	20.48	NA	NA	NA	NA	NA
3.A.2 - Manure Management	NA	3.69	0.45	NA	NA	NA	NA
3.B - Land	-1,066.17	NA	YES, NO	NA	NA	NA	NA
3.B.1 - Forest land	-896.69	NA	NA	NA	NA	NA	NA
3.B.2 - Cropland	-82.94	NA	NA	NA	NA	NA	NA
3.B.3 - Grassland	-135.06	NA	NA	NA	NA	NA	NA
3.B.4 - Wetlands	NO	NA,	NO	NA	NA	NA	NA
3.B.5 - Settlements	40.68	NA	NA	NA	NA	NA	NA
3.B.6 - Other Land	7.84	NA	NA	NA	NA	NA	NA
3.C - Aggregate sources and non-CO2 emissions sources on land	1.91	0.58	1.74	NA	NA	NA	NA
3.C.1 - Emissions from biomass burning	NA	NO	NO	NA	NA	NA	NA
3.C.2 - Liming	NO	NA	NA	NA	NA	NA	NA
3.C.3 - Urea application	1.91	NA	NA	NA	NA	NA	NA
3.C.4 - Direct N2O Emissions from managed soils	NA	NA	1.12	NA	NA	NA	NA
3.C.5 - Indirect N2O Emissions from managed soils	NA	NA	0.35	NA	NA	NA	NA
3.C.6 - Indirect N2O Emissions from manure management	NA	NA	0.27	NA	NA	NA	NA
3.C.7 - Rice cultivation	NA	0.58	NA	NA	NA	NA	NA
3.C.8 - Other (please specify)	NA	NO	NO	NA	NA	NA	NA
3.D - Other	NO	NO, NO	NO, NO	NA	NA	NA	NA
3.D.1 - Harvested Wood Products	NO	NA	NA	NA	NA	NA	NA
3.D.2 - Other (please specify)	NO	NO	NO	NA	NA	NA	NA
4 - Waste	6.28	27.67	0.14	NA	NA	NA	NA
4.A - Solid Waste Disposal	NA	22.97	NA	NA	NA	NA	NA
4.B - Biological Treatment of Solid Waste	NA	0.00	0.00	NA	NA	NA	NA
4.C - Incineration and Open Burning of Waste	6.28	0.47	0.01	NA	NA	NA	NA
4.D - Wastewater Treatment and Discharge		4.23	0.13	NA	NA	NA	NA
4.E - Other (please specify)	NO	NO	NO	NA	NA	NA	NA
5 - Other	NO	NO	NO	NA	NA	NA	NA
5.A - Indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3	NO	NO	NO	NA	NA	NA	NA
5.B - Other (please specify)	NO	NO	NO	NA	NA	NA	NA
				.			
Memo Items (5)				.			
International Bunkers	49.70	0.00	0.00	NA	NA	NA	NA
1.A.3.a.i - International Aviation (International Bunkers)	49.70	0.00	0.00	NA	NA	NA	NA
1.A.3.d.i - International water-borne navigation (International bunkers)	NO	NO	NO	NA	NA	NA	NA
1.A.5.c - Multilateral Operations	NO	NO	NO	NA	NA	NA	NA

NO - Not occurring; NA – Not Applicable; NE – Not Estimated

**Net CO2 emissions (emissions minus sinks)*

Table 44. Greenhouse gas inventory for 2022

Categories	Emissions (Gg)			Emissions CO2 equivalents (Gg)			
	Net CO2*	CH4	N2O	HFCs	PFCs	SF6	Other halogenated gases with conversion factors equivalent to CO2
Total National Emissions and Removals	5,239.43	59.78	2.45	286.87	NO, NO	NO, NO	NO, NO
1 - Energy	7,888.44	8.70	0.22	NA	NA	NA	NA
1.A - Fuel Combustion Activities	7,884.35	3.25	0.22	NA	NA	NA	NA
1.A.1 - Energy Industries	4,593.16	0.06	0.06	NA	NA	NA	NA
1.A.2 - Manufacturing Industries and Construction	827.97	0.05	0.01	NA	NA	NA	NA
1.A.3 - Transport	2,274.29	0.72	0.13	NA	NA	NA	NA
1.A.4 - Other Sectors	58.58	2.33	0.03	NA	NA	NA	NA
1.A.5 - Non-Specified	130.35	0.09	0.00	NA	NA	NA	NA
1.B - Fugitive emissions from fuels	4.09	5.45	NA	NA	NA	NA	NA
1.B.1 - Solid Fuels	4.09	5.45	NA	NA	NA	NA	NA
1.B.2 - Oil and Natural Gas	0.00	0.00	NA	NA	NA	NA	NA
1.B.3 - Other emissions from Energy Production	NO	NO	NA	NA	NA	NA	NA
1.C - Carbon dioxide Transport and Storage	NO	NA	NA	NA	NA	NA	NA
1.C.1 - Transport of CO2	NO	NA	NA	NA	NA	NA	NA
1.C.2 - Injection and Storage	NO	NA	NA	NA	NA	NA	NA
1.C.3 - Other	NO	NA	NA	NA	NA	NA	NA
2 - Industrial Processes and Product Use	429.02	0.00	NO, NO	286.87	NO, NO	NO, NO	NO, NO
2.A - Mineral Industry	366.78	NO, NO	NO, NO	NA	NA	NA	NA
2.A.1 - Cement production	365.79	NA	NA	NA	NA	NA	NA
2.A.2 - Lime production	NO	NA	NA	NA	NA	NA	NA
2.A.3 - Glass Production	0.09	NA	NA	NA	NA	NA	NA
2.A.4 - Other Process Uses of Carbonates	0.90	NA	NA	NA	NA	NA	NA
2.A.5 - Other (please specify)	NO	NO	NO	NA	NA	NA	NA
2.B - Chemical Industry	NO, NO	NO, NO	NO, NO	NA..NO	NO, NO	NO, NO	NO, NO
2.B.1 - Ammonia Production	NO.	NA	NA	NA	NA	NA	NA
2.B.2 - Nitric Acid Production	NA	NA	NO	NA	NA	NA	NA
2.B.3 - Adipic Acid Production	NA	NA	NO	NA	NA	NA	NA
2.B.4 - Caprolactam, Glyoxal and Glyoxylic Acid Production	NA	NA	NO	NA	NA	NA	NA
2.B.5 - Carbide Production	NO	NO	NA	NA	NA	NA	NA
2.B.6 - Titanium Dioxide Production	NO	NA	NA	NA	NA	NA	NA
2.B.7 - Soda Ash Production	NO	NA	NA	NA	NA	NA	NA
2.B.8 - Petrochemical and Carbon Black Production	NO	NO.	NA	NA	NA	NA	NA
2.B.9 - Fluorochemical Production	NA	NA	NA	NO	NO	NO	NO
2.B.10 - Other (Please specify)	NO	NO	NO	NO	NO	NO	NO
2.C - Metal Industry	62.25	0.00	NO, NO	NA..NO	NO, NO	NO, NO	NO, NO
2.C.1 - Iron and Steel Production	22.37	NO	NA	NA	NA	NA	NA
2.C.2 - Ferroalloys Production	33.77	0.00	NA	NA	NA	NA	NA
2.C.3 - Aluminium production	NO	NA	NA	NA	NO	NA	NA
2.C.4 - Magnesium production	NO	NA	NA	NA	NA	NO	NA
2.C.5 - Lead Production	6.11	NA	NA	NA	NA	NA	NA
2.C.6 - Zinc Production	NO	NA	NA	NA	NA	NA	NA
2.C.7 - Other (please specify)	NO	NO	NO	NO	NO	NO	NO
2.D - Non-Energy Products from Fuels and Solvent Use	0.00	NA..NO	NO, NO	NA	NA	NA	NA
2.D.1 - Lubricant Use	NO	NA	NA	NA	NA	NA	NA
2.D.2 - Paraffin Wax Use	NO	NA	NA	NA	NA	NA	NA
2.D.3 - Solvent Use	NA.	NA	NA	NA	NA	NA	NA
2.D.4 - Other (please specify)	0.00	NO	NO	NA	NA	NA	NA
2.E - Electronics Industry	NO, NO	NO, NO	NO, NO	NA..NO	NO, NO	NO, NO	NO, NO
2.E.1 - Integrated Circuit or Semiconductor	NA	NA	NA	NO	NO	NO	NO
2.E.2 - TFT Flat Panel Display	NA	NA	NA	NA	NO	NO	NO
2.E.3 - Photovoltaics	NA	NA	NA	NA	NO	NA	NA
2.E.4 - Heat Transfer Fluid	NA	NA	NA	NA	NO	NA	NA
2.E.5 - Other (please specify)	NO	NO	NO	NO	NO	NO	NO
2.F - Product Uses as Substitutes for Ozone Depleting Substances	NA	NA	NA	286.87	YES, NO, NO	NA	NA
2.F.1 - Refrigeration and Air Conditioning	NA	NA	NA	286.87	NA	NA	NA
2.F.2 - Foam Blowing Agents	NA	NA	NA	NO	NA	NA	NA
2.F.3 - Fire Protection	NA	NA	NA	NO	NO	NA	NA
2.F.4 - Aerosols	NA	NA	NA	NO	NA	NA	NA
2.F.5 - Solvents	NA	NA	NA	NO	NO	NA	NA
2.F.6 - Other Applications (please specify)	NA	NA	NA	NO	NO	NA	NA
2.G - Other Product Manufacture and Use	NO, NO	NO, NO	YES, NO, NO	NO, NO	NO, NO, NO	NO, NO, NO	NO, NO
2.G.1 - Electrical Equipment	NA	NA	NA	NA	NO	NO	NA
2.G.2 - SF6 and PFCs from Other Product Uses	NA	NA	NA	NA	NO	NO	NA
2.G.3 - N2O from Product Uses	NA	NA	NO	NA	NA	NA	NA

2.G.4 - Other (Please specify)	NO	NO	NO	NO	NO	NO	NO
2.H - Other	NO	NO	NA	NA	NA	NA	NA
2.H.1 - Pulp and Paper Industry	NO	NO	NA	NA	NA	NA	NA
2.H.2 - Food and Beverages Industry	NO	NO	NA	NA	NA	NA	NA
2.H.3 - Other (please specify)	NO	NO	NO.	NA	NA	NA	NA
3 - Agriculture, Forestry, and Other Land Use	-3,083.99	22.96	2.08	NA	NA	NA	NA
3.A - Livestock	NA	22.38	0.42	NA	NA	NA	NA
3.A.1 - Enteric Fermentation	NA	19.11	NA	NA	NA	NA	NA
3.A.2 - Manure Management	NA	3.27	0.42	NA	NA	NA	NA
3.B - Land	-3,085.90	NA	YES, NO	NA	NA	NA	NA
3.B.1 - Forest land	-3,258.72	NA	NA	NA	NA	NA	NA
3.B.2 - Cropland	-34.26	NA	NA	NA	NA	NA	NA
3.B.3 - Grassland	142.51	NA	NA	NA	NA	NA	NA
3.B.4 - Wetlands	NO	NA	NO	NA	NA	NA	NA
3.B.5 - Settlements	44.24	NA	NA	NA	NA	NA	NA
3.B.6 - Other Land	20.33	NA	NA	NA	NA	NA	NA
3.C - Aggregate sources and non-CO2 emissions sources on land	1.91	0.58	1.67	NA	NA	NA	NA
3.C.1 - Emissions from biomass burning	NA	NO	NO	NA	NA	NA	NA
3.C.2 - Liming	NO	NA	NA	NA	NA	NA	NA
3.C.3 - Urea application	1.91	NA	NA	NA	NA	NA	NA
3.C.4 - Direct N2O Emissions from managed soils	NA	NA	1.08	NA	NA	NA	NA
3.C.5 - Indirect N2O Emissions from managed soils	NA	NA	0.33	NA	NA	NA	NA
3.C.6 - Indirect N2O Emissions from manure management	NA	NA	0.25	NA	NA	NA	NA
3.C.7 - Rice cultivation	NA	0.58	NA	NA	NA	NA	NA
3.C.8 - Other (please specify)	NA	NO	NO	NA	NA	NA	NA
3.D - Other	NO	NO, NO	NO, NO	NA	NA	NA	NA
3.D.1 - Harvested Wood Products	NO	NA	NA	NA	NA	NA	NA
3.D.2 - Other (please specify)	NO	NO	NO	NA	NA	NA	NA
4 - Waste	5.95	28.12	0.14	NA	NA	NA	NA
4.A - Solid Waste Disposal	NA	23.55	NA	NA	NA	NA	NA
4.B - Biological Treatment of Solid Waste	NA	0.00	0.00	NA	NA	NA	NA
4.C - Incineration and Open Burning of Waste	5.95	0.44	0.01	NA	NA	NA	NA
4.D - Wastewater Treatment and Discharge		4.13	0.13	NA	NA	NA	NA
4.E - Other (please specify)	NO	NO	NO	NA	NA	NA	NA
5 - Other	NO	NO	NO	NA	NA	NA	NA
5.A - Indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3	NO	NO	NO	NA	NA	NA	NA
5.B - Other (please specify)	NO	NO	NO	NA	NA	NA	NA
				.			
Memo Items (5)				.			
International Bunkers	80.40	0.00	0.00	NA	NA	NA	NA
1.A.3.a.i - International Aviation (International Bunkers)	80.40	0.00	0.00	NA	NA	NA	NA
1.A.3.d.i - International water-borne navigation (International bunkers)	NO	NO	NO	NA	NA	NA	NA
1.A.5.c - Multilateral Operations	NO	NO	NO	NA	NA	NA	NA

NO - Not occurring; NA – Not Applicable; NE – Not Estimated

**Net CO2 emissions (emissions minus sinks)*

Annex III Detailed tables from the analysis of key categories

Table 45show the assessment of the level of key categories in 2022, respectively, where:

- **|Ex,t|**is the absolute value of the emission or sink estimate of the category that is a source or sink x of emissions in year t,
- **Lx,t**is an estimate of the level for source or sink x of emissions in the last year of the inventory (year t).

Table 46provides an overview of the trend assessment in 2022 compared to 1990, where:

- **Ex,t**and Ex,0 are the real values of the estimates for the category that is a source or sink x of emissions in years t and 0, respectively,
- **Tx,t**is an estimate of the trend of the category that

Table 45. Assessment of the level of key categories for 2022

IPCC category	GHG	1990 Ex,t(Gg CO2 Eq)	|Ex,t|(Gg CO2 Eq)	Lx,t	Cumulative sum ofLx,t
Energy Industries - Solid Fuels	CO2	3658.26	3658.26	0.25	0.25
Forest land Remaining Forest land	CO2	-2531.10	2531.10	0.17	0.42
Road Transportation - Liquid Fuels	CO2	2266.80	2266.80	0.15	0.58
Land Converted to Forest land	CO2	-727.61	727.61	0.05	0.63
Solid Waste Disposal	CH4	659.31	659.31	0.04	0.67
Manufacturing Industries and Construction - Liquid Fuels	CO2	588.98	588.98	0.04	0.71
Enteric Fermentation	CH4	534.96	534.96	0.04	0.75
Energy Industries - Liquid Fuels	CO2	478.87	478.87	0.03	0.78
Energy Industries - Gaseous Fuels	CO2	456.03	456.03	0.03	0.81
Cement production	CO2	365.79	365.79	0.02	0.84
Refrigeration and Air Conditioning	HFCs, PFCs	286.87	286.87	0.02	0.86
Direct N2O Emissions from managed soils	N2O	286.25	286.25	0.02	0.87
Cropland Remaining Cropland	CO2	-155.07	155.07	0.01	0.89
Manufacturing Industries and Construction - Solid Fuels	CO2	154.98	154.98	0.01	0.90
Coal mining and handling	CH4	152.47	152.47	0.01	0.91
Land Converted to Grassland	CO2	142.51	142.51	0.01	0.92
Land Converted to Cropland	CO2	120.81	120.81	0.01	0.92
Non-Specified - Liquid Fuels	CO2	118.57	118.57	0.01	0.93
Wastewater Treatment and Discharge	CH4	115.63	115.63	0.01	0.94
Manure Management	N2O	110.70	110.70	0.01	0.95
Manure Management	CH4	91.67	91.67	0.01	0.95

Table 46. Trend assessment of key categories (1990, 2022)

IPCC category	GHG	Calculation for 1990 Ex0(Gg CO2-eq)	Calculation for 2022 Ext(Gg CO2-eq)	Trend estimation (Txt)	Contribution to the trend in %	Cumulative sum of the contribution to the trend
Road Transportation - Liquid Fuels	CO2	639.82	2266.80	0.12	0.24	0.24
Land Converted to Forest land	CO2	-89.39	-727.61	0.04	0.08	0.32
Energy Industries - Solid Fuels	CO2	5689.78	3658.26	0.03	0.07	0.39
Energy Industries - Gaseous Fuels	CO2	0.00	456.03	0.03	0.06	0.45
Solid Waste Disposal	CH4	295.87	659.31	0.03	0.06	0.50
Forest land Remaining Forest land	CO2	-1654.78	-2531.10	0.03	0.06	0.56
Other Sectors - Liquid Fuels	CO2	545.31	56.62	0.02	0.05	0.61
Manufacturing Industries and Construction - Liquid Fuels	CO2	1197.05	588.98	0.02	0.04	0.64
Refrigeration and Air Conditioning	PFC	0.00	286.87	0.02	0.04	0.68
Manufacturing Industries and Construction - Solid Fuels	CO2	566.33	154.98	0.02	0.03	0.72
Enteric Fermentation	CH4	1017.21	534.96	0.01	0.03	0.74
Land Converted to Grassland	CO2	-15.58	142.51	0.01	0.02	0.77
Ferroalloys Production	CO2	266.65	33.77	0.01	0.02	0.79
Land Converted to Cropland	CO2	-27.79	120.81	0.01	0.02	0.81
Cement production	CO2	292.57	365.79	0.01	0.02	0.83
Direct N2O Emissions from managed soils	N2O	188.96	286.25	0.01	0.02	0.85
Zinc Production	CO2	186.23	0.00	0.01	0.02	0.87
Energy Industries - Liquid Fuels	CO2	481.55	478.87	0.01	0.02	0.88
Non-Specified - Liquid Fuels	CO2	0.00	118.57	0.01	0.02	0.90

Annex IV Detailed tables from the analysis of key categories

Table 47. Base year for trend uncertainty assessment: 1990, year T: 2020

2006 IPCC Categories		Gas	Base Year emissions or removals (Gg CO2 equivalent)	Year T emissions or removals (Gg CO2 equivalent)	Activity Data Uncertainty (%)	Emission Factor Uncertainty (%)	Combined Uncertainty (%)	Contribution to Variance by Category in Year T	Type A Sensitivity (%)	Type B Sensitivity (%)	Uncertainty in trend in national emissions introduced by emission factor uncertainty (%)	Uncertainty in trend in national emissions introduced by activity data uncertainty (%)
1.A - Fuel Combustion Activities												
1.A.1.a.i - Electricity Generation - Liquid Fuels	CO2	3.13	83.95	5.00	5.00	7.07	0.01	0.01	0.01	0.04	0.06	0.00
1.A.1.a.i - Electricity Generation - Liquid Fuels	CH4	0.00	0.09	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.a.i - Electricity Generation - Liquid Fuels	N2O	0.01	0.17	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.a.i - Electricity Generation - Solid Fuels	CO2	5610.05	3102.33	5.00	5.00	7.07	11.40	0.03	0.29	0.14	2.04	4.20
1.A.1.a.i - Electricity Generation - Solid Fuels	CH4	1.41	0.81	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.a.i - Electricity Generation - Solid Fuels	N2O	20.01	11.43	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.01	0.00
1.A.1.a.ii - Combined Heat and Power Generation (CHP) - Liquid Fuels	CO2	306.44	0.00	5.00	5.00	7.07	0.00	0.02	0.00	0.09	0.00	0.01
1.A.1.a.ii - Combined Heat and Power Generation (CHP) - Liquid Fuels	CH4	0.33	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.a.ii - Combined Heat and Power Generation (CHP) - Liquid Fuels	N2O	0.63	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.a.ii - Combined Heat and Power Generation (CHP) - Solid Fuels	CO2	79.73	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.02	0.00	0.00
1.A.1.a.ii - Combined Heat and Power Generation (CHP) - Solid Fuels	CH4	0.02	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.a.ii - Combined Heat and Power Generation (CHP) - Solid Fuels	N2O	0.31	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.a.ii - Combined Heat and Power Generation (CHP) - Gaseous Fuels	CO2	0.00	485.24	5.00	5.00	7.07	0.28	0.05	0.05	0.23	0.32	0.15
1.A.1.a.ii - Combined Heat and Power Generation (CHP) - Gaseous Fuels	CH4	0.00	0.24	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.a.ii - Combined Heat and Power Generation (CHP) - Gaseous Fuels	N2O	0.00	0.23	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.a.iii - Heat Plants - Liquid Fuels	CO2	171.98	0.00	5.00	5.00	7.07	0.00	0.01	0.00	0.05	0.00	0.00
1.A.1.a.iii - Heat Plants - Liquid Fuels	CH4	0.19	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.a.iii - Heat Plants - Liquid Fuels	N2O	0.35	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.a.iii - Heat Plants - Gaseous Fuels	CO2	0.00	62.41	5.00	5.00	7.07	0.00	0.01	0.01	0.03	0.04	0.00
1.A.1.a.iii - Heat Plants - Gaseous Fuels	CH4	0.00	0.03	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00

1.A.1.a.iii - Heat Plants - Gaseous Fuels	N2O	0.00	0.03	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.a - Iron and Steel - Liquid Fuels	CO2	346.16	250.17	5.00	5.00	7.07	0.07	0.00	0.02	0.02	0.16	0.03
1.A.2.a - Iron and Steel - Liquid Fuels	CH4	0.34	0.24	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.a - Iron and Steel - Liquid Fuels	N2O	0.62	0.45	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.a - Iron and Steel - Solid Fuels	CO2	272.72	249.06	5.00	5.00	7.07	0.07	0.01	0.02	0.04	0.16	0.03
1.A.2.a - Iron and Steel - Solid Fuels	CH4	0.77	0.72	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.a - Iron and Steel - Solid Fuels	N2O	1.09	1.02	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.a - Iron and Steel - Gaseous Fuels	CO2	0.00	48.21	5.00	5.00	7.07	0.00	0.00	0.00	0.02	0.03	0.00
1.A.2.a - Iron and Steel - Gaseous Fuels	CH4	0.00	0.02	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.a - Iron and Steel - Gaseous Fuels	N2O	0.00	0.02	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.a - Iron and Steel - Biomass - solid	CO2	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.a - Iron and Steel - Biomass - solid	CH4	0.00	0.42	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.a - Iron and Steel - Biomass - solid	N2O	0.00	0.53	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.b - Non-Ferrous Metals - Liquid Fuels	CO2	65.25	3.71	5.00	5.00	7.07	0.00	0.00	0.00	0.02	0.00	0.00
1.A.2.b - Non-Ferrous Metals - Liquid Fuels	CH4	0.07	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.b - Non-Ferrous Metals - Liquid Fuels	N2O	0.13	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.b - Non-Ferrous Metals - Solid Fuels	CO2	271.19	0.00	5.00	5.00	7.07	0.00	0.02	0.00	0.08	0.00	0.01
1.A.2.b - Non-Ferrous Metals - Solid Fuels	CH4	0.80	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.b - Non-Ferrous Metals - Solid Fuels	N2O	1.14	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.c - Chemicals - Liquid Fuels	CO2	77.52	3.46	5.00	5.00	7.07	0.00	0.00	0.00	0.02	0.00	0.00
1.A.2.c - Chemicals - Liquid Fuels	CH4	0.08	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.c - Chemicals - Liquid Fuels	N2O	0.16	0.01	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.c - Chemicals - Gaseous Fuels	CO2	0.00	4.11	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.c - Chemicals - Gaseous Fuels	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.c - Chemicals - Gaseous Fuels	N2O	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.c - Chemicals - Biomass - solid	CO2	0.00	0.00	5.00	18.69	19.35	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.c - Chemicals - Biomass - solid	CH4	0.00	0.00	5.00	245.45	245.51	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.c - Chemicals - Biomass - solid	N2O	0.00	0.00	5.00	281.82	281.86	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.d - Pulp, Paper and Print - Liquid Fuels	CO2	0.00	1.59	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.d - Pulp, Paper and Print - Liquid Fuels	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.d - Pulp, Paper and Print - Liquid Fuels	N2O	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00

1.A.2.d - Pulp, Paper and Print - Gaseous Fuels	CO2	0.00	1.28	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.d - Pulp, Paper and Print - Gaseous Fuels	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.d - Pulp, Paper and Print - Gaseous Fuels	N2O	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.d - Pulp, Paper and Print - Biomass - solid	CO2	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.d - Pulp, Paper and Print - Biomass - solid	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.d - Pulp, Paper and Print - Biomass - solid	N2O	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.e - Food Processing, Beverages and Tobacco - Liquid Fuels	CO2	46.92	52.43	5.00	5.00	7.07	0.00	0.00	0.00	0.01	0.03	0.00
1.A.2.e - Food Processing, Beverages and Tobacco - Liquid Fuels	CH4	0.05	0.05	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.e - Food Processing, Beverages and Tobacco - Liquid Fuels	N2O	0.10	0.10	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.e - Food Processing, Beverages and Tobacco - Solid Fuels	CO2	6.90	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.e - Food Processing, Beverages and Tobacco - Solid Fuels	CH4	0.02	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.e - Food Processing, Beverages and Tobacco - Solid Fuels	N2O	0.03	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.e - Food Processing, Beverages and Tobacco - Gaseous Fuels	CO2	0.00	13.88	5.00	5.00	7.07	0.00	0.00	0.00	0.01	0.01	0.00
1.A.2.e - Food Processing, Beverages and Tobacco - Gaseous Fuels	CH4	0.00	0.01	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.e - Food Processing, Beverages and Tobacco - Gaseous Fuels	N2O	0.00	0.01	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.e - Food Processing, Beverages and Tobacco - Biomass - solid	CO2	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.e - Food Processing, Beverages and Tobacco - Biomass - solid	CH4	0.00	0.12	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.e - Food Processing, Beverages and Tobacco - Biomass - solid	N2O	0.00	0.15	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.f - Non-Metallic Minerals - Liquid Fuels	CO2	132.98	281.88	5.00	5.00	7.07	0.09	0.02	0.03	0.09	0.19	0.04
1.A.2.f - Non-Metallic Minerals - Liquid Fuels	CH4	0.11	0.24	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.f - Non-Metallic Minerals - Liquid Fuels	N2O	0.19	0.45	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.f - Non-Metallic Minerals - Solid Fuels	CO2	0.00	27.29	5.00	5.00	7.07	0.00	0.00	0.00	0.01	0.02	0.00
1.A.2.f - Non-Metallic Minerals - Solid Fuels	CH4	0.00	0.08	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.f - Non-Metallic Minerals - Solid Fuels	N2O	0.00	0.11	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.f - Non-Metallic Minerals - Gaseous Fuels	CO2	0.00	7.72	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.01	0.00
1.A.2.f - Non-Metallic Minerals - Gaseous Fuels	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.f - Non-Metallic Minerals - Gaseous Fuels	N2O	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.f - Non-Metallic Minerals - Biomass - solid	CO2	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.f - Non-Metallic Minerals - Biomass - solid	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.f - Non-Metallic Minerals - Biomass - solid	N2O	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.h - Machinery - Liquid Fuels	CO2	5.81	10.70	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.01	0.00

1.A.2.h - Machinery - Liquid Fuels	CH4	0.00	0.01	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.h - Machinery - Liquid Fuels	N2O	0.00	0.02	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.h - Machinery - Solid Fuels	CO2	3.45	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.h - Machinery - Solid Fuels	CH4	0.01	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.h - Machinery - Solid Fuels	N2O	0.01	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.h - Machinery - Gaseous Fuels	CO2	0.00	5.87	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.h - Machinery - Gaseous Fuels	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.h - Machinery - Gaseous Fuels	N2O	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.h - Machinery - Biomass - solid	CO2	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.h - Machinery - Biomass - solid	CH4	0.00	0.01	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.h - Machinery - Biomass - solid	N2O	0.00	0.01	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.i - Mining (excluding fuels) and Quarrying - Liquid Fuels	CO2	43.77	36.22	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.02	0.00
1.A.2.i - Mining (excluding fuels) and Quarrying - Liquid Fuels	CH4	0.05	0.04	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.i - Mining (excluding fuels) and Quarrying - Liquid Fuels	N2O	0.09	0.08	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.i - Mining (excluding fuels) and Quarrying - Biomass - solid	CO2	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.i - Mining (excluding fuels) and Quarrying - Biomass - solid	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.i - Mining (excluding fuels) and Quarrying - Biomass - solid	N2O	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.l - Textile and Leather - Liquid Fuels	CO2	9.29	13.07	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.01	0.00
1.A.2.l - Textile and Leather - Liquid Fuels	CH4	0.01	0.01	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.l - Textile and Leather - Liquid Fuels	N2O	0.02	0.03	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.l - Textile and Leather - Solid Fuels	CO2	10.35	2.36	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.l - Textile and Leather - Solid Fuels	CH4	0.03	0.01	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.l - Textile and Leather - Solid Fuels	N2O	0.04	0.01	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.l - Textile and Leather - Gaseous Fuels	CO2	0.00	0.17	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.l - Textile and Leather - Gaseous Fuels	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.l - Textile and Leather - Gaseous Fuels	N2O	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.l - Textile and Leather - Biomass - solid	CO2	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.l - Textile and Leather - Biomass - solid	CH4	0.00	0.01	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.l - Textile and Leather - Biomass - solid	N2O	0.00	0.02	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4.b - Residential - Liquid Fuels	CO2	404.05	24.43	5.00	5.00	7.07	0.00	0.02	0.00	0.10	0.02	0.01
1.A.4.b - Residential - Liquid Fuels	CH4	0.86	0.04	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00

1.A.4.b - Residential - Liquid Fuels	N2O	0.85	0.03	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4.b - Residential - Solid Fuels	CO2	21.09	2.48	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4.b - Residential - Solid Fuels	CH4	1.75	0.21	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4.b - Residential - Solid Fuels	N2O	0.08	0.01	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4.b - Residential - Gaseous Fuels	CO2	0.00	0.58	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4.b - Residential - Gaseous Fuels	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4.b - Residential - Gaseous Fuels	N2O	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4.b - Residential - Biomass - solid	CO2	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4.b - Residential - Biomass - solid	CH4	61.79	66.24	5.00	5.00	7.07	0.01	0.00	0.01	0.01	0.04	0.00
1.A.4.b - Residential - Biomass - solid	N2O	7.80	8.36	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.01	0.00
1.A.4.c.i - Stationary - Liquid Fuels	CO2	141.26	32.71	5.00	5.00	7.07	0.00	0.00	0.00	0.02	0.02	0.00
1.A.4.c.i - Stationary - Liquid Fuels	CH4	0.53	0.12	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4.c.i - Stationary - Liquid Fuels	N2O	0.30	0.07	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4.c.i - Stationary - Solid Fuels	CO2	0.00	2.48	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4.c.i - Stationary - Solid Fuels	CH4	0.00	0.21	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4.c.i - Stationary - Solid Fuels	N2O	0.00	0.01	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4.c.i - Stationary - Biomass - solid	CO2	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4.c.i - Stationary - Biomass - solid	CH4	0.00	0.49	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4.c.i - Stationary - Biomass - solid	N2O	0.00	0.06	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.5.a - Stationary - Liquid Fuels	CO2	0.00	143.76	5.00	5.00	7.07	0.02	0.01	0.01	0.07	0.09	0.01
1.A.5.a - Stationary - Liquid Fuels	CH4	0.00	0.51	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.5.a - Stationary - Liquid Fuels	N2O	0.00	0.28	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.5.a - Stationary - Solid Fuels	CO2	22.84	2.05	5.00	5.00	7.07	0.00	0.00	0.00	0.01	0.00	0.00
1.A.5.a - Stationary - Solid Fuels	CH4	0.06	0.17	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.5.a - Stationary - Solid Fuels	N2O	0.09	0.01	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.5.a - Stationary - Gaseous Fuels	CO2	0.00	13.69	5.00	5.00	7.07	0.00	0.00	0.00	0.01	0.01	0.00
1.A.5.a - Stationary - Gaseous Fuels	CH4	0.00	0.03	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.5.a - Stationary - Gaseous Fuels	N2O	0.00	0.01	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.5.a - Stationary - Biomass - solid	CO2	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.5.a - Stationary - Biomass - solid	CH4	0.00	1.53	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.5.a - Stationary - Biomass - solid	N2O	0.00	0.19	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00

1.A.1.c.i - Manufacture of Solid Fuels	CO2	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.c.i - Manufacture of Solid Fuels	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.c.i - Manufacture of Solid Fuels	N2O	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.c.ii - Other Energy Industries - Liquid Fuels	CO2	0.00	4.06	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.c.ii - Other Energy Industries - Liquid Fuels	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.c.ii - Other Energy Industries - Liquid Fuels	N2O	0.00	0.01	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.c.ii - Other Energy Industries - Biomass - solid	CO2	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.c.ii - Other Energy Industries - Biomass - solid	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.c.ii - Other Energy Industries - Biomass - solid	N2O	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.m - Non-specified Industry - Liquid Fuels	CO2	469.36	50.66	5.00	5.00	7.07	0.00	0.02	0.00	0.11	0.03	0.01
1.A.2.m - Non-specified Industry - Liquid Fuels	CH4	0.51	0.06	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.m - Non-specified Industry - Liquid Fuels	N2O	0.97	0.11	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.m - Non-specified Industry - Solid Fuels	CO2	1.72	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.m - Non-specified Industry - Solid Fuels	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.m - Non-specified Industry - Solid Fuels	N2O	0.01	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.m - Non-specified Industry - Gaseous Fuels	CO2	0.00	2.54	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.m - Non-specified Industry - Gaseous Fuels	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.m - Non-specified Industry - Gaseous Fuels	N2O	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.m - Non-specified Industry - Biomass - solid	CO2	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.m - Non-specified Industry - Biomass - solid	CH4	0.00	0.02	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.m - Non-specified Industry - Biomass - solid	N2O	0.00	0.03	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.a.i - International Aviation (International Bunkers) - Liquid Fuels	CO2	15.77	46.85	5.00	5.00	7.07	0.00	0.00	0.00	0.02	0.03	0.00
1.A.3.a.i - International Aviation (International Bunkers) - Liquid Fuels	CH4	0.00	0.01	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.a.i - International Aviation (International Bunkers) - Liquid Fuels	N2O	0.12	0.35	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.a.ii - Domestic Aviation - Liquid Fuels	CO2	0.00	0.12	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.a.ii - Domestic Aviation - Liquid Fuels	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.a.ii - Domestic Aviation - Liquid Fuels	N2O	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.i.1 - Passenger cars with 3-way catalysts - Liquid Fuels	CO2	0.00	1090.99	5.00	5.00	7.07	1.41	0.10	0.10	0.51	0.72	0.78
1.A.3.b.i.1 - Passenger cars with 3-way catalysts - Liquid Fuels	CH4	0.00	5.47	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.i.1 - Passenger cars with 3-way catalysts - Liquid Fuels	N2O	0.00	13.86	5.00	5.00	7.07	0.00	0.00	0.00	0.01	0.01	0.00
1.A.3.b.i.2 - Passenger cars without 3-way catalysts - Liquid Fuels	CO2	454.08	228.12	5.00	5.00	7.07	0.06	0.00	0.02	0.02	0.15	0.02

1.A.3.b.i.2 - Passenger cars without 3-way catalysts - Liquid Fuels	CH4	5.27	1.22	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.i.2 - Passenger cars without 3-way catalysts - Liquid Fuels	N2O	5.67	2.87	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.ii.1 - Light-duty trucks with 3-way catalysts - Liquid Fuels	CO2	17.90	224.08	5.00	5.00	7.07	0.06	0.02	0.02	0.10	0.15	0.03
1.A.3.b.ii.1 - Light-duty trucks with 3-way catalysts - Liquid Fuels	CH4	0.06	0.44	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.ii.1 - Light-duty trucks with 3-way catalysts - Liquid Fuels	N2O	0.24	3.11	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.ii.2 - Light-duty trucks without 3-way catalysts - Liquid Fuels	CO2	56.87	31.23	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.02	0.00
1.A.3.b.ii.2 - Light-duty trucks without 3-way catalysts - Liquid Fuels	CH4	0.29	0.06	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.ii.2 - Light-duty trucks without 3-way catalysts - Liquid Fuels	N2O	0.76	0.43	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.iii - Heavy-duty trucks and buses - Liquid Fuels	CO2	109.88	372.34	5.00	5.00	7.07	0.16	0.03	0.03	0.14	0.25	0.08
1.A.3.b.iii - Heavy-duty trucks and buses - Liquid Fuels	CH4	1.03	1.08	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.iii - Heavy-duty trucks and buses - Liquid Fuels	N2O	1.41	5.12	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.iii - Heavy-duty trucks and buses - Gaseous Fuels	CO2	0.00	2.51	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.iii - Heavy-duty trucks and buses - Gaseous Fuels	CH4	0.00	7.54	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.iii - Heavy-duty trucks and buses - Gaseous Fuels	N2O	0.00	2.21	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.iv - Motorcycles - Liquid Fuels	CO2	1.10	3.34	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.iv - Motorcycles - Liquid Fuels	CH4	0.01	0.04	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.iv - Motorcycles - Liquid Fuels	N2O	0.01	0.04	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.vi - Urea-based catalysts	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.c - Railways - Liquid Fuels	CO2	22.30	3.83	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.c - Railways - Liquid Fuels	CH4	0.03	0.01	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.c - Railways - Liquid Fuels	N2O	2.28	0.39	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1 - Fugitive Emissions from Fuels - Solid Fuels												
1.B.1.a.i.1 - Mining	CO2	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.a.i.1 - Mining	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.a.i.2 - Post-mining seam gas emissions	CO2	0.00	0.00	5.00	200.00	200.06	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.a.i.2 - Post-mining seam gas emissions	CH4	0.00	0.00	5.00	200.00	200.06	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.a.i.3 - Abandoned underground mines	CH4	0.00	0.00	5.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.a.i.3 - Abandoned underground mines	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.a.i.4 - Flaring of drained methane or conversion of methane to CO2	CO2	0.00	0.00	5.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.a.i.4 - Flaring of drained methane or conversion of methane to CO2	CH4	0.00	0.00	5.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.a.ii.1 - Mining	CO2	5.62	4.05	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00

1.B.1.a.ii.1 - Mining	CH4	196.31	141.48	5.00	5.00	7.07	0.02	0.00	0.01	0.01	0.09	0.01
1.B.1.a.ii.2 - Post-mining seam gas emissions	CO2	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.a.ii.2 - Post-mining seam gas emissions	CH4	13.09	9.43	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.01	0.00
1.B.1.a.ii.3 - Abandoned surface mines	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.a.ii.3 - Abandoned surface mines	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.c.i - Charcoal and Biochar production	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.c.i - Charcoal and Biochar production	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.c.i - Charcoal and Biochar production	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.c.ii - Coke production	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.c.ii - Coke production	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.c.ii - Coke production	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.c.iv - Gasification transformation	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.c.iv - Gasification transformation	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.c.iv - Gasification transformation	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2 - Fugitive Emissions from Fuels - Oil and Natural Gas												
1.B.2.a.i - Venting	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.i - Venting	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.i - Venting	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.ii - Flaring	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.ii - Flaring	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.ii - Flaring	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.1 - Exploration	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.1 - Exploration	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.1 - Exploration	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.2 - Production and Upgrading	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.2 - Production and Upgrading	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.2 - Production and Upgrading	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.3 - Transport	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.3 - Transport	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.3 - Transport	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.4 - Refining	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

1.B.2.a.iii.4 - Refining	CH4	0.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.4 - Refining	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.5 - Distribution of oil products	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.5 - Distribution of oil products	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.5 - Distribution of oil products	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.6 - Other	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.6 - Other	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.6 - Other	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.i - Venting	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.i - Venting	CH4	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.i - Venting	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.ii - Flaring	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.ii - Flaring	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.ii - Flaring	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.1 - Exploration	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.1 - Exploration	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.1 - Exploration	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.2 - Production	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.2 - Production	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.2 - Production	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.3 - Processing	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.3 - Processing	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.3 - Processing	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.4 - Transmission and Storage	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.4 - Transmission and Storage	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.4 - Transmission and Storage	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.5 - Distribution	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.5 - Distribution	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.5 - Distribution	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.6 - Other	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.6 - Other	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

1.B.2.b.iii.6 - Other	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.3 - Other emissions from Energy Production	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.3 - Other emissions from Energy Production	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.3 - Other emissions from Energy Production	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.C - CO2 Transport Injection and Storage												
1.C.1.a - Pipelines	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.C.1.b - Ships	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.C.1.c - Other (please specify)	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.C.2.a - Injection	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.C.2.b - Storage	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.C.3 - Other	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.A - Mineral Industry												
2.A.1 - Cement production	CO2	292.57	400.78	10.00	3.00	10.44	0.41	0.02	0.04	0.06	0.53	0.28
2.A.2 - Lime production	CO2	33.72	0.00	21.21	3.00	21.42	0.00	0.00	0.00	0.01	0.00	0.00
2.A.3 - Glass Production	CO2	0.33	0.04	5.00	30.00	30.41	0.00	0.00	0.00	0.00	0.00	0.00
2.A.4.a - Ceramics	CO2	2.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.A.4.b - Other Uses of Soda Ash	CO2	2.68	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.A.4.c - Non Metallurgical Magnesia Production	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.A.4.d - Other (please specify)	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.A.5 - Other (please specify)	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.A.5 - Other (please specify)	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.A.5 - Other (please specify)	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B - Chemical Industry												
2.B.1 - Ammonia Production	CO2	0.00	0.00	5.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B.2 - Nitric Acid Production	N2O	0.00	0.00	2.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B.3 - Adipic Acid Production	N2O	0.00	0.00	2.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B.4 - Caprolactam, Glyoxal and Glyoxylic Acid Production	N2O	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B.5 - Carbide Production	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B.5 - Carbide Production	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B.6 - Titanium Dioxide Production	CO2	0.00	0.00	7.07	0.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
2.B.7 - Soda Ash Production	CO2	0.00	0.00	5.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00

2.B.8.a - Methanol	CO2	0.00	0.00	14.14	0.00	14.14	0.00	0.00	0.00	0.00	0.00	0.00
2.B.8.a - Methanol	CH4	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B.8.b - Ethylene	CO2	0.00	0.00	14.14	0.00	14.14	0.00	0.00	0.00	0.00	0.00	0.00
2.B.8.b - Ethylene	CH4	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B.8.c - Ethylene Dichloride and Vinyl Chloride Monomer	CO2	0.00	0.00	14.14	0.00	14.14	0.00	0.00	0.00	0.00	0.00	0.00
2.B.8.c - Ethylene Dichloride and Vinyl Chloride Monomer	CH4	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B.8.d - Ethylene Oxide	CO2	0.00	0.00	14.14	0.00	14.14	0.00	0.00	0.00	0.00	0.00	0.00
2.B.8.d - Ethylene Oxide	CH4	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B.8.e - Acrylonitrile	CO2	0.00	0.00	14.14	0.00	14.14	0.00	0.00	0.00	0.00	0.00	0.00
2.B.8.e - Acrylonitrile	CH4	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B.8.f - Carbon Black	CO2	0.00	0.00	14.14	0.00	14.14	0.00	0.00	0.00	0.00	0.00	0.00
2.B.8.f - Carbon Black	CH4	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B.8.x - Other petrochemical production	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B.8.x - Other petrochemical production	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B.9.a - By-product emissions	CHF3	0.00	0.00	14.14	0.00	14.14	0.00	0.00	0.00	0.00	0.00	0.00
2.B.10 - Hydrogen Production	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B.10 - Hydrogen Production	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B.10 - Hydrogen Production	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.C - Metal Industry												
2.C.1 - Iron and Steel Production	CO2	24.75	16.32	10.00	5.00	11.18	0.00	0.00	0.00	0.00	0.02	0.00
2.C.1 - Iron and Steel Production	CH4	0.00	0.00	10.00	5.00	11.18	0.00	0.00	0.00	0.00	0.00	0.00
2.C.2 - Ferroalloys Production	CO2	266.65	71.27	5.00	5.00	7.07	0.01	0.01	0.01	0.04	0.05	0.00
2.C.2 - Ferroalloys Production	CH4	1.48	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
2.C.3 - Aluminium production	CO2	8.78	0.00	2.00	5.00	5.39	0.00	0.00	0.00	0.00	0.00	0.00
2.C.3 - Aluminium production	CF4	58.21	0.00	3.46	5.00	6.08	0.00	0.00	0.00	0.02	0.00	0.00
2.C.3 - Aluminium production	C2F6	24.36	0.00	3.46	5.00	6.08	0.00	0.00	0.00	0.01	0.00	0.00
2.C.4 - Magnesium production	CO2	0.00	0.00	5.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00
2.C.4 - Magnesium production	SF6	0.00	0.00	5.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00
2.C.5 - Lead Production	CO2	22.09	5.38	10.00	5.00	11.18	0.00	0.00	0.00	0.00	0.01	0.00
2.C.6 - Zinc Production	CO2	186.23	0.00	10.00	5.00	11.18	0.00	0.01	0.00	0.05	0.00	0.00
2.C.7 - Rare Earths Production	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

2.C.7 - Rare Earths Production	CF4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.C.7 - Rare Earths Production	C2F6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.C.7 - Rare Earths Production	C3F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.D - Non-Energy Products from Fuels and Solvent Use												
2.D.1 - Lubricant Use	CO2	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.D.2 - Paraffin Wax Use	CO2	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.D.4 - Other (please specify)	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.D.4 - Other (please specify)	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.D.4 - Other (please specify)	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E - Electronics Industry												
2.E.1 - Integrated Circuit or Semiconductor	CHF3	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.1 - Integrated Circuit or Semiconductor	CF4	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.1 - Integrated Circuit or Semiconductor	C2F6	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.1 - Integrated Circuit or Semiconductor	C3F8	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.1 - Integrated Circuit or Semiconductor	SF6	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.1 - Integrated Circuit or Semiconductor	NF3	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.1 - Integrated Circuit or Semiconductor	CH2F2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.1 - Integrated Circuit or Semiconductor	CHF2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.1 - Integrated Circuit or Semiconductor	c-C4F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.1 - Integrated Circuit or Semiconductor	NF3 Remote	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.1 - Integrated Circuit or Semiconductor	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.2 - TFT Flat Panel Display	CF4	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.2 - TFT Flat Panel Display	SF6	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.2 - TFT Flat Panel Display	NF3	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.2 - TFT Flat Panel Display	CHF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.2 - TFT Flat Panel Display	CH2F2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.2 - TFT Flat Panel Display	CHF2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.2 - TFT Flat Panel Display	C2F6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.2 - TFT Flat Panel Display	C3F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.2 - TFT Flat Panel Display	c-C4F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.2 - TFT Flat Panel Display	NF3 Remote	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

2.E.2 - TFT Flat Panel Display	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.3 - Photovoltaics	CF4	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.3 - Photovoltaics	C2F6	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.3 - Photovoltaics	CHF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.3 - Photovoltaics	CH2F2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.3 - Photovoltaics	CHF2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.3 - Photovoltaics	C3F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.3 - Photovoltaics	c-C4F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.3 - Photovoltaics	SF6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.3 - Photovoltaics	NF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.3 - Photovoltaics	NF3 Remote	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.4 - Heat Transfer Fluid	n-C6F14	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.5 - Other (please specify)	CF4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.5 - Other (please specify)	c-C4F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.5 - Other (please specify)	SF6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F - Product Uses as Substitutes for Ozone Depleting Substances												
2.F.1.a - Refrigeration and Stationary Air Conditioning	CHF3	0.00	0.12	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.a - Refrigeration and Stationary Air Conditioning	CH2F2	0.00	10.44	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.01	0.00
2.F.1.a - Refrigeration and Stationary Air Conditioning	CHF2CF3	0.00	85.18	5.00	5.00	7.07	0.01	0.01	0.01	0.04	0.06	0.00
2.F.1.a - Refrigeration and Stationary Air Conditioning	CH2FCF3	0.00	90.56	5.00	5.00	7.07	0.01	0.01	0.01	0.04	0.06	0.01
2.F.1.a - Refrigeration and Stationary Air Conditioning	CH3CHF2	0.00	6.09	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.a - Refrigeration and Stationary Air Conditioning	CH3CF3	0.00	84.54	5.00	5.00	7.07	0.01	0.01	0.01	0.04	0.06	0.00
2.F.1.a - Refrigeration and Stationary Air Conditioning	CF3CHFCF3	0.00	18.97	5.00	5.00	7.07	0.00	0.00	0.00	0.01	0.01	0.00
2.F.1.a - Refrigeration and Stationary Air Conditioning	CF3CH2CF3	0.00	0.06	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.a - Refrigeration and Stationary Air Conditioning	CF3CHFCHFCF2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.a - Refrigeration and Stationary Air Conditioning	CHF2CH2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.a - Refrigeration and Stationary Air Conditioning	CH3CF2CH2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.a - Refrigeration and Stationary Air Conditioning	CF4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.a - Refrigeration and Stationary Air Conditioning	C2F6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.a - Refrigeration and Stationary Air Conditioning	C3F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.a - Refrigeration and Stationary Air Conditioning	C4F10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

2.F.1.a - Refrigeration and Stationary Air Conditioning	c-C4F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.a - Refrigeration and Stationary Air Conditioning	n-C5F12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.a - Refrigeration and Stationary Air Conditioning	n-C6F14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	CH2FCF3	0.00	0.00	5.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	CH3CHF2	0.00	0.00	5.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	CHF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	CH2F2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	CF3CHFCHFCF2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	CHF2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	CH3CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	CF3CHFCF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	CF3CH2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	CHF2CH2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	CH3CF2CH2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	CF4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	C2F6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	C3F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	C4F10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	c-C4F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	n-C5F12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	n-C6F14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	CH2FCF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	CH3CHF2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	CHF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	CH2F2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	CF3CHFCHFCF2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	CHF2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	CH3CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	CF3CHFCF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	CF3CH2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	CHF2CH2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

2.F.2 - Foam Blowing Agents	CH3CF2CH2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	CF4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	C2F6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	C3F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	C4F10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	c-C4F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	n-C5F12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	n-C6F14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.3 - Fire Protection	CH2FCF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.3 - Fire Protection	CH3CHF2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.3 - Fire Protection	CF3CHFCF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.3 - Fire Protection	CF3CH2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.4 - Aerosols	CF3CHFCHFCF2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.4 - Aerosols	CH2FCF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.4 - Aerosols	CH3CHF2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.4 - Aerosols	CF3CHFCF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.4 - Aerosols	CHF2CH2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.4 - Aerosols	CH3CF2CH2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.4 - Aerosols	n-C6F14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.5 - Solvents	CF3CHFCHFCF2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.5 - Solvents	CH3CF2CH2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.5 - Solvents	n-C6F14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	CHF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	CH2F2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	CF3CHFCHFCF2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	CHF2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	CH2FCF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	CH3CHF2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	CH3CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	CF3CHFCF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	CF3CH2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

2.F.6 - Other Applications (please specify)	CHF2CH2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	CH3CF2CH2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	CF4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	C2F6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	C3F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	C4F10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	c-C4F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	n-C5F12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	n-C6F14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	SF6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	NF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	NF3 Remote	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G - Electrical Equipment												
2.G.1 - Electrical Equipment	CF4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1 - Electrical Equipment	C2F6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1 - Electrical Equipment	C3F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1 - Electrical Equipment	C4F10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1 - Electrical Equipment	c-C4F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1 - Electrical Equipment	n-C5F12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1 - Electrical Equipment	n-C6F14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1 - Electrical Equipment	SF6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.a - Manufacture of Electrical Equipment	CF4	0.00	0.00	30.00	30.00	42.43	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.a - Manufacture of Electrical Equipment	C2F6	0.00	0.00	30.00	30.00	42.43	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.a - Manufacture of Electrical Equipment	C3F8	0.00	0.00	30.00	30.00	42.43	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.a - Manufacture of Electrical Equipment	C4F10	0.00	0.00	30.00	30.00	42.43	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.a - Manufacture of Electrical Equipment	c-C4F8	0.00	0.00	30.00	30.00	42.43	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.a - Manufacture of Electrical Equipment	n-C5F12	0.00	0.00	30.00	30.00	42.43	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.a - Manufacture of Electrical Equipment	n-C6F14	0.00	0.00	30.00	30.00	42.43	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.a - Manufacture of Electrical Equipment	SF6	0.00	0.00	30.00	30.00	42.43	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.b - Use of Electrical Equipment	CF4	0.00	0.00	30.00	30.00	42.43	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.b - Use of Electrical Equipment	C2F6	0.00	0.00	30.00	30.00	42.43	0.00	0.00	0.00	0.00	0.00	0.00

2.G.1.b - Use of Electrical Equipment	C3F8	0.00	0.00	30.00	30.00	42.43	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.b - Use of Electrical Equipment	C4F10	0.00	0.00	30.00	30.00	42.43	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.b - Use of Electrical Equipment	c-C4F8	0.00	0.00	30.00	30.00	42.43	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.b - Use of Electrical Equipment	n-C5F12	0.00	0.00	30.00	30.00	42.43	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.b - Use of Electrical Equipment	n-C6F14	0.00	0.00	30.00	30.00	42.43	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.b - Use of Electrical Equipment	SF6	0.00	0.00	30.00	30.00	42.43	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.c - Disposal of Electrical Equipment	CF4	0.00	0.00	40.00	40.00	56.57	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.c - Disposal of Electrical Equipment	C2F6	0.00	0.00	40.00	40.00	56.57	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.c - Disposal of Electrical Equipment	C3F8	0.00	0.00	40.00	40.00	56.57	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.c - Disposal of Electrical Equipment	C4F10	0.00	0.00	40.00	40.00	56.57	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.c - Disposal of Electrical Equipment	c-C4F8	0.00	0.00	40.00	40.00	56.57	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.c - Disposal of Electrical Equipment	n-C5F12	0.00	0.00	40.00	40.00	56.57	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.c - Disposal of Electrical Equipment	n-C6F14	0.00	0.00	40.00	40.00	56.57	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.c - Disposal of Electrical Equipment	SF6	0.00	0.00	40.00	40.00	56.57	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.a - Military Applications	CF4	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.a - Military Applications	C2F6	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.a - Military Applications	C3F8	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.a - Military Applications	C4F10	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.a - Military Applications	c-C4F8	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.a - Military Applications	n-C5F12	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.a - Military Applications	n-C6F14	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.a - Military Applications	SF6	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.b - Accelerators	CF4	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.b - Accelerators	C2F6	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.b - Accelerators	C3F8	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.b - Accelerators	C4F10	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.b - Accelerators	c-C4F8	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.b - Accelerators	n-C5F12	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.b - Accelerators	n-C6F14	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.b - Accelerators	SF6	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.c - Other (please specify)	CF4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

2.G.2.c - Other (please specify)	C2F6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.c - Other (please specify)	c-C3F6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.c - Other (please specify)	C3F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.c - Other (please specify)	C4F10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.c - Other (please specify)	c-C4F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.c - Other (please specify)	n-C5F12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.c - Other (please specify)	n-C6F14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.c - Other (please specify)	SF6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.c - Other (please specify)	CHF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.3.a - Medical Applications	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.3.b - Propellant for pressure and aerosol products	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.3.c - Other (Please specify)	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.H - Other												
2.H.1 - Pulp and Paper Industry	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.H.1 - Pulp and Paper Industry	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.H.1 - Pulp and Paper Industry	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.H.2 - Food and Beverages Industry	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.H.2 - Food and Beverages Industry	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.H.2 - Food and Beverages Industry	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A - Livestock												
3.A.1.a.i - Dairy Cows	CH4	460.81	354.68	5.00	30.00	30.41	2.76	0.01	0.03	0.21	0.23	0.10
3.A.1.a.ii - Other Cattle	CH4	196.40	170.17	5.00	30.00	30.41	0.63	0.00	0.02	0.14	0.11	0.03
3.A.1.b - Buffalo	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A.1.c - Sheep	CH4	321.60	88.29	5.00	30.00	30.41	0.17	0.01	0.01	0.30	0.06	0.09
3.A.1.d - Goats	CH4	0.00	13.30	5.00	30.00	30.41	0.00	0.00	0.00	0.04	0.01	0.00
3.A.1.e - Camels	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A.1.f - Horses	CH4	33.41	6.06	5.00	30.00	30.41	0.00	0.00	0.00	0.04	0.00	0.00
3.A.1.g - Mules and Asses	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A.1.h - Swine	CH4	5.00	9.23	5.00	30.00	30.41	0.00	0.00	0.00	0.02	0.01	0.00
3.A.1.i - Poultry	CH4	0.00	0.00	5.00	30.00	30.41	0.00	0.00	0.00	0.00	0.00	0.00
3.A.1.j - Other (please specify)	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

3.A.2.a.i - Dairy cows	CH4	93.09	23.40	5.00	30.00	30.41	0.01	0.00	0.00	0.09	0.02	0.01
3.A.2.a.i - Dairy cows	N2O	20.67	8.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A.2.a.ii - Other cattle	CH4	30.48	26.41	5.00	30.00	30.41	0.02	0.00	0.00	0.02	0.02	0.00
3.A.2.a.ii - Other cattle	N2O	10.69	7.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A.2.b - Buffalo	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A.2.b - Buffalo	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A.2.c - Sheep	CH4	9.65	2.65	5.00	30.00	30.41	0.00	0.00	0.00	0.01	0.00	0.00
3.A.2.c - Sheep	N2O	8.80	3.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A.2.d - Goats	CH4	0.00	0.45	5.00	30.00	30.41	0.00	0.00	0.00	0.00	0.00	0.00
3.A.2.d - Goats	N2O	0.00	0.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A.2.e - Camels	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A.2.e - Camels	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A.2.f - Horses	CH4	3.04	0.55	5.00	30.00	30.41	0.00	0.00	0.00	0.00	0.00	0.00
3.A.2.f - Horses	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A.2.g - Mules and Asses	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A.2.g - Mules and Asses	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A.2.h - Swine	CH4	29.99	51.70	5.00	30.00	30.41	0.06	0.00	0.00	0.09	0.03	0.01
3.A.2.h - Swine	N2O	3.00	90.22	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00
3.A.2.i - Poultry	CH4	3.21	0.95	5.00	30.00	30.41	0.00	0.00	0.00	0.00	0.00	0.00
3.A.2.i - Poultry	N2O	0.64	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A.2.j - Other (please specify)	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A.2.j - Other (please specify)	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B - Land												
3.B.1.a - Forest land Remaining Forest land	CO2	-1654.78	-3556.27	20.00	10.00	22.36	149.75	0.24	0.33	2.38	9.38	93.61
3.B.1.b.i - Cropland converted to Forest Land	CO2	-1.21	-56.99	10.00	10.00	14.14	0.02	0.01	0.01	0.05	0.08	0.01
3.B.1.b.ii - Grassland converted to Forest Land	CO2	-45.18	-107.59	10.00	10.00	14.14	0.05	0.01	0.01	0.07	0.14	0.03
3.B.1.b.iii - Wetlands converted to Forest Land	CO2	-0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.1.b.iv - Settlements converted to Forest Land	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.1.b.v - Other Land converted to Forest Land	CO2	-42.93	-25.04	10.00	10.00	14.14	0.00	0.00	0.00	0.00	0.03	0.00
3.B.2.a - Cropland Remaining Cropland	CO2	-183.11	-158.12	20.00	50.00	53.85	1.72	0.00	0.01	0.22	0.42	0.22
3.B.2.b.i - Forest Land converted to Cropland	CO2	38.39	62.07	10.00	50.00	50.99	0.24	0.00	0.01	0.18	0.08	0.04

3.B.2.b.ii - Grassland converted to Cropland	CO2	-3.48	-8.00	10.00	50.00	50.99	0.00	0.00	0.00	0.03	0.01	0.00
3.B.2.b.iii - Wetlands converted to Cropland	CO2	-0.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.2.b.iv - Settlements converted to Cropland	CO2	0.00	-0.34	10.00	50.00	50.99	0.00	0.00	0.00	0.00	0.00	0.00
3.B.2.b.v - Other Land converted to Cropland	CO2	-61.71	-0.25	10.00	50.00	50.99	0.00	0.00	0.00	0.17	0.00	0.03
3.B.3.a - Grassland Remaining Grassland	CO2	0.00	0.00	20.00	50.00	53.85	0.00	0.00	0.00	0.00	0.00	0.00
3.B.3.b.i - Forest Land converted to Grassland	CO2	11.42	77.86	10.00	50.00	50.99	0.37	0.01	0.01	0.33	0.10	0.12
3.B.3.b.ii - Cropland converted to Grassland	CO2	6.95	9.78	10.00	50.00	50.99	0.01	0.00	0.00	0.03	0.01	0.00
3.B.3.b.iii - Wetlands converted to Grassland	CO2	-0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.3.b.iv - Settlements converted to Grassland	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.3.b.v - Other Land converted to Grassland	CO2	-33.70	-281.06	10.00	50.00	50.99	4.86	0.02	0.03	1.21	0.37	1.61
3.B.4.a.i - Peat Extraction remaining Peat Extraction	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.4.a.iii - Other Wetlands Remaining Other Wetlands	CO2	0.00	0.00	10.00	50.00	50.99	0.00	0.00	0.00	0.00	0.00	0.00
3.B.4.b.i - Land converted for Peat Extraction	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.4.b.ii - Land converted to Flooded Land	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.4.b.iii - Land converted to Other Wetlands	CO2	1.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.5.a - Settlements Remaining Settlements	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.5.b.i - Forest Land converted to Settlements	CO2	0.00	30.13	10.00	50.00	50.99	0.06	0.00	0.00	0.14	0.04	0.02
3.B.5.b.ii - Cropland converted to Settlements	CO2	3.62	1.77	10.00	50.00	50.99	0.00	0.00	0.00	0.00	0.00	0.00
3.B.5.b.iii - Grassland converted to Settlements	CO2	4.52	1.44	10.00	50.00	50.99	0.00	0.00	0.00	0.01	0.00	0.00
3.B.5.b.iv - Wetlands converted to Settlements	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.5.b.v - Other Land converted to Settlements	CO2	0.00	-0.81	10.00	50.00	50.99	0.00	0.00	0.00	0.00	0.00	0.00
3.B.6.b.i - Forest Land converted to Other Land	CO2	83.06	226.38	20.00	50.00	53.85	3.52	0.02	0.02	0.82	0.60	1.03
3.B.6.b.ii - Cropland converted to Other Land	CO2	63.77	24.49	10.00	50.00	50.99	0.04	0.00	0.00	0.07	0.03	0.01
3.B.6.b.iii - Grassland converted to Other Land	CO2	3.91	2.14	10.00	50.00	50.99	0.00	0.00	0.00	0.00	0.00	0.00
3.B.6.b.iv - Wetlands converted to Other Land	CO2	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.6.b.v - Settlements converted to Other Land	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C - Aggregate sources and non-CO2 emissions sources on land												
3.C.1.a - Burning in Forest Land	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.1.a - Burning in Forest Land	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.1.a - Burning in Forest Land	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.1.b - Burning in Cropland	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

3.C.1.b - Burning in Cropland	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.1.b - Burning in Cropland	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.1.c - Burning in Grassland	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.1.c - Burning in Grassland	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.1.c - Burning in Grassland	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.1.d - Burning in all other land uses	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.1.d - Burning in all other land uses	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.1.d - Burning in all other land uses	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.2 - Liming	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.3 - Urea application	CO2	3.74	3.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.4 - Direct N2O Emissions from managed soils	N2O	188.96	300.47	0.00	0.00	0.00	0.00	0.02	0.03	0.00	0.00	0.00
3.C.5 - Indirect N2O Emissions from managed soils	N2O	69.11	91.64	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
3.C.6 - Indirect N2O Emissions from manure management	N2O	31.94	67.40	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
3.C.7 - Rice cultivation	CH4	32.67	16.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.8 - CH4 from Drained Organic Soils	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.9 - CH4 from Drainage Ditches on Organic Soils	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.10 - CH4 from Rewetting of Organic Soils	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.11 - CH4 Emissions from Rewetting of Mangroves and Tidal Marshes	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.12 - N2O Emissions from Aquaculture	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.13 - CH4 Emissions from Rewetted and Created Wetlands on Inland Wetland Mineral Soils	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.14 - Other (please specify)	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.14 - Other (please specify)	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.14 - Other (please specify)	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.D - Other												
3.D.1 - Harvested Wood Products	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.D.2 - Other (please specify)	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.D.2 - Other (please specify)	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.D.2 - Other (please specify)	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.A - Solid Waste Disposal												
4.A.1 - Managed Waste Disposal Sites	CH4	0.00	163.02	20.00	20.00	28.28	0.50	0.02	0.02	0.30	0.43	0.28
4.A.2 - Unmanaged Waste Disposal Sites	CH4	1.22	227.20	20.00	20.00	28.28	0.98	0.02	0.02	0.42	0.60	0.54

4.A.3 - Uncategorised Waste Disposal Sites	CH4	294.66	235.49	20.00	20.00	28.28	1.05	0.01	0.02	0.11	0.62	0.40
4.B - Biological Treatment of Solid Waste												
4.B - Biological Treatment of Solid Waste	CH4	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.B - Biological Treatment of Solid Waste	N2O	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.C - Incineration and Open Burning of Waste												
4.C.1 - Waste Incineration	CO2	0.00	0.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.C.1 - Waste Incineration	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.C.1 - Waste Incineration	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.C.2 - Open Burning of Waste	CO2	2.86	5.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.C.2 - Open Burning of Waste	CH4	6.63	13.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.C.2 - Open Burning of Waste	N2O	1.40	2.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.D - Wastewater Treatment and Discharge												
4.D.1 - Domestic Wastewater Treatment and Discharge	CH4	152.76	103.19	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
4.D.1 - Domestic Wastewater Treatment and Discharge	N2O	34.99	34.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.D.2 - Industrial Wastewater Treatment and Discharge	CH4	22.23	15.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.D.2 - Industrial Wastewater Treatment and Discharge	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.E - Other (please specify)												
4.E - Other (please specify)	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.E - Other (please specify)	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.E - Other (please specify)	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.A - Indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3												
5.A - Indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.B - Indirect CO2 emissions from the atmospheric oxidation of CH4, CO and NMVOC												
5.B - Indirect CO2 emissions from the atmospheric oxidation of CH4, CO and NMVOC	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.C - Other												
		Sum(C): 10,727.441	Sum(D): 6,498.255				Sum(H): 180.967					Sum(M): 103.931
							Uncertainty in total inventory: 13.452					Trend uncertainty: 10.195

Table 48. Base year for trend uncertainty assessment: 1990, year T: 2022

2006 IPCC Categories		Gas	Base Year emissions or removals (Gg CO2 equivalent)	Year T emissions or removals (Gg CO2 equivalent)	Activity Data Uncertainty (%)	Emission Factor Uncertainty (%)	Combined Uncertainty (%)	Contribution to Variance by Category in Year T	Type A Sensitivity (%)	Type B Sensitivity (%)	Uncertainty in trend in national emissions introduced by emission factor uncertainty (%)	Uncertainty in trend in national emissions introduced by activity data uncertainty (%)
1.A - Fuel Combustion Activities												
1.A.1.a.i - Electricity Generation - Liquid Fuels	CO2	3.13	474.65	5.00	5.00	7.07	0.18	0.04	0.04	0.22	0.31	0.15
1.A.1.a.i - Electricity Generation - Liquid Fuels	CH4	0.00	0.51	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.a.i - Electricity Generation - Liquid Fuels	N2O	0.01	0.97	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.a.i - Electricity Generation - Solid Fuels	CO2	5610.05	3658.26	5.00	5.00	7.07	10.64	0.05	0.34	0.23	2.41	5.87
1.A.1.a.i - Electricity Generation - Solid Fuels	CH4	1.41	0.95	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.a.i - Electricity Generation - Solid Fuels	N2O	20.01	13.48	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.01	0.00
1.A.1.a.ii - Combined Heat and Power Generation (CHP) - Liquid Fuels	CO2	306.44	0.00	5.00	5.00	7.07	0.00	0.02	0.00	0.11	0.00	0.01
1.A.1.a.ii - Combined Heat and Power Generation (CHP) - Liquid Fuels	CH4	0.33	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.a.ii - Combined Heat and Power Generation (CHP) - Liquid Fuels	N2O	0.63	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.a.ii - Combined Heat and Power Generation (CHP) - Solid Fuels	CO2	79.73	0.00	5.00	5.00	7.07	0.00	0.01	0.00	0.03	0.00	0.00
1.A.1.a.ii - Combined Heat and Power Generation (CHP) - Solid Fuels	CH4	0.02	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.a.ii - Combined Heat and Power Generation (CHP) - Solid Fuels	N2O	0.31	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.a.ii - Combined Heat and Power Generation (CHP) - Gaseous Fuels	CO2	0.00	418.65	5.00	5.00	7.07	0.14	0.04	0.04	0.20	0.28	0.11
1.A.1.a.ii - Combined Heat and Power Generation (CHP) - Gaseous Fuels	CH4	0.00	0.21	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.a.ii - Combined Heat and Power Generation (CHP) - Gaseous Fuels	N2O	0.00	0.20	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.a.iii - Heat Plants - Liquid Fuels	CO2	171.98	0.00	5.00	5.00	7.07	0.00	0.01	0.00	0.06	0.00	0.00
1.A.1.a.iii - Heat Plants - Liquid Fuels	CH4	0.19	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.a.iii - Heat Plants - Liquid Fuels	N2O	0.35	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.a.iii - Heat Plants - Gaseous Fuels	CO2	0.00	37.38	5.00	5.00	7.07	0.00	0.00	0.00	0.02	0.02	0.00
1.A.1.a.iii - Heat Plants - Gaseous Fuels	CH4	0.00	0.02	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.a.iii - Heat Plants - Gaseous Fuels	N2O	0.00	0.02	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.a - Iron and Steel - Liquid Fuels	CO2	346.16	139.15	5.00	5.00	7.07	0.02	0.01	0.01	0.05	0.09	0.01
1.A.2.a - Iron and Steel - Liquid Fuels	CH4	0.34	0.13	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.a - Iron and Steel - Liquid Fuels	N2O	0.62	0.25	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.a - Iron and Steel - Solid Fuels	CO2	272.72	128.14	5.00	5.00	7.07	0.01	0.01	0.01	0.03	0.08	0.01

1.A.2.a - Iron and Steel - Solid Fuels	CH4	0.77	0.37	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.a - Iron and Steel - Solid Fuels	N2O	1.09	0.53	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.a - Iron and Steel - Gaseous Fuels	CO2	0.00	55.50	5.00	5.00	7.07	0.00	0.01	0.01	0.03	0.04	0.00
1.A.2.a - Iron and Steel - Gaseous Fuels	CH4	0.00	0.03	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.a - Iron and Steel - Gaseous Fuels	N2O	0.00	0.03	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.a - Iron and Steel - Biomass - solid	CO2	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.a - Iron and Steel - Biomass - solid	CH4	0.00	0.22	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.a - Iron and Steel - Biomass - solid	N2O	0.00	0.27	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.b - Non-Ferrous Metals - Liquid Fuels	CO2	65.25	3.79	5.00	5.00	7.07	0.00	0.00	0.00	0.02	0.00	0.00
1.A.2.b - Non-Ferrous Metals - Liquid Fuels	CH4	0.07	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.b - Non-Ferrous Metals - Liquid Fuels	N2O	0.13	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.b - Non-Ferrous Metals - Solid Fuels	CO2	271.19	0.00	5.00	5.00	7.07	0.00	0.02	0.00	0.09	0.00	0.01
1.A.2.b - Non-Ferrous Metals - Solid Fuels	CH4	0.80	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.b - Non-Ferrous Metals - Solid Fuels	N2O	1.14	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.b - Non-Ferrous Metals - Biomass - solid	CO2	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.b - Non-Ferrous Metals - Biomass - solid	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.b - Non-Ferrous Metals - Biomass - solid	N2O	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.c - Chemicals - Liquid Fuels	CO2	77.52	1.79	5.00	5.00	7.07	0.00	0.01	0.00	0.03	0.00	0.00
1.A.2.c - Chemicals - Liquid Fuels	CH4	0.08	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.c - Chemicals - Liquid Fuels	N2O	0.16	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.c - Chemicals - Gaseous Fuels	CO2	0.00	4.65	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.c - Chemicals - Gaseous Fuels	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.c - Chemicals - Gaseous Fuels	N2O	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.c - Chemicals - Biomass - solid	CO2	0.00	0.00	5.00	18.69	19.35	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.c - Chemicals - Biomass - solid	CH4	0.00	0.00	5.00	245.45	245.51	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.c - Chemicals - Biomass - solid	N2O	0.00	0.00	5.00	281.82	281.86	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.d - Pulp, Paper and Print - Liquid Fuels	CO2	0.00	1.63	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.d - Pulp, Paper and Print - Liquid Fuels	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.d - Pulp, Paper and Print - Liquid Fuels	N2O	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.d - Pulp, Paper and Print - Gaseous Fuels	CO2	0.00	1.14	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.d - Pulp, Paper and Print - Gaseous Fuels	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00

1.A.2.d - Pulp, Paper and Print - Gaseous Fuels	N2O	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.d - Pulp, Paper and Print - Biomass - solid	CO2	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.d - Pulp, Paper and Print - Biomass - solid	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.d - Pulp, Paper and Print - Biomass - solid	N2O	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.e - Food Processing, Beverages and Tobacco - Liquid Fuels	CO2	46.92	52.56	5.00	5.00	7.07	0.00	0.00	0.00	0.01	0.03	0.00
1.A.2.e - Food Processing, Beverages and Tobacco - Liquid Fuels	CH4	0.05	0.05	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.e - Food Processing, Beverages and Tobacco - Liquid Fuels	N2O	0.10	0.09	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.e - Food Processing, Beverages and Tobacco - Solid Fuels	CO2	6.90	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.e - Food Processing, Beverages and Tobacco - Solid Fuels	CH4	0.02	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.e - Food Processing, Beverages and Tobacco - Solid Fuels	N2O	0.03	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.e - Food Processing, Beverages and Tobacco - Gaseous Fuels	CO2	0.00	10.28	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.01	0.00
1.A.2.e - Food Processing, Beverages and Tobacco - Gaseous Fuels	CH4	0.00	0.01	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.e - Food Processing, Beverages and Tobacco - Gaseous Fuels	N2O	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.e - Food Processing, Beverages and Tobacco - Biomass - solid	CO2	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.e - Food Processing, Beverages and Tobacco - Biomass - solid	CH4	0.00	0.13	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.e - Food Processing, Beverages and Tobacco - Biomass - solid	N2O	0.00	0.16	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.f - Non-Metallic Minerals - Liquid Fuels	CO2	132.98	288.40	5.00	5.00	7.07	0.07	0.02	0.03	0.09	0.19	0.04
1.A.2.f - Non-Metallic Minerals - Liquid Fuels	CH4	0.11	0.25	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.f - Non-Metallic Minerals - Liquid Fuels	N2O	0.19	0.46	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.f - Non-Metallic Minerals - Solid Fuels	CO2	0.00	23.52	5.00	5.00	7.07	0.00	0.00	0.00	0.01	0.02	0.00
1.A.2.f - Non-Metallic Minerals - Solid Fuels	CH4	0.00	0.07	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.f - Non-Metallic Minerals - Solid Fuels	N2O	0.00	0.10	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.f - Non-Metallic Minerals - Gaseous Fuels	CO2	0.00	2.43	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.f - Non-Metallic Minerals - Gaseous Fuels	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.f - Non-Metallic Minerals - Gaseous Fuels	N2O	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.f - Non-Metallic Minerals - Biomass - solid	CO2	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.f - Non-Metallic Minerals - Biomass - solid	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.f - Non-Metallic Minerals - Biomass - solid	N2O	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.h - Machinery - Liquid Fuels	CO2	5.81	8.93	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.01	0.00
1.A.2.h - Machinery - Liquid Fuels	CH4	0.00	0.01	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.h - Machinery - Liquid Fuels	N2O	0.00	0.01	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00

1.A.2.h - Machinery - Solid Fuels	CO2	3.45	0.40	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.h - Machinery - Solid Fuels	CH4	0.01	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.h - Machinery - Solid Fuels	N2O	0.01	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.h - Machinery - Gaseous Fuels	CO2	0.00	7.75	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.01	0.00
1.A.2.h - Machinery - Gaseous Fuels	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.h - Machinery - Gaseous Fuels	N2O	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.h - Machinery - Biomass - solid	CO2	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.h - Machinery - Biomass - solid	CH4	0.00	0.01	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.h - Machinery - Biomass - solid	N2O	0.00	0.01	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.i - Mining (excluding fuels) and Quarrying - Liquid Fuels	CO2	43.77	40.54	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.03	0.00
1.A.2.i - Mining (excluding fuels) and Quarrying - Liquid Fuels	CH4	0.05	0.05	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.i - Mining (excluding fuels) and Quarrying - Liquid Fuels	N2O	0.09	0.09	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.i - Mining (excluding fuels) and Quarrying - Biomass - solid	CO2	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.i - Mining (excluding fuels) and Quarrying - Biomass - solid	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.i - Mining (excluding fuels) and Quarrying - Biomass - solid	N2O	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.l - Textile and Leather - Liquid Fuels	CO2	9.29	9.47	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.01	0.00
1.A.2.l - Textile and Leather - Liquid Fuels	CH4	0.01	0.01	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.l - Textile and Leather - Liquid Fuels	N2O	0.02	0.02	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.l - Textile and Leather - Solid Fuels	CO2	10.35	2.93	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.l - Textile and Leather - Solid Fuels	CH4	0.03	0.01	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.l - Textile and Leather - Solid Fuels	N2O	0.04	0.01	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.l - Textile and Leather - Gaseous Fuels	CO2	0.00	0.33	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.l - Textile and Leather - Gaseous Fuels	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.l - Textile and Leather - Gaseous Fuels	N2O	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.l - Textile and Leather - Biomass - solid	CO2	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.l - Textile and Leather - Biomass - solid	CH4	0.00	0.02	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.l - Textile and Leather - Biomass - solid	N2O	0.00	0.02	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4.b - Residential - Liquid Fuels	CO2	404.05	21.58	5.00	5.00	7.07	0.00	0.03	0.00	0.13	0.01	0.02
1.A.4.b - Residential - Liquid Fuels	CH4	0.86	0.04	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4.b - Residential - Liquid Fuels	N2O	0.85	0.03	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4.b - Residential - Solid Fuels	CO2	21.09	0.77	5.00	5.00	7.07	0.00	0.00	0.00	0.01	0.00	0.00

1.A.4.b - Residential - Solid Fuels	CH4	1.75	0.06	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4.b - Residential - Solid Fuels	N2O	0.08	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4.b - Residential - Gaseous Fuels	CO2	0.00	0.33	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4.b - Residential - Gaseous Fuels	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4.b - Residential - Gaseous Fuels	N2O	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4.b - Residential - Biomass - solid	CO2	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4.b - Residential - Biomass - solid	CH4	61.79	64.43	5.00	5.00	7.07	0.00	0.00	0.01	0.01	0.04	0.00
1.A.4.b - Residential - Biomass - solid	N2O	7.80	8.13	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.01	0.00
1.A.4.c.i - Stationary - Liquid Fuels	CO2	141.26	35.04	5.00	5.00	7.07	0.00	0.01	0.00	0.03	0.02	0.00
1.A.4.c.i - Stationary - Liquid Fuels	CH4	0.53	0.13	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4.c.i - Stationary - Liquid Fuels	N2O	0.30	0.07	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4.c.i - Stationary - Solid Fuels	CO2	0.00	0.85	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4.c.i - Stationary - Solid Fuels	CH4	0.00	0.07	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4.c.i - Stationary - Solid Fuels	N2O	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4.c.i - Stationary - Biomass - solid	CO2	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4.c.i - Stationary - Biomass - solid	CH4	0.00	0.49	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.4.c.i - Stationary - Biomass - solid	N2O	0.00	0.06	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.5.a - Stationary - Liquid Fuels	CO2	0.00	118.57	5.00	5.00	7.07	0.01	0.01	0.01	0.06	0.08	0.01
1.A.5.a - Stationary - Liquid Fuels	CH4	0.00	0.42	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.5.a - Stationary - Liquid Fuels	N2O	0.00	0.23	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.5.a - Stationary - Solid Fuels	CO2	22.84	0.97	5.00	5.00	7.07	0.00	0.00	0.00	0.01	0.00	0.00
1.A.5.a - Stationary - Solid Fuels	CH4	0.06	0.08	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.5.a - Stationary - Solid Fuels	N2O	0.09	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.5.a - Stationary - Gaseous Fuels	CO2	0.00	10.81	5.00	5.00	7.07	0.00	0.00	0.00	0.01	0.01	0.00
1.A.5.a - Stationary - Gaseous Fuels	CH4	0.00	0.03	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.5.a - Stationary - Gaseous Fuels	N2O	0.00	0.01	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.5.a - Stationary - Biomass - solid	CO2	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.5.a - Stationary - Biomass - solid	CH4	0.00	2.06	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.5.a - Stationary - Biomass - solid	N2O	0.00	0.26	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.c.i - Manufacture of Solid Fuels	CO2	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.c.i - Manufacture of Solid Fuels	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00

1.A.1.c.i - Manufacture of Solid Fuels	N2O	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.c.ii - Other Energy Industries - Liquid Fuels	CO2	0.00	4.22	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.c.ii - Other Energy Industries - Liquid Fuels	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.c.ii - Other Energy Industries - Liquid Fuels	N2O	0.00	0.01	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.c.ii - Other Energy Industries - Biomass - solid	CO2	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.c.ii - Other Energy Industries - Biomass - solid	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.1.c.ii - Other Energy Industries - Biomass - solid	N2O	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.m - Non-specified Industry - Liquid Fuels	CO2	469.36	42.71	5.00	5.00	7.07	0.00	0.03	0.00	0.14	0.03	0.02
1.A.2.m - Non-specified Industry - Liquid Fuels	CH4	0.51	0.05	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.m - Non-specified Industry - Liquid Fuels	N2O	0.97	0.09	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.m - Non-specified Industry - Solid Fuels	CO2	1.72	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.m - Non-specified Industry - Solid Fuels	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.m - Non-specified Industry - Solid Fuels	N2O	0.01	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.m - Non-specified Industry - Gaseous Fuels	CO2	0.00	1.93	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.m - Non-specified Industry - Gaseous Fuels	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.m - Non-specified Industry - Gaseous Fuels	N2O	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.m - Non-specified Industry - Biomass - solid	CO2	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.m - Non-specified Industry - Biomass - solid	CH4	0.00	0.05	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.m - Non-specified Industry - Biomass - solid	N2O	0.00	0.06	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.a.i - International Aviation (International Bunkers) - Liquid Fuels	CO2	15.77	80.40	5.00	5.00	7.07	0.01	0.01	0.01	0.03	0.05	0.00
1.A.3.a.i - International Aviation (International Bunkers) - Liquid Fuels	CH4	0.00	0.02	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.a.i - International Aviation (International Bunkers) - Liquid Fuels	N2O	0.12	0.60	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.a.ii - Domestic Aviation - Liquid Fuels	CO2	0.00	0.26	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.a.ii - Domestic Aviation - Liquid Fuels	CH4	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.a.ii - Domestic Aviation - Liquid Fuels	N2O	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.i.1 - Passenger cars with 3-way catalysts - Liquid Fuels	CO2	0.00	1177.80	5.00	5.00	7.07	1.10	0.11	0.11	0.55	0.78	0.90
1.A.3.b.i.1 - Passenger cars with 3-way catalysts - Liquid Fuels	CH4	0.00	5.47	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.i.1 - Passenger cars with 3-way catalysts - Liquid Fuels	N2O	0.00	15.16	5.00	5.00	7.07	0.00	0.00	0.00	0.01	0.01	0.00
1.A.3.b.i.2 - Passenger cars without 3-way catalysts - Liquid Fuels	CO2	454.08	232.84	5.00	5.00	7.07	0.04	0.01	0.02	0.05	0.15	0.03
1.A.3.b.i.2 - Passenger cars without 3-way catalysts - Liquid Fuels	CH4	5.27	1.14	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.i.2 - Passenger cars without 3-way catalysts - Liquid Fuels	N2O	5.67	2.98	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00

1.A.3.b.ii.1 - Light-duty trucks with 3-way catalysts - Liquid Fuels	CO2	17.90	297.48	5.00	5.00	7.07	0.07	0.03	0.03	0.13	0.20	0.06
1.A.3.b.ii.1 - Light-duty trucks with 3-way catalysts - Liquid Fuels	CH4	0.06	0.62	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.ii.1 - Light-duty trucks with 3-way catalysts - Liquid Fuels	N2O	0.24	4.12	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.ii.2 - Light-duty trucks without 3-way catalysts - Liquid Fuels	CO2	56.87	44.17	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.03	0.00
1.A.3.b.ii.2 - Light-duty trucks without 3-way catalysts - Liquid Fuels	CH4	0.29	0.09	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.ii.2 - Light-duty trucks without 3-way catalysts - Liquid Fuels	N2O	0.76	0.61	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.iii - Heavy-duty trucks and buses - Liquid Fuels	CO2	109.88	510.95	5.00	5.00	7.07	0.21	0.04	0.05	0.20	0.34	0.15
1.A.3.b.iii - Heavy-duty trucks and buses - Liquid Fuels	CH4	1.03	1.52	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.iii - Heavy-duty trucks and buses - Liquid Fuels	N2O	1.41	7.02	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.iii - Heavy-duty trucks and buses - Gaseous Fuels	CO2	0.00	3.72	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.iii - Heavy-duty trucks and buses - Gaseous Fuels	CH4	0.00	11.18	5.00	5.00	7.07	0.00	0.00	0.00	0.01	0.01	0.00
1.A.3.b.iii - Heavy-duty trucks and buses - Gaseous Fuels	N2O	0.00	3.27	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.iv - Motorcycles - Liquid Fuels	CO2	1.10	3.55	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.iv - Motorcycles - Liquid Fuels	CH4	0.01	0.05	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.iv - Motorcycles - Liquid Fuels	N2O	0.01	0.04	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.b.vi - Urea-based catalysts	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.c - Railways - Liquid Fuels	CO2	22.30	3.51	5.00	5.00	7.07	0.00	0.00	0.00	0.01	0.00	0.00
1.A.3.c - Railways - Liquid Fuels	CH4	0.03	0.01	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.A.3.c - Railways - Liquid Fuels	N2O	2.28	0.36	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1 - Fugitive Emissions from Fuels - Solid Fuels												
1.B.1.a.i.1 - Mining	CO2	0.00	0.00	5.00	100.00	100.12	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.a.i.1 - Mining	CH4	0.00	0.00	5.00	100.00	100.12	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.a.i.2 - Post-mining seam gas emissions	CO2	0.00	0.00	5.00	200.00	200.06	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.a.i.2 - Post-mining seam gas emissions	CH4	0.00	0.00	5.00	200.00	200.06	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.a.i.3 - Abandoned underground mines	CH4	0.00	0.00	5.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.a.i.3 - Abandoned underground mines	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.a.i.4 - Flaring of drained methane or conversion of methane to CO2	CO2	0.00	0.00	5.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.a.i.4 - Flaring of drained methane or conversion of methane to CO2	CH4	0.00	0.00	5.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.a.ii.1 - Mining	CO2	5.62	4.09	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.a.ii.1 - Mining	CH4	196.31	142.94	5.00	5.00	7.07	0.02	0.00	0.01	0.00	0.09	0.01
1.B.1.a.ii.2 - Post-mining seam gas emissions	CO2	0.00	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00

1.B.1.a.ii.2 - Post-mining seam gas emissions	CH4	13.09	9.53	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.01	0.00
1.B.1.a.ii.3 - Abandoned surface mines	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.a.ii.3 - Abandoned surface mines	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.c.i - Charcoal and Biochar production	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.c.i - Charcoal and Biochar production	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.c.i - Charcoal and Biochar production	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.c.ii - Coke production	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.c.ii - Coke production	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.c.ii - Coke production	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.c.iv - Gasification transformation	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.c.iv - Gasification transformation	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.1.c.iv - Gasification transformation	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2 - Fugitive Emissions from Fuels - Oil and Natural Gas												
1.B.2.a.i - Venting	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.i - Venting	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.i - Venting	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.ii - Flaring	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.ii - Flaring	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.ii - Flaring	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.1 - Exploration	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.1 - Exploration	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.1 - Exploration	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.2 - Production and Upgrading	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.2 - Production and Upgrading	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.2 - Production and Upgrading	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.3 - Transport	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.3 - Transport	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.3 - Transport	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.4 - Refining	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.4 - Refining	CH4	0.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.4 - Refining	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

1.B.2.a.iii.5 - Distribution of oil products	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.5 - Distribution of oil products	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.5 - Distribution of oil products	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.6 - Other	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.6 - Other	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.a.iii.6 - Other	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.i - Venting	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.i - Venting	CH4	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.i - Venting	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.ii - Flaring	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.ii - Flaring	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.ii - Flaring	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.1 - Exploration	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.1 - Exploration	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.1 - Exploration	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.2 - Production	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.2 - Production	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.2 - Production	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.3 - Processing	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.3 - Processing	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.3 - Processing	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.4 - Transmission and Storage	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.4 - Transmission and Storage	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.4 - Transmission and Storage	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.5 - Distribution	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.5 - Distribution	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.5 - Distribution	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.6 - Other	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.6 - Other	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.b.iii.6 - Other	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.3 - Other emissions from Energy Production	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

1.B.3 - Other emissions from Energy Production	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.3 - Other emissions from Energy Production	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.C - CO2 Transport Injection and Storage												
1.C.1.a - Pipelines	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.C.1.b - Ships	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.C.1.c - Other (please specify)	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.C.2.a - Injection	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.C.2.b - Storage	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.C.3 - Other	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.A - Mineral Industry												
2.A.1 - Cement production	CO2	292.57	365.79	10.00	3.00	10.44	0.23	0.01	0.03	0.04	0.48	0.23
2.A.2 - Lime production	CO2	33.72	0.00	21.21	3.00	21.42	0.00	0.00	0.00	0.01	0.00	0.00
2.A.3 - Glass Production	CO2	0.33	0.09	5.00	30.00	30.41	0.00	0.00	0.00	0.00	0.00	0.00
2.A.4.a - Ceramics	CO2	2.62	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.A.4.b - Other Uses of Soda Ash	CO2	2.68	0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.A.4.c - Non Metallurgical Magnesia Production	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.A.4.d - Other (please specify)	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.A.5 - Other (please specify)	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.A.5 - Other (please specify)	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.A.5 - Other (please specify)	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B - Chemical Industry												
2.B.1 - Ammonia Production	CO2	0.00	0.00	5.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B.2 - Nitric Acid Production	N2O	0.00	0.00	2.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B.3 - Adipic Acid Production	N2O	0.00	0.00	2.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B.4 - Caprolactam, Glyoxal and Glyoxylic Acid Production	N2O	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B.5 - Carbide Production	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B.5 - Carbide Production	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B.6 - Titanium Dioxide Production	CO2	0.00	0.00	7.07	0.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
2.B.7 - Soda Ash Production	CO2	0.00	0.00	5.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B.8.a - Methanol	CO2	0.00	0.00	14.14	0.00	14.14	0.00	0.00	0.00	0.00	0.00	0.00
2.B.8.a - Methanol	CH4	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00

2.B.8.b - Ethylene	CO2	0.00	0.00	14.14	0.00	14.14	0.00	0.00	0.00	0.00	0.00	0.00
2.B.8.b - Ethylene	CH4	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B.8.c - Ethylene Dichloride and Vinyl Chloride Monomer	CO2	0.00	0.00	14.14	0.00	14.14	0.00	0.00	0.00	0.00	0.00	0.00
2.B.8.c - Ethylene Dichloride and Vinyl Chloride Monomer	CH4	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B.8.d - Ethylene Oxide	CO2	0.00	0.00	14.14	0.00	14.14	0.00	0.00	0.00	0.00	0.00	0.00
2.B.8.d - Ethylene Oxide	CH4	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B.8.e - Acrylonitrile	CO2	0.00	0.00	14.14	0.00	14.14	0.00	0.00	0.00	0.00	0.00	0.00
2.B.8.e - Acrylonitrile	CH4	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B.8.f - Carbon Black	CO2	0.00	0.00	14.14	0.00	14.14	0.00	0.00	0.00	0.00	0.00	0.00
2.B.8.f - Carbon Black	CH4	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B.8.x - Other petrochemical production	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B.8.x - Other petrochemical production	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B.9.a - By-product emissions	CHF3	0.00	0.00	14.14	0.00	14.14	0.00	0.00	0.00	0.00	0.00	0.00
2.B.10 - Hydrogen Production	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B.10 - Hydrogen Production	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.B.10 - Hydrogen Production	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.C - Metal Industry												
2.C.1 - Iron and Steel Production	CO2	24.75	22.37	10.00	5.00	11.18	0.00	0.00	0.00	0.00	0.03	0.00
2.C.1 - Iron and Steel Production	CH4	0.00	0.00	10.00	7.07	12.25	0.00	0.00	0.00	0.00	0.00	0.00
2.C.2 - Ferroalloys Production	CO2	266.65	33.77	5.00	5.00	7.07	0.00	0.02	0.00	0.08	0.02	0.01
2.C.2 - Ferroalloys Production	CH4	1.48	0.00	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
2.C.3 - Aluminium production	CO2	8.78	0.00	2.00	5.00	5.39	0.00	0.00	0.00	0.00	0.00	0.00
2.C.3 - Aluminium production	CF4	58.21	0.00	3.46	5.00	6.08	0.00	0.00	0.00	0.02	0.00	0.00
2.C.3 - Aluminium production	C2F6	24.36	0.00	3.46	5.00	6.08	0.00	0.00	0.00	0.01	0.00	0.00
2.C.4 - Magnesium production	CO2	0.00	0.00	5.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00
2.C.4 - Magnesium production	SF6	0.00	0.00	5.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00
2.C.5 - Lead Production	CO2	22.09	6.11	10.00	5.00	11.18	0.00	0.00	0.00	0.00	0.01	0.00
2.C.6 - Zinc Production	CO2	186.23	0.00	10.00	5.00	11.18	0.00	0.01	0.00	0.06	0.00	0.00
2.C.7 - Rare Earths Production	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.C.7 - Rare Earths Production	CF4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.C.7 - Rare Earths Production	C2F6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

2.C.7 - Rare Earths Production	C3F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.D - Non-Energy Products from Fuels and Solvent Use												
2.D.1 - Lubricant Use	CO2	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.D.2 - Paraffin Wax Use	CO2	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.D.4 - Other (please specify)	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.D.4 - Other (please specify)	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.D.4 - Other (please specify)	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E - Electronics Industry												
2.E.1 - Integrated Circuit or Semiconductor	CHF3	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.1 - Integrated Circuit or Semiconductor	CF4	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.1 - Integrated Circuit or Semiconductor	C2F6	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.1 - Integrated Circuit or Semiconductor	C3F8	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.1 - Integrated Circuit or Semiconductor	SF6	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.1 - Integrated Circuit or Semiconductor	NF3	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.1 - Integrated Circuit or Semiconductor	CH2F2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.1 - Integrated Circuit or Semiconductor	CHF2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.1 - Integrated Circuit or Semiconductor	c-C4F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.1 - Integrated Circuit or Semiconductor	NF3 Remote	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.1 - Integrated Circuit or Semiconductor	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.2 - TFT Flat Panel Display	CF4	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.2 - TFT Flat Panel Display	SF6	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.2 - TFT Flat Panel Display	NF3	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.2 - TFT Flat Panel Display	CHF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.2 - TFT Flat Panel Display	CH2F2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.2 - TFT Flat Panel Display	CHF2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.2 - TFT Flat Panel Display	C2F6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.2 - TFT Flat Panel Display	C3F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.2 - TFT Flat Panel Display	c-C4F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.2 - TFT Flat Panel Display	NF3 Remote	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.2 - TFT Flat Panel Display	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.3 - Photovoltaics	CF4	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00

2.E.3 - Photovoltaics	C2F6	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.3 - Photovoltaics	CHF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.3 - Photovoltaics	CH2F2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.3 - Photovoltaics	CHF2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.3 - Photovoltaics	C3F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.3 - Photovoltaics	c-C4F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.3 - Photovoltaics	SF6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.3 - Photovoltaics	NF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.3 - Photovoltaics	NF3 Remote	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.4 - Heat Transfer Fluid	n-C6F14	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.5 - Other (please specify)	CF4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.5 - Other (please specify)	c-C4F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.E.5 - Other (please specify)	SF6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F - Product Uses as Substitutes for Ozone Depleting Substances												
2.F.1.a - Refrigeration and Stationary Air Conditioning	CHF3	0.00	0.12	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.a - Refrigeration and Stationary Air Conditioning	CH2F2	0.00	9.44	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.01	0.00
2.F.1.a - Refrigeration and Stationary Air Conditioning	CHF2CF3	0.00	91.21	5.00	5.00	7.07	0.01	0.01	0.01	0.04	0.06	0.01
2.F.1.a - Refrigeration and Stationary Air Conditioning	CH2FCF3	0.00	62.52	5.00	5.00	7.07	0.00	0.01	0.01	0.03	0.04	0.00
2.F.1.a - Refrigeration and Stationary Air Conditioning	CH3CHF2	0.00	15.14	5.00	5.00	7.07	0.00	0.00	0.00	0.01	0.01	0.00
2.F.1.a - Refrigeration and Stationary Air Conditioning	CH3CF3	0.00	94.64	5.00	5.00	7.07	0.01	0.01	0.01	0.04	0.06	0.01
2.F.1.a - Refrigeration and Stationary Air Conditioning	CF3CHFCF3	0.00	13.74	5.00	5.00	7.07	0.00	0.00	0.00	0.01	0.01	0.00
2.F.1.a - Refrigeration and Stationary Air Conditioning	CF3CH2CF3	0.00	0.06	5.00	5.00	7.07	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.a - Refrigeration and Stationary Air Conditioning	CF3CHFCHFCF2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.a - Refrigeration and Stationary Air Conditioning	CHF2CH2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.a - Refrigeration and Stationary Air Conditioning	CH3CF2CH2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.a - Refrigeration and Stationary Air Conditioning	CF4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.a - Refrigeration and Stationary Air Conditioning	C2F6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.a - Refrigeration and Stationary Air Conditioning	C3F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.a - Refrigeration and Stationary Air Conditioning	C4F10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.a - Refrigeration and Stationary Air Conditioning	c-C4F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.a - Refrigeration and Stationary Air Conditioning	n-C5F12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

2.F.1.a - Refrigeration and Stationary Air Conditioning	n-C6F14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	CH2FCF3	0.00	0.00	5.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	CH3CHF2	0.00	0.00	5.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	CHF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	CH2F2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	CF3CHFCHFCF2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	CHF2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	CH3CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	CF3CHFCF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	CF3CH2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	CHF2CH2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	CH3CF2CH2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	CF4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	C2F6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	C3F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	C4F10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	c-C4F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	n-C5F12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.1.b - Mobile Air Conditioning	n-C6F14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	CH2FCF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	CH3CHF2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	CHF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	CH2F2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	CF3CHFCHFCF2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	CHF2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	CH3CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	CF3CHFCF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	CF3CH2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	CHF2CH2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	CH3CF2CH2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	CF4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

2.F.2 - Foam Blowing Agents	C2F6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	C3F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	C4F10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	c-C4F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	n-C5F12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.2 - Foam Blowing Agents	n-C6F14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.3 - Fire Protection	CH2FCF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.3 - Fire Protection	CH3CHF2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.3 - Fire Protection	CF3CHFCF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.3 - Fire Protection	CF3CH2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.4 - Aerosols	CF3CHFCHFCF2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.4 - Aerosols	CH2FCF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.4 - Aerosols	CH3CHF2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.4 - Aerosols	CF3CHFCF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.4 - Aerosols	CHF2CH2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.4 - Aerosols	CH3CF2CH2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.4 - Aerosols	n-C6F14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.5 - Solvents	CF3CHFCHFCF2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.5 - Solvents	CH3CF2CH2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.5 - Solvents	n-C6F14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	CHF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	CH2F2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	CF3CHFCHFCF2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	CHF2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	CH2FCF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	CH3CHF2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	CH3CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	CF3CHFCF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	CF3CH2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	CHF2CH2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	CH3CF2CH2CF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

2.F.6 - Other Applications (please specify)	CF4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	C2F6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	C3F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	C4F10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	c-C4F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	n-C5F12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	n-C6F14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	SF6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	NF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.F.6 - Other Applications (please specify)	NF3 Remote	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G - Electrical Equipment												
2.G.1 - Electrical Equipment	CF4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1 - Electrical Equipment	C2F6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1 - Electrical Equipment	C3F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1 - Electrical Equipment	C4F10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1 - Electrical Equipment	c-C4F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1 - Electrical Equipment	n-C5F12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1 - Electrical Equipment	n-C6F14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1 - Electrical Equipment	SF6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.a - Manufacture of Electrical Equipment	CF4	0.00	0.00	30.00	30.00	42.43	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.a - Manufacture of Electrical Equipment	C2F6	0.00	0.00	30.00	30.00	42.43	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.a - Manufacture of Electrical Equipment	C3F8	0.00	0.00	30.00	30.00	42.43	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.a - Manufacture of Electrical Equipment	C4F10	0.00	0.00	30.00	30.00	42.43	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.a - Manufacture of Electrical Equipment	c-C4F8	0.00	0.00	30.00	30.00	42.43	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.a - Manufacture of Electrical Equipment	n-C5F12	0.00	0.00	30.00	30.00	42.43	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.a - Manufacture of Electrical Equipment	n-C6F14	0.00	0.00	30.00	30.00	42.43	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.a - Manufacture of Electrical Equipment	SF6	0.00	0.00	30.00	30.00	42.43	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.b - Use of Electrical Equipment	CF4	0.00	0.00	30.00	30.00	42.43	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.b - Use of Electrical Equipment	C2F6	0.00	0.00	30.00	30.00	42.43	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.b - Use of Electrical Equipment	C3F8	0.00	0.00	30.00	30.00	42.43	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.b - Use of Electrical Equipment	C4F10	0.00	0.00	30.00	30.00	42.43	0.00	0.00	0.00	0.00	0.00	0.00

2.G.1.b - Use of Electrical Equipment	c-C4F8	0.00	0.00	30.00	30.00	42.43	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.b - Use of Electrical Equipment	n-C5F12	0.00	0.00	30.00	30.00	42.43	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.b - Use of Electrical Equipment	n-C6F14	0.00	0.00	30.00	30.00	42.43	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.b - Use of Electrical Equipment	SF6	0.00	0.00	30.00	30.00	42.43	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.c - Disposal of Electrical Equipment	CF4	0.00	0.00	40.00	40.00	56.57	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.c - Disposal of Electrical Equipment	C2F6	0.00	0.00	40.00	40.00	56.57	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.c - Disposal of Electrical Equipment	C3F8	0.00	0.00	40.00	40.00	56.57	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.c - Disposal of Electrical Equipment	C4F10	0.00	0.00	40.00	40.00	56.57	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.c - Disposal of Electrical Equipment	c-C4F8	0.00	0.00	40.00	40.00	56.57	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.c - Disposal of Electrical Equipment	n-C5F12	0.00	0.00	40.00	40.00	56.57	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.c - Disposal of Electrical Equipment	n-C6F14	0.00	0.00	40.00	40.00	56.57	0.00	0.00	0.00	0.00	0.00	0.00
2.G.1.c - Disposal of Electrical Equipment	SF6	0.00	0.00	40.00	40.00	56.57	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.a - Military Applications	CF4	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.a - Military Applications	C2F6	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.a - Military Applications	C3F8	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.a - Military Applications	C4F10	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.a - Military Applications	c-C4F8	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.a - Military Applications	n-C5F12	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.a - Military Applications	n-C6F14	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.a - Military Applications	SF6	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.b - Accelerators	CF4	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.b - Accelerators	C2F6	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.b - Accelerators	C3F8	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.b - Accelerators	C4F10	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.b - Accelerators	c-C4F8	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.b - Accelerators	n-C5F12	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.b - Accelerators	n-C6F14	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.b - Accelerators	SF6	0.00	0.00	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.c - Other (please specify)	CF4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.c - Other (please specify)	C2F6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.c - Other (please specify)	c-C3F6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

2.G.2.c - Other (please specify)	C3F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.c - Other (please specify)	C4F10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.c - Other (please specify)	c-C4F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.c - Other (please specify)	n-C5F12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.c - Other (please specify)	n-C6F14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.c - Other (please specify)	SF6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.2.c - Other (please specify)	CHF3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.3.a - Medical Applications	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.3.b - Propellant for pressure and aerosol products	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.G.3.c - Other (Please specify)	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.H - Other												
2.H.1 - Pulp and Paper Industry	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.H.1 - Pulp and Paper Industry	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.H.1 - Pulp and Paper Industry	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.H.2 - Food and Beverages Industry	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.H.2 - Food and Beverages Industry	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.H.2 - Food and Beverages Industry	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A - Livestock												
3.A.1.a.i - Dairy Cows	CH4	460.81	321.50	5.00	30.00	30.41	1.52	0.00	0.03	0.05	0.21	0.05
3.A.1.a.ii - Other Cattle	CH4	196.40	96.17	5.00	30.00	30.41	0.14	0.00	0.01	0.14	0.06	0.02
3.A.1.b - Buffalo	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A.1.c - Sheep	CH4	321.60	90.51	5.00	30.00	30.41	0.12	0.01	0.01	0.41	0.06	0.17
3.A.1.d - Goats	CH4	0.00	11.23	5.00	30.00	30.41	0.00	0.00	0.00	0.03	0.01	0.00
3.A.1.e - Camels	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A.1.f - Horses	CH4	33.41	6.17	5.00	30.00	30.41	0.00	0.00	0.00	0.05	0.00	0.00
3.A.1.g - Mules and Asses	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A.1.h - Swine	CH4	5.00	9.39	5.00	30.00	30.41	0.00	0.00	0.00	0.02	0.01	0.00
3.A.1.i - Poultry	CH4	0.00	0.00	5.00	30.00	30.41	0.00	0.00	0.00	0.00	0.00	0.00
3.A.1.j - Other (please specify)	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A.2.a.i - Dairy cows	CH4	93.09	21.17	5.00	30.00	30.41	0.01	0.00	0.00	0.13	0.01	0.02
3.A.2.a.i - Dairy cows	N2O	20.67	7.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

3.A.2.a.ii - Other cattle	CH4	30.48	14.92	5.00	30.00	30.41	0.00	0.00	0.00	0.02	0.01	0.00
3.A.2.a.ii - Other cattle	N2O	10.69	4.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A.2.b - Buffalo	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A.2.b - Buffalo	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A.2.c - Sheep	CH4	9.65	2.72	5.00	30.00	30.41	0.00	0.00	0.00	0.01	0.00	0.00
3.A.2.c - Sheep	N2O	8.80	3.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A.2.d - Goats	CH4	0.00	0.38	5.00	30.00	30.41	0.00	0.00	0.00	0.00	0.00	0.00
3.A.2.d - Goats	N2O	0.00	0.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A.2.e - Camels	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A.2.e - Camels	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A.2.f - Horses	CH4	3.04	0.56	5.00	30.00	30.41	0.00	0.00	0.00	0.00	0.00	0.00
3.A.2.f - Horses	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A.2.g - Mules and Asses	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A.2.g - Mules and Asses	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A.2.h - Swine	CH4	29.99	51.02	5.00	30.00	30.41	0.04	0.00	0.00	0.08	0.03	0.01
3.A.2.h - Swine	N2O	3.00	94.52	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00
3.A.2.i - Poultry	CH4	3.21	0.90	5.00	30.00	30.41	0.00	0.00	0.00	0.00	0.00	0.00
3.A.2.i - Poultry	N2O	0.64	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A.2.j - Other (please specify)	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.A.2.j - Other (please specify)	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B - Land												
3.B.1.a - Forest land Remaining Forest land	CO2	-1654.78	-2531.10	20.00	10.00	22.36	50.94	0.12	0.24	1.22	6.67	46.03
3.B.1.b.i - Cropland converted to Forest Land	CO2	-1.21	-33.02	10.00	10.00	14.14	0.00	0.00	0.00	0.03	0.04	0.00
3.B.1.b.ii - Grassland converted to Forest Land	CO2	-45.18	-281.78	10.00	10.00	14.14	0.25	0.02	0.03	0.23	0.37	0.19
3.B.1.b.iii - Wetlands converted to Forest Land	CO2	-0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.1.b.iv - Settlements converted to Forest Land	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.1.b.v - Other Land converted to Forest Land	CO2	-42.93	-412.81	10.00	10.00	14.14	0.54	0.04	0.04	0.36	0.54	0.42
3.B.2.a - Cropland Remaining Cropland	CO2	-183.11	-155.07	20.00	50.00	53.85	1.11	0.00	0.01	0.09	0.41	0.18
3.B.2.b.i - Forest Land converted to Cropland	CO2	38.39	121.47	10.00	50.00	50.99	0.61	0.01	0.01	0.43	0.16	0.21
3.B.2.b.ii - Grassland converted to Cropland	CO2	-3.48	0.24	10.00	50.00	50.99	0.00	0.00	0.00	0.01	0.00	0.00
3.B.2.b.iii - Wetlands converted to Cropland	CO2	-0.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

3.B.2.b.iv - Settlements converted to Cropland	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.2.b.v - Other Land converted to Cropland	CO2	-61.71	-0.91	10.00	50.00	50.99	0.00	0.00	0.00	0.21	0.00	0.04
3.B.3.a - Grassland Remaining Grassland	CO2	0.00	0.00	20.00	50.00	53.85	0.00	0.00	0.00	0.00	0.00	0.00
3.B.3.b.i - Forest Land converted to Grassland	CO2	11.42	751.98	10.00	50.00	50.99	23.38	0.07	0.07	3.47	0.99	12.99
3.B.3.b.ii - Cropland converted to Grassland	CO2	6.95	9.39	10.00	50.00	50.99	0.00	0.00	0.00	0.02	0.01	0.00
3.B.3.b.iii - Wetlands converted to Grassland	CO2	-0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.3.b.iv - Settlements converted to Grassland	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.3.b.v - Other Land converted to Grassland	CO2	-33.70	-618.87	10.00	50.00	50.99	15.83	0.06	0.06	2.77	0.82	8.33
3.B.4.a.i - Peat Extraction remaining Peat Extraction	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.4.a.iii - Other Wetlands Remaining Other Wetlands	CO2	0.00	0.00	10.00	50.00	50.99	0.00	0.00	0.00	0.00	0.00	0.00
3.B.4.b.i - Land converted for Peat Extraction	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.4.b.ii - Land converted to Flooded Land	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.4.b.iii - Land converted to Other Wetlands	CO2	1.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.5.a - Settlements Remaining Settlements	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.5.b.i - Forest Land converted to Settlements	CO2	0.00	41.68	10.00	50.00	50.99	0.07	0.00	0.00	0.19	0.05	0.04
3.B.5.b.ii - Cropland converted to Settlements	CO2	3.62	2.02	10.00	50.00	50.99	0.00	0.00	0.00	0.00	0.00	0.00
3.B.5.b.iii - Grassland converted to Settlements	CO2	4.52	1.69	10.00	50.00	50.99	0.00	0.00	0.00	0.01	0.00	0.00
3.B.5.b.iv - Wetlands converted to Settlements	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.5.b.v - Other Land converted to Settlements	CO2	0.00	-1.15	10.00	50.00	50.99	0.00	0.00	0.00	0.01	0.00	0.00
3.B.6.b.i - Forest Land converted to Other Land	CO2	83.06	16.35	20.00	50.00	53.85	0.01	0.00	0.00	0.21	0.04	0.05
3.B.6.b.ii - Cropland converted to Other Land	CO2	63.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.6.b.iii - Grassland converted to Other Land	CO2	3.91	3.97	10.00	50.00	50.99	0.00	0.00	0.00	0.01	0.01	0.00
3.B.6.b.iv - Wetlands converted to Other Land	CO2	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.6.b.v - Settlements converted to Other Land	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C - Aggregate sources and non-CO2 emissions sources on land												
3.C.1.a - Burning in Forest Land	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.1.a - Burning in Forest Land	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.1.a - Burning in Forest Land	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.1.b - Burning in Cropland	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.1.b - Burning in Cropland	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.1.b - Burning in Cropland	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

3.C.1.c - Burning in Grassland	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.1.c - Burning in Grassland	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.1.c - Burning in Grassland	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.1.d - Burning in all other land uses	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.1.d - Burning in all other land uses	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.1.d - Burning in all other land uses	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.2 - Liming	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.3 - Urea application	CO2	3.74	1.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.4 - Direct N2O Emissions from managed soils	N2O	188.96	286.25	0.00	0.00	0.00	0.00	0.01	0.03	0.00	0.00	0.00
3.C.5 - Indirect N2O Emissions from managed soils	N2O	69.11	88.65	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
3.C.6 - Indirect N2O Emissions from manure management	N2O	31.94	66.58	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
3.C.7 - Rice cultivation	CH4	32.67	16.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.8 - CH4 from Drained Organic Soils	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.9 - CH4 from Drainage Ditches on Organic Soils	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.10 - CH4 from Rewetting of Organic Soils	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.11 - CH4 Emissions from Rewetting of Mangroves and Tidal Marshes	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.12 - N2O Emissions from Aquaculture	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.13 - CH4 Emissions from Rewetted and Created Wetlands on Inland Wetland Mineral Soils	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.14 - Other (please specify)	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.14 - Other (please specify)	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.C.14 - Other (please specify)	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.D - Other												
3.D.1 - Harvested Wood Products	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.D.2 - Other (please specify)	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.D.2 - Other (please specify)	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.D.2 - Other (please specify)	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.A - Solid Waste Disposal												
4.A.1 - Managed Waste Disposal Sites	CH4	0.00	173.27	20.00	20.00	28.28	0.38	0.02	0.02	0.32	0.46	0.31
4.A.2 - Unmanaged Waste Disposal Sites	CH4	1.22	249.99	20.00	20.00	28.28	0.80	0.02	0.02	0.46	0.66	0.65
4.A.3 - Uncategorised Waste Disposal Sites	CH4	294.66	236.05	20.00	20.00	28.28	0.71	0.00	0.02	0.03	0.62	0.39
4.B - Biological Treatment of Solid Waste												

4.B - Biological Treatment of Solid Waste	CH4	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.B - Biological Treatment of Solid Waste	N2O	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.C - Incineration and Open Burning of Waste												
4.C.1 - Waste Incineration	CO2	0.00	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.C.1 - Waste Incineration	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.C.1 - Waste Incineration	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.C.2 - Open Burning of Waste	CO2	2.86	5.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.C.2 - Open Burning of Waste	CH4	6.63	12.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.C.2 - Open Burning of Waste	N2O	1.40	2.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.D - Wastewater Treatment and Discharge												
4.D.1 - Domestic Wastewater Treatment and Discharge	CH4	152.76	100.48	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
4.D.1 - Domestic Wastewater Treatment and Discharge	N2O	34.99	34.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.D.2 - Industrial Wastewater Treatment and Discharge	CH4	22.23	15.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.D.2 - Industrial Wastewater Treatment and Discharge	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.E - Other (please specify)												
4.E - Other (please specify)	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.E - Other (please specify)	CH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.E - Other (please specify)	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.A - Indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3												
5.A - Indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.B - Indirect CO2 emissions from the atmospheric oxidation of CH4, CO and NMVOC												
5.B - Indirect CO2 emissions from the atmospheric oxidation of CH4, CO and NMVOC	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.C - Other												
		Sum(C): 10,727.441	Sum(D): 7,930.147				Sum(H): 109.247					Sum(M): 77.799
							Uncertainty in total inventory: 10.452					Trend uncertainty: 8.820

Annex IV Activity data

12.1 Energy

Table 49. Energy balance for 2019

	Coaking Coal	Coke Oven Coke	Sub-bituminous coal	Lignite	Crude oil	Feedstocks	Total petroleum products	Refinery gas	LPG	Naphtha	Motor spirit	Kerosenes, jet fuels	Road diesel	Heating and other gasoil	Residual fuel oil	Petroleum coke	Other petroleum products	Natural gas	Geothermal heat	Fuel wood	Wood of fruit trees and other plant residues	Wood wastes, wood briquettes and pellets	Hydro energy	Solar electricity	Solar thermal	Wind electricity	Biogas	Biodiesel
Total primary production	-	-	-	36015.14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	204.82	6523.83	81.82	287.34	4188.42	83.60	-	366.44	204.28	-
Recovered products	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Imports	2202.59	15.58	2732.14	1714.63	-	-	52605.42	-	3772.32	-	5330.30	2475.81	30365.93	1878.11	3232.43	3040.78	2509.75	10216.40	-	221.45	-	1309.50	-	-	-	-	-	2.88
Stock change	62.87	1.95	-55.10	1742.79	-	-	-838.62	-	69.67	-	16.37	-24.16	-885.21	2.63	-67.30	7.48	41.90	3.30	-	75.32	-	1.73	-	-	-	-	-	0.92
Exports	3.18	-	16.67	0.18	-	-	6367.93	-	72.45	-	763.72	1280.33	2712.09	-	188.00	1250.18	101.16	-	-	0.46	-	11.37	-	-	-	-	-	-
Gross inland consumption	2262.28	17.53	2660.38	37932.38	-	-	45398.87	-	3769.54	-	4582.95	1171.31	26768.63	1880.74	2977.12	1798.08	2450.48	10219.70	204.82	6820.14	81.82	1587.20	4188.42	83.60	-	366.44	204.28	3.80
Transformation input	-	-	-	37541.34	-	-	684.46	-	-	-	-	-	-	-	684.46	-	-	8361.47	-	-	-	-	-	-	-	-	204.28	-
.. Puclic thermal power stations	-	-	-	37541.34	-	-	684.46	-	-	-	-	-	-	-	684.46	-	-	-	-	-	-	-	-	-	-	-	-	-
.. Autoproducers plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
.. CHP plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7229.74	-	-	-	-	-	-	-	-	-	-
.. Briq	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

uetting plants																												
.. Biogas plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	204.28	-
.. Refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
.. Main activity producer heat plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1127.26	-	-	-	-	-	-	-	-	-	-
Transformation output	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
.. Public thermal power stations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
.. Autoproducers plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
..CHP plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
..Briquetting plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
..Biogas plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
..Refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
.. Main activity producer heat plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Exchanges	-	-	-	-	-	-	3.81	-	-	-	-	-	3.81	-	-	-	-	-	-	-	-	-	- 4188.42	- 83.60	-	- 366.44	-	- 3.80

and transfers, returns																												
Consumption of the energy branch	-	-	-	-	-	-	60.45	-	-	-	-	-	50.41	0.86	9.18	-	-	-	-	0.27	-	-	-	-	-	-	-	-
Distribution losses	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	51.69	18.10	-	-	-	-	-	-	-	-	-
Available for final consumption	2262.28	17.53	2660.38	391.04	-	-	44657.77	-	3769.54	-	4582.95	1171.31	26722.03	1879.88	2283.49	1798.08	2450.48	1806.55	186.72	6819.87	81.82	1587.20	-	-	-	-	-	-
Final non-energy consumption	-	-	-	-	-	-	2450.48	-	-	-	-	-	-	-	-	-	2450.48	-	-	-	-	-	-	-	-	-	-	-
Final energy consumption	2262.28	17.53	2660.38	391.04	-	-	42207.29	-	3769.54	-	4582.95	1171.31	26722.03	1879.88	2283.49	1798.08	-	1806.55	186.72	6819.87	81.82	1587.20	-	-	-	-	-	-
..Industry	2202.25	17.53	2660.38	319.93	-	-	5927.11	-	573.09	-	-	-	1054.15	610.20	1891.60	1798.08	-	1483.06	-	72.48	-	241.99	-	-	-	-	-	-
...Iron and steel industry	28.45	17.53	2660.38	148.47	-	-	2149.25	-	9.43	-	-	-	87.19	3.01	983.05	1066.58	-	934.13	-	0.69	-	94.99	-	-	-	-	-	-
...Non-ferrous metallurgy	-	-	-	-	-	-	49.45	-	47.67	-	-	-	0.69	1.10	-	-	-	-	-	-	-	0.08	-	-	-	-	-	-
...Chemical industry	-	-	-	-	-	-	85.84	-	0.11	-	-	-	2.79	20.27	62.66	-	-	38.02	-	0.03	-	0.15	-	-	-	-	-	-
... Glass, pottery and building mat. industry	2173.80	-	-	145.76	-	-	1416.76	-	331.32	-	-	-	44.86	89.43	219.66	731.50	-	76.58	-	0.13	-	0.47	-	-	-	-	-	-

... Ore-extraction industry	-	-	-	-	-	-	527.82	-	1.01	-	-	-	514.80	12.01	-	-	-	-	-	0.32	-	0.34	-	-	-	-	-	-
... Food, drink and tobacco industry	-	-	-	0.46	-	-	686.56	-	119.64	-	-	-	10.97	247.57	308.38	-	-	235.72	-	44.38	-	108.55	-	-	-	-	-	-
...Textile, leather and clothing industry	-	-	-	25.24	-	-	177.78	-	2.17	-	-	-	-	79.83	95.77	-	-	4.19	-	12.24	-	3.77	-	-	-	-	-	-
...Paper and printing	-	-	-	-	-	-	20.95	-	4.35	-	-	-	0.34	5.63	10.62	-	-	19.78	-	1.32	-	1.98	-	-	-	-	-	-
...Engineering and other metal industry	-	-	-	-	-	-	264.93	-	53.46	-	-	-	10.35	42.71	158.40	-	-	166.21	-	4.63	-	5.62	-	-	-	-	-	-
...Other industries	-	-	-	-	-	-	547.77	-	3.92	-	-	-	382.16	108.65	53.04	-	-	8.43	-	8.74	-	26.03	-	-	-	-	-	-
..Transport	-	-	-	-	-	-	32966.78	-	2656.23	-	4565.14	1170.07	24575.34	-	-	-	-	73.38	-	-	-	-	-	-	-	-	-	-
...Railways	-	-	-	-	-	-	110.01	-	-	-	-	-	110.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
...Road transport	-	-	-	-	-	-	31684.14	-	2656.23	-	4562.57	-	24465.33	-	-	-	-	73.38	-	-	-	-	-	-	-	-	-	-
...Air transport	-	-	-	-	-	-	1172.64	-	-	-	2.57	1170.07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
.. Households, commerce, pub. auth., etc.	60.03	-	-	71.11	-	-	3313.39	-	540.22	-	17.81	1.25	1092.54	1269.68	391.89	-	-	250.10	186.72	6747.39	81.82	1345.21	-	-	-	-	-	-
...Households	-	-	-	25.11	-	-	376.51	-	203.58	-	-	-	-	172.93	-	-	-	8.33	-	6542.07	81.82	1313.00	-	-	-	-	-	-

...Agriculture	60.03	-	-	21.48	-	-	530.75	-	1.66	-	17.81	1.25	287.99	25.61	196.42	-	-	-	145.12	57.91	-	-	-	-	-	-	-	-
...Other	-	-	-	24.53	-	-	2406.14	-	334.98	-	-	-	804.56	1071.14	195.47	-	-	241.77	41.60	147.41	-	32.21	-	-	-	-	-	-
Statistical difference	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 50. Energy balance for 2020

	Coking coal	Coke oven coke	Sub-bituminous coal	Lignite	Crude oil	Feedstocks	Total petroleum products	Refinery gas	LPG	Naphtha	Motor spirit	Kerosenes, jet fuels	Road diesel	Heating and other gasoil	Residual fuel oil	Petroleum coke	Other petroleum products	Natural gas	Geothermal heat	Fuel wood	Wood of fruit trees and oth. plant residues	Wood wastes, wood briquettes and pellets	Hydro energy	Solar electricity	Solar thermal	Wind electricity	Biogas	Biodiesel
Total primary production	-	-	-	28672.29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	195.95	6440.50	83.15	167.70	4596.83	86.97	-	420.70	824.92	49.90
Recovered products	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Imports	27.34	21.82	3089.75	261.94	-	-	47665.16	-	3149.52	-	3776.95	1329.66	26588.53	1569.70	3239.56	5648.83	2362.40	11696.84	-	242.75	-	2019.01	-	-	-	-	-	-
Stock change	187.07	-2.09	-806.00	268.17	-	-	-1434.55	-	11.88	-	-38.85	-10.39	-821.56	48.67	147.68	-770.20	-1.78	1.23	-	75.32	-	-196.84	-	-	-	-	-	-47.39
Exports	1.41	-	11.83	-	-	-	4370.58	-	81.47	-	391.47	663.05	2202.88	-	69.36	887.70	74.65	-	-	0.46	-	6.17	-	-	-	-	-	-
Gross inland consumption	212.99	19.73	2271.92	29202.40	-	-	41860.04	-	3079.94	-	3346.62	656.23	23564.08	1618.37	3317.89	3990.93	2285.97	11698.08	195.95	6758.11	83.15	1983.70	4596.83	86.97	-	420.70	824.92	2.52
Transformation input	-	-	-	28755.60	-	-	1075.64	-	-	-	-	-	-	-	1075.64	-	-	9818.90	-	-	-	-	-	-	-	-	824.92	-
.. Public thermal power stations	-	-	-	28755.60	-	-	1075.64	-	-	-	-	-	-	-	1075.64	-	-	-	-	-	-	-	-	-	-	-	-	-
.. Autoproducers plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
.. CHP plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8699.97	-	-	-	-	-	-	-	-	-	-
.. Briquetting plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

..Biogas plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	824.92	-
..Refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
..Main activity producer heat plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1118.93	-	-	-	-	-	-	-	-	-	-
Transformation output	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
..Public thermal power stations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
..Autoproducers plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
..CHP plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
..Briquetting plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
..Biogas plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
..Refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
..Main activity producer heat plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Exchanges and transfers,	-	-	-	-	-	-	2.52	-	-	-	-	-	2.52	-	-	-	-	-	-	-	-	-	-4596.83	-86.97	-	-420.70	-	-2.52

returns																												
Consumption of the energy branch	-	-	-	-	-	-	54.57	-	-	-	-	-	49.94	1.29	3.33	-	-	-	-	0.34	-	-	-	-	-	-	-	-
Distribution losses	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	39.33	11.48	-	-	-	-	-	-	-	-	-
Available for final consumption	212.99	19.73	2271.92	446.80	-	-	40732.35	-	3079.94	-	3346.62	656.23	23516.65	1617.07	2238.92	3990.93	2285.97	1839.84	184.47	6757.77	83.15	1983.70	-	-	-	-	-	-
Final non-energy consumption	-	-	-	-	-	-	2285.97	-	-	-	-	-	-	-	-	-	2285.97	-	-	-	-	-	-	-	-	-	-	-
Final energy consumption	212.99	19.73	2271.92	446.80	-	-	38446.37	-	3079.94	-	3346.62	656.23	23516.65	1617.07	2238.92	3990.93	-	1839.84	184.47	6757.77	83.15	1983.70	-	-	-	-	-	-
..Industry	196.89	19.73	2271.92	392.40	-	-	8212.35	-	513.32	-	-	-	1131.37	611.29	1970.11	3984.47	-	1502.08	-	80.71	-	616.64	-	-	-	-	-	-
...Iron and steel industry	24.03	19.73	2271.92	260.77	-	-	2818.80	-	9.12	-	-	-	88.48	1.80	1143.09	1576.31	-	864.29	-	0.13	-	502.85	-	-	-	-	-	-
...Non-ferrous metal industry	-	-	-	-	-	-	58.49	-	56.48	-	-	-	0.94	1.07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
...Chemical industry	-	-	-	-	-	-	45.44	-	0.30	-	-	-	4.44	15.24	25.46	-	-	73.71	-	0.03	-	0.53	-	-	-	-	-	-
...Glass, pottery and building mat. industry	172.86	-	-	108.32	-	-	3064.88	-	243.05	-	-	-	58.52	77.77	277.39	2408.16	-	138.41	-	0.13	-	1.84	-	-	-	-	-	-
...Ore-extra	-	-	-	-	-	-	489.09	-	2.41	-	-	-	476.63	10.05	-	-	-	-	-	0.40	-	0.03	-	-	-	-	-	-

ction industry																												
... Food, drink and tobacco industry	-	-	-	-	-	-	710.93	-	135.67	-	-	-	16.79	242.80	315.67	-	-	248.85	-	55.74	-	82.14	-	-	-	-	-	-
... Textile, leather and clothing industry	-	-	-	23.32	-	-	172.99	-	5.34	-	-	-	-	88.08	79.56	-	-	3.03	-	10.79	-	4.87	-	-	-	-	-	-
...Paper and printing	-	-	-	-	-	-	21.18	-	1.92	-	-	-	0.34	6.80	12.11	-	-	22.91	-	1.39	-	2.03	-	-	-	-	-	-
...Engineering and other metal industry	-	-	-	-	-	-	150.47	-	53.85	-	-	-	17.57	45.28	33.76	-	-	105.29	-	4.32	-	2.98	-	-	-	-	-	-
...Other industries	-	-	-	-	-	-	680.09	-	5.17	-	-	-	469.45	122.38	83.09	-	-	45.59	-	7.78	-	19.37	-	-	-	-	-	-
..Transport	-	-	-	-	-	-	27468.31	-	2096.71	-	3328.29	655.21	21388.09	-	-	-	-	81.88	-	-	-	-	-	-	-	-	-	-
...Railways	-	-	-	-	-	-	51.66	-	-	-	-	-	51.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
...Road transport	-	-	-	-	-	-	26759.68	-	2096.71	-	3326.53	-	21336.44	-	-	-	-	81.88	-	-	-	-	-	-	-	-	-	-
...Air transport	-	-	-	-	-	-	656.97	-	-	-	1.76	655.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
.. Households, commerce, pub. auth., etc.	16.10	-	-	54.40	-	-	2765.71	-	469.91	-	18.33	1.02	995.39	1005.79	268.81	6.47	-	255.88	184.47	6677.06	83.15	1367.06	-	-	-	-	-	-
...Households	-	-	-	24.58	-	-	358.44	-	193.81	-	-	-	-	164.63	-	-	-	10.37	-	6468.41	83.15	1334.33	-	-	-	-	-	-
...Agriculture	16.10	-	-	9.48	-	-	435.82	-	2.40	-	18.33	1.02	287.35	25.27	94.99	6.47	-	-	146.07	58.85	-	-	-	-	-	-	-	-

...Other	-	-	-	20.34	-	-	1971.44	-	273.69	-	-	-	708.05	815.88	173.82	-	-	245.51	38.40	149.80	-	32.73	-	-	-	-	-	-
Statistical difference	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 51. Energy balance for 2021

	Coking coal	Coke oven coke	Sub-bituminous coal	Lignite	Crude oil	Feedstocks	Total petroleum products	Refinery gas	LPG	Naphta	Motor spirit	Kerosenes, jet fuels	Road diesel	Heating and other gasoil	Residual fuel oil	Petroleum coke	Other petroleum products	Natural gas	Geothermal heat	Fuel wood	Wood of fruit trees and oth. plant residues	Wood wastes, wood briquettes and pellets	Hydro energy	Solar electricity	Solar thermal	Wind electricity	Biogas	Biodiesel
Total primary production	-	-	-	23100.45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	200.47	6625.12	85.78	416.01	5224.84	183.56	120.93	371.94	774.83	-
Recovered products	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Import	1191.54	12.21	1406.20	2218.58	-	-	52173.41	-	3216.32	-	4261.53	1332.41	30895.05	1366.65	3714.92	5238.65	2147.88	14848.13	-	164.16	-	1600.50	-	-	-	-	-	-
Stock change	-166.52	4.09	960.43	-824.33	-	-	-484.32	-	0.03	-	5.80	27.47	35.39	-0.79	-146.47	-407.66	1.93	4.04	-	-13.88	-	-47.22	-	-	-	-	-	3.55
Exports	4.25	-	-	-	-	-	6256.09	-	85.54	-	508.28	663.05	3718.36	-	115.05	954.85	210.96	-	-	-	-	9.35	-	-	-	-	-	-
Gross inland consumption	1020.77	16.30	2366.63	24494.70	-	-	45433.00	-	3130.80	-	3759.05	696.83	27212.08	1365.86	3453.40	3876.13	1938.85	14852.17	200.47	6775.40	85.78	1959.95	5224.84	183.56	120.93	371.94	774.83	3.55
Transformation input	-	-	-	24043.86	-	-	1531.75	-	-	-	-	-	-	-	1531.75	-	-	12614.19	-	-	-	-	-	-	-	-	774.83	-
.. Public thermal power stations	-	-	-	24043.86	-	-	1531.75	-	-	-	-	-	-	-	1531.75	-	-	-	-	-	-	-	-	-	-	-	-	-
.. Autoproducers plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
.. CHP plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11633.16	-	-	-	-	-	-	-	-	-	-
.. Briquetting plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
.. Biogas	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	774.83	-

plants																												
.. Refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
.. Main activity producer heat plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	981.03	-	-	-	-	-	-	-	-	-	-
Transformation output	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
.. Public thermal power stations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
.. Autoproducers plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
.. CHP plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
..Briquetting plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
..Biogas plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
..Refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
.. Main activity producer heat plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Exchanges and transfers, returns	-	-	-	-	-	-	3.55	-	-	-	-	-	3.55	-	-	-	-	-	-	-	-	-	-5224.84	-183.56	-	-371.94	-	-3.55

Consumption of the energy branch	-	-	-	-	-	-	47.20	-	-	-	-	-	39.87	1.46	5.87	-	-	-	-	0.48	-	-	-	-	-	-	-	-
Distribution losses	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41.80	16.75	-	-	-	-	-	-	-	-	-
Available for final consumption	1020.77	16.30	2366.63	450.85	-	-	43857.60	-	3130.80	-	3759.05	696.83	27175.76	1364.39	1915.78	3876.13	1938.85	2196.18	183.72	6774.92	85.78	1959.95	-	-	120.93	-	-	-
Final non-energy consumption	-	-	-	-	-	-	1938.85	-	-	-	-	-	-	-	-	-	1938.85	-	-	-	-	-	-	-	-	-	-	-
Final energy consumption	1020.77	16.30	2366.63	450.85	-	-	41918.75	-	3130.80	-	3759.05	696.83	27175.76	1364.39	1915.78	3876.13	-	2196.18	183.72	6774.92	85.78	1959.95	-	-	120.93	-	-	-
..Industry	994.15	16.30	2366.63	416.70	-	-	7893.29	-	594.74	-	-	-	1171.24	576.17	1731.78	3819.37	-	1720.66	-	84.42	-	503.79	-	-	-	-	-	-
...Iron and steel industry	27.74	16.30	2366.63	375.22	-	-	2713.96	-	8.04	-	-	-	99.95	0.56	975.21	1630.20	-	967.30	-	0.12	-	337.58	-	-	-	-	-	-
...Non-ferrous metal industry	-	-	-	-	-	-	72.11	-	69.88	-	-	-	0.56	1.67	-	-	-	-	-	-	-	0.19	-	-	-	-	-	-
...Chemical industry	-	-	-	-	-	-	25.79	-	0.37	-	-	-	2.37	19.05	4.01	-	-	104.56	-	-	-	0.74	-	-	-	-	-	-
...Glass, pottery and building mat. industry	966.42	-	-	5.48	-	-	2908.09	-	255.31	-	-	-	77.51	79.58	306.52	2189.16	-	178.62	-	0.13	-	1.90	-	-	-	-	-	-
...Ore-extraction	-	-	-	-	-	-	540.54	-	2.01	-	-	-	529.86	8.67	-	-	-	-	-	0.37	-	0.11	-	-	-	-	-	-

industry																												
...Food, drink and tobacco industry	-	-	-	-	-	-	705.83	-	163.81	-	-	-	16.08	230.84	295.10	-	-	281.99	-	54.54	-	106.49	-	-	-	-	-	-
...Textile, leather and clothing industry	-	-	-	31.16	-	-	146.30	-	4.47	-	-	-	-	73.68	68.15	-	-	5.07	-	12.95	-	4.76	-	-	-	-	-	-
...Paper and printing	-	-	-	-	-	-	27.58	-	3.22	-	-	-	4.83	5.73	13.79	-	-	24.01	-	2.06	-	2.57	-	-	-	-	-	-
...Engineering and other metal industry	-	-	-	4.84	-	-	147.60	-	75.35	-	-	-	16.05	48.42	7.78	-	-	144.92	-	4.53	-	3.05	-	-	-	-	-	-
...Other industries	-	-	-	-	-	-	605.49	-	12.28	-	-	-	424.03	107.96	61.22	-	-	14.19	-	9.72	-	46.40	-	-	-	-	-	-
..Transport	-	-	-	-	-	-	31391.12	-	2056.23	-	3740.67	695.09	24899.13	-	-	-	-	176.51	-	-	-	-	-	-	-	-	-	-
...Railway	-	-	-	-	-	-	61.36	-	-	-	-	-	61.36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
...Road transport	-	-	-	-	-	-	30632.16	-	2056.23	-	3738.16	-	24837.77	-	-	-	-	176.51	-	-	-	-	-	-	-	-	-	-
...Air transport	-	-	-	-	-	-	697.60	-	-	-	2.51	695.09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
..Households, commerce, pub. auth., etc.	26.62	-	-	34.14	-	-	2634.34	-	479.83	-	18.38	1.75	1105.39	788.23	184.00	56.77	-	299.01	183.72	6690.50	85.78	1456.15	-	-	120.93	-	-	-
...Households	-	-	-	7.69	-	-	368.21	-	199.10	-	-	-	-	169.12	-	-	-	12.21	-	6497.13	85.78	1335.65	-	-	120.93	-	-	-
...Agriculture	26.62	-	-	9.17	-	-	489.52	-	2.43	-	18.38	1.75	287.18	25.44	97.58	56.77	-	-	146.65	60.71	-	-	-	-	-	-	-	-

	Coking coal	Coke oven coke	Sub-bituminous coal	Lignite	Crude oil	Feedstocks	Total petroleum products	Refinery gas	LPG	Naptha	Motor spirit	Kerosenes, jet fuels	Road diesel	Heating and other gasoil	Residual fuel oil	Petroleum coke	Other petroleum products	Natural gas	Geothermal heat	Fuel wood	Wood of fruit trees and oth. plant residues	Wood wastes, wood briquettes and pellets	Hydro energy	Solar electricity	Solar thermal	Wind electricity	Biogas	Biodiesel
...Other	-	-	-	17.28	-	-	1776.61	-	278.30	-	-	-	818.22	593.67	86.42	-	-	286.80	37.07	132.67	-	120.51	-	-	-	-	-	-
Statistical difference	-	-	-	-	-	-	-	-	-	#VALUE!	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 52. Energy balance for 2022

	Coking coal	Coke oven coke	Sub-bituminous coal	Lignite	Crude oil	Feedstocks	Total petroleum products	Refinery gas	LPG	Naptha	Motor spirit	Kerosenes, jet fuels	Road diesel	Heating and other gasoil	Residual fuel oil	Petroleum coke	Other petroleum products	Natural gas	Geothermal heat	Fuel wood	Wood of fruit trees and oth. plant residues	Wood wastes, wood briquettes and pellets	Hydro energy	Solar electricity	Solar thermal	Wind electricity	Biogas	Biodiesel
Total primary production	-	-	-	29718.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	184.80	6658.16	83.10	421.62	4842.21	363.13	121.35	387.49	739.73	-
Recovered products	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Imports	25.58	11.63	1454.20	4481.64	-	-	56079.13	-	3167.25	-	4569.28	2231.35	30809.03	1219.06	8442.49	3806.97	1833.71	10005.82	-	29.94	-	1338.42	-	-	-	-	-	-
Stock change	177.70	0.04	-262.71	477.10	-	-	-1348.17	-	14.27	-	-103.54	-13.88	-495.42	-12.75	-757.26	21.04	-0.64	-0.21	-	-126.42	-	80.89	-	-	-	-	-	8.69
Exports	-	0.11	-	536.28	-	-	5428.28	-	83.88	-	306.95	1092.40	3067.54	-	112.26	531.33	233.92	-	-	0.22	-	4.20	-	-	-	-	-	-
Gross inland consumption	203.28	11.56	1191.50	34140.71	-	-	49302.68	-	3097.64	-	4158.80	1125.07	27246.07	1206.31	7572.97	3296.68	1599.15	10005.62	184.80	6561.46	83.10	1836.73	4842.21	363.13	121.35	387.49	739.73	8.69
Transformation input	-	-	-	33908.23	-	-	6081.52	-	-	-	-	-	-	-	6081.52	-	-	8176.55	-	-	-	-	-	-	-	-	739.73	-
..Public thermal power stations	-	-	-	33908.23	-	-	6081.52	-	-	-	-	-	-	-	6081.52	-	-	-	-	-	-	-	-	-	-	-	-	-
..Autoproducers plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
..CHP plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7506.38	-	-	-	-	-	-	-	-	-	-

.. Briquetting plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
.. Biogas plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	739.73	-
.. Refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
.. Main activity producer heat plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	670.17	-	-	-	-	-	-	-	-	-	-
Transformation output	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-82.97	-	-	-	-
.. Public thermal power stations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
.. Public thermal power stations)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-82.97	-	-	-	-
..CHP plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
..Briquetting plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
..Biogas plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
..Refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
.. Main activity producer heat	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

plants																												
Exchanges and transfers, returns	-	-	-	-	-	-	8.69	-	-	-	-	-	8.69	-	-	-	-	-	-	-	-	-	-4842.21	-280.16	-	-387.49	-	-8.69
Consumption of the energy branch	-	-	-	-	-	-	56.65	-	-	-	-	-	50.61	1.12	4.93	-	-	-	-	0.25	-	-	-	-	-	-	-	-
Distribution losses	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	44.80	16.93	-	-	-	-	-	-	-	-	-
Available for final consumption	203.28	11.56	1191.50	232.48	-	-	43173.21	-	3097.64	-	4158.80	1125.07	27204.16	1205.20	1486.52	3296.68	1599.15	1784.26	167.87	6561.21	83.10	1836.73	-	-	121.35	-	-	-
Final non-energy consumption	-	-	-	-	-	-	1599.15	-	-	-	-	-	-	-	-	-	1599.15	-	-	-	-	-	-	-	-	-	-	-
Final energy consumption	203.28	11.56	1191.50	232.48	-	-	41574.06	-	3097.64	-	4158.80	1125.07	27204.16	1205.20	1486.52	3296.68	-	1784.26	167.87	6561.21	83.10	1836.73	-	-	121.35	-	-	-
..Industry	203.28	11.56	1191.50	206.75	-	-	6955.43	-	701.60	-	-	-	1142.18	504.77	1362.96	3243.91	-	1506.38	-	79.91	-	425.76	-	-	-	-	-	-
...Iron and steel industry	22.92	11.56	1191.50	101.33	-	-	1563.63	-	7.44	-	-	-	75.73	1.29	577.96	901.20	-	995.15	-	0.09	-	257.82	-	-	-	-	-	-
...Non-ferrous metallurgy	-	-	-	-	-	-	59.90	-	59.01	-	-	-	0.58	0.30	-	-	-	-	-	-	-	0.12	-	-	-	-	-	-
...Chemical industry	-	-	-	-	-	-	24.11	-	0.60	-	-	-	4.04	17.35	2.12	-	-	83.35	-	-	-	0.79	-	-	-	-	-	-
...Glass, pottery and build	180.35	-	-	63.90	-	-	3186.67	-	351.24	-	-	-	81.05	78.42	333.25	2342.71	-	43.62	-	0.59	-	1.75	-	-	-	-	-	-

ing mat. industry																												
...Ore-extraction industry	-	-	-	8.60	-	-	547.46	-	2.59	-	-	-	537.22	7.64	-	-	-	-	-	0.23	-	0.27	-	-	-	-	-	-
...Food, drink and tobacco industry	-	-	-	-	-	-	720.88	-	184.65	-	-	-	15.17	222.70	298.36	-	-	184.32	-	50.51	-	102.34	-	-	-	-	-	-
...Textile, leather and clothing industry	-	-	-	29.00	-	-	124.45	-	6.31	-	-	-	-	37.43	80.71	-	-	5.83	-	13.25	-	8.78	-	-	-	-	-	-
...Paper and printing	-	-	-	-	-	-	21.91	-	4.58	-	-	-	0.67	4.36	12.31	-	-	20.48	-	1.83	-	1.68	-	-	-	-	-	-
...Engineering and other metal industry	-	-	-	3.92	-	-	131.20	-	72.32	-	-	-	12.79	45.24	0.84	-	-	139.01	-	3.88	-	4.43	-	-	-	-	-	-
...Other industries	-	-	-	-	-	-	575.21	-	12.85	-	-	-	414.92	90.02	57.41	-	-	34.62	-	9.52	-	47.79	-	-	-	-	-	-
..Transport	-	-	-	-	-	-	32217.04	-	1996.35	-	4140.37	1124.41	24955.91	-	-	-	-	78.17	-	-	-	-	-	-	-	-	-	-
...Railways tr	-	-	-	-	-	-	47.41	-	-	-	-	-	47.41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
...Road transport	-	-	-	-	-	-	31041.52	-	1996.35	-	4136.66	-	24908.50	-	-	-	-	78.17	-	-	-	-	-	-	-	-	-	-
...Air transport	-	-	-	-	-	-	1128.12	-	-	-	3.70	1124.41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
.. Households, commerce, pub. auth., etc.	-	-	-	25.73	-	-	2401.59	-	399.69	-	18.43	0.65	1106.07	700.43	123.55	52.77	-	199.71	167.87	6481.30	83.10	1410.97	-	-	121.35	-	-	-

...Households	-	-	-	7.65	-	-	314.27	-	154.78	-	-	-	-	159.48	-	-	-	5.94	-	6293.97	83.10	1293.88	-	-	121.35	-	-	-
...Agriculture	-	-	-	8.46	-	-	454.19	-	2.39	-	18.43	0.65	287.00	25.26	67.70	52.77	-	-	137.98	58.81	-	-	-	-	-	-	-	-
...Other	-	-	-	9.62	-	-	1633.13	-	242.52	-	-	-	819.07	515.69	55.86	-	-	193.77	29.89	128.52	-	117.08	-	-	-	-	-	-
Statistical difference	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

12.2 Industrial processes and product use

Table 53. Activity data used in the Industrial Processes sector

Categories	2.A -Mineral industry	2.A.1 Cement production (t)	2.A.2 Lime production (t)	2.A.3 Glass production (t)	2.A.4 Other processes using	2.A.4.a Ceramics*(t)	2.A.4.b Other uses of bicarbonate of	2 C Metal Industry	2.C.1 Iron and steel production (t)	2.C.2 Production of ferroalloys (t)	2.C.3 Aluminum production (t)	2.C.5 Lead production (t)	2.C.6 Zinc production (t)
1990		732926	47000	1648		5929	6457		274993	85193	5487	53826	108275
1991		690992	38758	1429		4965.7	5153		233500	77442	5994	53203	110858
1992		580366	40240	1094		3273.6	4555		181436	107866	5786	51201	109614
1993		572142	27982	821		1774.1	4315		140898	78357	6457	45456	108961
1994		554421	16063	778		1571.5	5769		69643	62937	7014	41534	91534
1995		586296	14274	432		780.4	8226		32143	71980	5445	46497	90802
1996		551956	11155	263		342.8	3718		23435	92638	5315	52843	118664
1997		680085	5182	320		849.7	3917		30480	85908	5351	56554	112840
1998		514893	1462	155		1222.8	3643		54166	106661	6565	57657	116027
1999		620399	5518	138		1110.1	3564.6		54372	78009	5694	46824	102922
2000		870188	15397	230		919.9	3487.8		168386	57842	3763	56077	126992
2001		630044	14261	244		472.4	3412.7		448199	27287	3444	47829	120262
2002		777510	11858	240		534.6	3339.2		459865	5135	5649	32902	108232
2003		832314	7652	143		348.4	3267.3		589871	55534	3793	16916	49347
2004		811515	12581	87		380.9	3196.9		626587	72082	194	3591	NO
2005		886529	14980	68		676.7	3128.1		647036	79390	20	NO	
2006		924225	12670	230		1578.5	3060.7		357826	69965	230		
2007		944529	7506	170		1200.9	2994.8		369128	120007	72		
2008		912546	NO	98		1223.6	2930.3		256632	112566	15		
2009		909105		105		261.8	2867.2		271700	19657	375		
2010		819825		84		252	2805.5		294339	81204	309		
2011		981010		56		63.2	2745.1		388501	124578	423		
2012		683132		43		6.3	2685.9		219183	75829	426		
2013		762161	381	56		15.1	2628.1		101720	92280	101		
2014		686497	10836	56		27.8	2571.5		189248	91067	NO		
2015		695923	8003	45		21.6	2516.1		122632	63747		2648	
2016		882222	9125	241		35.7	2462		170091	35038		4472	
2017		945393	1399	273		10.4	2409		275323	7196		7486	
2018		952790	6834	225		12.4	2357		267968	10285		10576	
2019		955430	29236	366		11.5	2306.3		241260	15319		10962	
2020		1001426	NO	214		9.8	2256.6		181312	17747		10339	
2021		1015245		328		24.2	2208		315949	17714		10339	
2022		936034		433		15.7	2160.5		248501	8410		11747	

*Clay consumption

Table 54. Activity data used in the sector Use of products as alternatives to ozone-depleting substances

	Import/year (t)												
	HFC 134a	**HFC-227ea**	**HFC-152a**	**HFC-32**	**HFC-23**	**HFC-236fa**	**HFC-125 (CHF2CF2)**	**HFC-143a**	**HFC blends**				
									HFC-404A	**HFC-407C**	**HFC-410A**	**HFC-507**	**HFC-452a**
2000	14.0						1.3	1.6					
2001	65.97			0.23			5.71	6.42					
2002	5.22			0.79			4.9	4.77					
2003	29.87			0.5			7.28	7.96					
2004	102.09			3.15			16.34	15.52					
2005	57.42			4.58			21.18	19.44					
2006	88.11			1.54			29.6	32.79					
2007	43.63			8.19			22.55	16.61					
2008	59.86			7.21			47.48	45.95					
2009	52.22			8.19			28.3	22.78					
2010	35.1			10.06			36.74	29.68					
2011	26.07			1.57			7.59	7					
2012	31.7	0	0	0	0	0	0.01	0.01	18.52	6.54	8.39	1.12	0
2013	36.85	0	0	0	0	0	0.01	0.01	18.8	6.66	8.96	0.77	0
2014	38.87	0	0	0	0	0	0.02	0.01	18.92	6.78	9.53	0.89	0
2015	40.89	0	0	0	0	0	0.02	0.01	25.94	6.9	10.1	0.21	0
2016	44.03	0.08	0	0	0	0	0.03	0.02	42.49	8.09	13.55	1.29	0
2017	107.39	0	100	0.7	0.02	0	0.07	0.04	76.06	33.82	49.75	10.8	0
2018	115.82	20.55	14.98	1.19	0.05	0	0.04	0.02	39.65	16.02	36,753	0	0
2019	68.87	0	51	0	0	0.05	0.04	0.02	42.45	23.75	20.74	1.02	0
2020	48.36	1	178.7	5.63	0	0			49.39	6.61	23.45	1.99	0
2021	56.81	0	297.78	2.92	0	0			45.7	5.91	16.16	0.68	0
2022	60.59	0	265.79	1.35	0	0			45.28	7.05	19.1	4	0

	Import/year (kg)							
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
HFC-23	0.0	0.0	0.0	0.0	0.0	20.0	45.0	0.0
HFC-32 (CH2F2)	5.7	6.0	6.3	6.6	8.6	732.7	1212.1	15.8
HFC-125 (CHF2CF2)	14.5	14.8	15.2	18.3	28.1	72.2	39.8	35.5
HFC-134a (CH2FCF3)	31704.1	36854.2	38874.3	40894.6	44031.9	107408.6	115827.9	68879.0
HFC-143a	10.2	10.2	10.3	13.6	22.7	45.0	20.6	22.6
HFC-152a	0	0	0	0	0	100000	14980	51000
HFC-227ea	0	0	0	0	80	0	20545	0
HFC-236fa	0	0	0	0	0	0	0	50

12.3 Agriculture

Table 55. Data on farm animal population used for the inventory of greenhouse gases from Livestock (number of heads)

	Number of heads		
	2020	2021	2022
Total	2760191	2561115	2634456
Cattle	214991	177743	158824
Cattle - dairy cows	110206	105542	99606
Cattle – other cattle	104785	72201	59218
Sheep	511116	524525	533175
Sheep up to one year	119518	108756	113313
Goats	77462	62450	63921
Goats up to one year	17546	13303	16265
Horses	12022	12165	12236
Mules and Asses	18395	20331	21457
Fatteners	145679	165815	161147
Poultry-layers	1482348	1235894	1367092
Broilers	101268	97181	124332
Turkeys	13640	19143	13502
Other poultry	46206	123809	49192

12.4 Forestry and land use

Table 56. Land and conversion of land from one type to another

	2016	2017	2018	2019	2020	2021	2022
Forest Land Remaining Forest Land	1026558.11	1031084	1033295	1037179	1059691	1070911	1086953.3
Cropland converted to Forest Land	2897.23	1135.16	2782.99	1536.05	3512	331.8	2598
Grassland converted to Forest Land	1548.56	1468.6	1685.62	2691.41	7056	13715	17564
Wetlands converted to Forest Land	15.26	62.97	29.32	0	0	0	0
Settlements converted to Forest Land	0	0	0	0	0	0	0
Other Land converted to Forest Land	1346.27	1249.57	1343.16	1126.76	1256	4000	20231
Unmanaged Forest	30525.23	30659.8	30725.55	30841.06	12120	11500	10456
Cultivable Surfaces							
Cropland Remaining Cropland	533592	531458	528163	525441	520216	519844	517550
Forest Land converted to Cropland	766	678	790	579	200	254	391
Grassland converted to Cropland	543	1256	599	655	1490	1021	1212
Wetlands converted to Cropland	0	55	9	0	0	0	0
Settlements converted to Cropland	106	134	0	0	20	36	0
Other land converted to Cropland	897	111	896	90	11	20	39
Grassland							
Grassland Remaining Grassland	625424.93	623927.3	624771.9	623234.4	618076.3	620822.7	626507.83
Forest Land converted to Grassland	589.42	232.19	391.03	665.02	256	832	2450
Cropland converted to Grassland	263.23	1884.79	1456.76	1976.39	1870	1650	1795
Wetlands converted to Grassland	26.63	24.83	13.92				
Settlements converted to Grassland							
Remaining Land converted to Grassland	1179.43	1413.42	1721.41	1003.3	15756	22367	34693

Wetlands							
Wetlands Remaining Wetlands	53291.09	53358.04	53472.5	53625.86	53625.86	53625.86	53625.86
Forest Land converted to Wetlands	61.88	36.04	13.77	0	0	0	0
Cropland converted to Wetlands	61.36	10.49	18.87				
Grassland converted to Wetlands	51.63	85.66	69.14				
Settlements converted to Wetlands	45.81	41.08	36.32				
Other Land converted to Wetlands	95.14	35.03	15.25				
Populated places							
Settlements Remaining Settlements	43557.7	43668.3	43910	44200.6	44443.76	44871.18	45465.82
Forest Land converted to Settlements	14.77	15.63	9.85	28.04	96	123	132.8
Cropland converted to Settlements	65.82	47.34	115.03	99.9	105.3	110.8	119.7
Grassland converted to Settlements	35.45	128.67	138.65	98	132.12	143.9	155.4
Wetlands converted to Settlements	56.76	58.94	0.37				
Other Land converted to Settlements	113.1	27.43	26.72	37.2	130	218	184
Other Land							
Other land Remaining Other land	215537.53	214887.7	213102.5	212697.1	198891.5	174485.8	119609.4
Forest Land converted to Other Land	463.01	185.08	435.09	569.15	1012	15	74
Cropland converted to Other Land	1156.23	1367.93	1156.23	1135.96	1061.5	0	0
Grassland converted to Other Land	481.08	617.29	218.55	1642.24	125	256	232
Wetlands converted to Other Land	71.43	47.05	41.61	0	0	0	0
Settlements converted to Other Land	14.83	0	0	0	0	0	0

12.5 Waste

Table 57. Population used for estimating emissions from Municipal solid waste and wastewater treatment and discharge

Eastern region															
Year.	**1950**	**1951**	**1952**	**1953**	**1954**	**1955**	**1956**	**1957**	**1958**	**1959**	**1960**	**1961**	**1962**	**1963**	**1964**
	127388	131035	134681	138327	138946	139565	140184	140803	141422	142041	142660	143279	144689	146098	147508
Year.	**1965**	**1966**	**1967**	**1968**	**1969**	**1970**	**1971**	**1972**	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**
	148917	150327	151736	153146	154555	155965	157374	158853	160332	161811	163290	164769	166247	167726	169205
Year.	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**
	170684	172163	173660	175157	176654	178152	179649	181146	182643	184140	185637	187135	184783	182432	180081
Year.	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
	180303	180525	180747	180970	181192	181414	181636	181858	181155	179847	178155	176447	174714	172976	171129
Year.	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**		
	169306	167796	166400	165045	163855	162665	161389	159982	158260	156178	153077	150155	149145		
Southwestern region															
Year.	**1950**	**1951**	**1952**	**1953**	**1954**	**1955**	**1956**	**1957**	**1958**	**1959**	**1960**	**1961**	**1962**	**1963**	**1964**
	150341	152857	155372	157888	158641	159394	160147	160900	161652	162405	163158	163911	165905	167899	169894
Year.	**1965**	**1966**	**1967**	**1968**	**1969**	**1970**	**1971**	**1972**	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**
	171888	173882	175876	177870	179865	181859	183853	186560	189267	191974	194681	197388	200094	202801	205508
Year.	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**
	208215	210922	212523	214124	215726	217327	218928	220529	222130	223731	225333	226934	223868	220803	217737
Year.	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
	218213	218689	219165	219642	220118	220594	221070	221546	220345	218406	215999	213576	211123	208665	206077
Year.	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**		
	203519	201338	199296	197300	195502	193703	191800	189740	187467	184642	180693	177682	176900		
Vardar region															
Year.	**1950**	**1951**	**1952**	**1953**	**1954**	**1955**	**1956**	**1957**	**1958**	**1959**	**1960**	**1961**	**1962**	**1963**	**1964**
	116695	119436	122178	124920	124811	124703	124594	124485	124376	124268	124159	124050	124875	125700	126525
Year.	**1965**	**1966**	**1967**	**1968**	**1969**	**1970**	**1971**	**1972**	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**
	127350	128175	128999	129824	130649	131474	132299	133571	134843	136114	137386	138658	139930	141202	142473
Year.	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**
	143745	145017	146248	147480	148711	149943	151174	152406	153637	154869	156100	157332	155328	153324	151320
Year.	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
	151722	152124	152526	152928	153329	153731	154133	154535	154531	154013	153166	152305	151420	150528	149540
Year.	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**		
	148568	147871	147274	146714	146302	145892	145407	144804	143995	142990	140996	138835	137972		
Southeast region															
Year.	**1950**	**1951**	**1952**	**1953**	**1954**	**1955**	**1956**	**1957**	**1958**	**1959**	**1960**	**1961**	**1962**	**1963**	**1964**
	111814	114067	116319	118571	118881	119191	119501	119812	120122	120432	120742	121052	122879	124705	126532
Year.	**1965**	**1966**	**1967**	**1968**	**1969**	**1970**	**1971**	**1972**	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**
	128358	130185	132011	133838	135664	137491	139317	141277	143236	145196	147155	149115	151074	153034	154993
Year.	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**
	156953	158912	160476	162041	163605	165170	166734	168299	169863	171428	172992	174557	172531	170506	168481
Year.	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
	168848	169215	169582	169949	170315	170682	171049	171416	171127	170268	169045	167806	166543	165273	163898
Year.	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**		
	162543	161488	160544	159638	158894	158151	157325	156372	155014	153334	150837	148522	147653		
Pelagonia region															
Year.	**1950**	**1951**	**1952**	**1953**	**1954**	**1955**	**1956**	**1957**	**1958**	**1959**	**1960**	**1961**	**1962**	**1963**	**1964**
	233572	238500	243427	248355	249728	251101	252474	253847	255220	256593	257966	259339	260764	262189	263614
Year.	**1965**	**1966**	**1967**	**1968**	**1969**	**1970**	**1971**	**1972**	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**
	265039	266465	267890	269315	270740	272165	273590	275288	276987	278685	280383	282082	283780	285478	287176
Year.	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**
	288875	290573	288148	285722	283297	280872	278447	276021	273596	271171	268745	266320	258418	250516	242614

Year.	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
	242054	241495	240935	240375	239815	239256	238696	238136	237917	236907	235390	233851	232277	230694	228962
Year.	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**		
	227258	225974	224843	223768	222918	222072	221109	219968	218262	216386	213601	210502	209142		
POLOG REGION															
Year.	**1950**	**1951**	**1952**	**1953**	**1954**	**1955**	**1956**	**1957**	**1958**	**1959**	**1960**	**1961**	**1962**	**1963**	**1964**
	145989	149382	152774	156166	157952	159738	161523	163309	165095	166881	168666	170452	174308	178164	182021
Year.	**1965**	**1966**	**1967**	**1968**	**1969**	**1970**	**1971**	**1972**	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**
	185877	189733	193589	197445	201302	205158	209014	213917	218819	223722	228625	233528	238430	243333	248236
Year.	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**
	253138	258041	260672	263302	265933	268563	271194	273824	276455	279086	281716	284347	281130	277913	274696
Year.	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
	278375	282053	285732	289411	293089	296768	300446	304125	302889	300640	297749	294833	291875	288908	285760
Year.	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**		
	282651	280065	277671	275344	273292	271241	269045	266631	264110	260894	255804	252114	251690		
NORTHEAST REGION															
Year.	**1950**	**1951**	**1952**	**1953**	**1954**	**1955**	**1956**	**1957**	**1958**	**1959**	**1960**	**1961**	**1962**	**1963**	**1964**
	138423	141183	143942	146701	147566	148431	149296	150161	151026	151891	152756	153621	154549	155477	156404
Year.	**1965**	**1966**	**1967**	**1968**	**1969**	**1970**	**1971**	**1972**	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**
	157332	158260	159188	160116	161043	161971	162899	163467	164034	164602	165170	165738	166305	166873	167441
Year.	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**
	168008	168576	169190	169803	170417	171030	171644	172257	172871	173484	174098	174711	171732	168752	165773
Year.	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
	166650	167527	168403	169280	170157	171034	171910	172787	172654	171947	170872	169781	168664	167540	166309
Year.	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**		
	165098	164192	163397	162642	162052	161464	160791	159989	158987	157650	155320	153120	152518		
SKOPJE REGION															
Year.	**1950**	**1951**	**1952**	**1953**	**1954**	**1955**	**1956**	**1957**	**1958**	**1959**	**1960**	**1961**	**1962**	**1963**	**1964**
	188546	196746	204946	213146	220290	227434	234578	241723	248867	256011	263155	270299	282165	294032	305898
Year.	**1965**	**1966**	**1967**	**1968**	**1969**	**1970**	**1971**	**1972**	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**
	317764	329631	341497	353363	365229	377096	388962	400559	412156	423753	435350	446947	458544	470141	481738
Year.	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**
	493335	504932	510702	516471	522241	528011	533781	539550	545320	551090	556860	562629	556829	551028	545228
Year.	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
	549343	553457	557572	561686	565801	569915	574030	578144	582107	584157	584955	585688	586317	586909	587107
Year.	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**		
	587355	588674	590395	592265	594743	597243	599446	601171	602956	604188	605796	606184	606692		

Table 58. Waste per capita (kg/capita/year)

Eastern region															
Year.	**1950-1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
	260	264	268	271	275	279	283	287	290	294	298	302	305	309	313
Year.	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
	327	341	354	368	462	427	484	498	438	402	444	409	349	391	639
Year.	**2020**	**2021**	**2022**												
	698	735	720												
SOUTHWESTERN REGION															
Year.	**1950-1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
	260	264	268	271	275	279	283	287	290	294	298	302	305	309	313
Year.	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
	423	532	642	752	522	522	436	436	492	492	487	574	505	602	877
Year.	**2020**	**2021**	**2022**												

	1020	1033	1037												
VARDAR REGION															
Year.	**1950-1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
	260	264	268	271	275	279	283	287	290	294	298	302	305	309	313
Year.	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
	345	377	409	441	470	497	527	807	876	502	639	528	580	777	632
Year.	**2020**	**2021**	**2022**												
	634	688	637												
SOUTHEAST REGION															
Year.	**1950-1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
	260	264	268	271	275	279	283	287	290	294	298	302	305	309	313
Year.	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
	299	284	270	256	306	334	566	424	322	477	296	380	375	391	394
Year.	**2020**	**2021**	**2022**												
	475	467	486												
PELAGONIA REGION															
Year.	**1950-1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
	260	264	268	271	275	279	283	287	290	294	298	302	305	309	313
Year.	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
	303	294	284	274	362	374	341	380	365	403	364	362	397	491	640
Year.	**2020**	**2021**	**2022**												
	454	417	434												
POLOG REGION															
Year.	**1950-1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
	260	264	268	271	275	279	283	287	290	294	298	302	305	309	313
Year.	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
	318	324	329	335	343	399	323	376	387	428	555	476	521	497	518
Year.	**2020**	**2021**	**2022**												
	503	510	335												
NORTHEAST REGION															
Year.	**1950-1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
	260	264	268	271	275	279	283	287	290	294	298	302	305	309	313
Year.	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
	309	305	301	297	387	340	350	441	516	482	514	580	571	621	394
Year.	**2020**	**2021**	**2022**												
	402	273	371												
SKOPJE REGION															
Year.	**1950-1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
	260	264	268	271	275	279	283	287	290	294	298	302	305	309	313
Year.	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
	309	305	301	297	296	274	292	285	290	284	276	304	291	283	277
Year.	**2020**	**2021**	**2022**												
	285	295	287												

Table 59. Composition of waste disposed of in municipal solid waste landfills (%)

	Eastern region							Southwestern region						
	Food	**Gardening**	**Pelenin**	**Paper**	**Textile**	**Tree**	**Other**	**Food**	**Gardening**	**Pelenin**	**Paper**	**Textile**	**Tree**	**Other**
1950-1995	32	3	0	17	3	2	42	32	2	0	17	3	3	43
1996	32	4	0	16	3	2	42	32	3	0	17	3	2	42
1997	32	5	1	16	3	2	41	32	4	1	17	4	2	41
1998	33	5	1	16	3	2	40	32	4	1	17	4	2	41
1999	33	6	1	15	3	2	40	32	5	1	16	4	2	40

2000	33	7	1	15	3	2	39	32	5	2	16	4	2	39
2001	33	7	1	15	3	2	39	32	6	2	16	4	2	38
2002	34	8	1	15	3	2	38	32	7	2	16	5	2	37
2003	34	9	2	14	3	1	37	32	7	3	16	5	2	37
2004	34	9	2	14	3	1	37	32	8	3	15	5	2	36
2005	34	10	2	14	3	1	36	32	8	3	15	5	2	35
2006	35	11	2	13	3	1	35	32	9	3	15	5	1	34
2007	35	12	2	13	3	1	35	32	10	4	15	6	1	33
2008	35	12	2	13	3	1	34	32	10	4	15	6	1	33
2009	35	13	3	12	3	1	33	32	11	4	14	6	1	32
2010	35	14	3	12	3	1	33	32	11	5	14	6	1	31
2011	36	14	3	12	3	1	32	32	12	5	14	6	1	30
2012	36	15	3	11	3	0	31	32	13	5	14	7	1	29
2013	36	16	3	11	3	0	31	32	13	6	14	7	1	29
2014	36	16	3	11	3	0	30	32	14	6	13	7	1	28
2015	37	17	4	10	3	0	30	32	14	6	13	7	1	27
2016	37	17	4	10	3	0	30	31	14	7	12	7	1	28
2017	37	17	4	10	3	0	30	31	14	7	12	7	1	28
2018	37	17	4	10	3	0	30	31	14	7	12	7	1	28
2019	37	17	4	10	3	0	30	31	14	7	12	7	1	28
2020	37	17	4	10	3	0	30	31	14	7	12	7	1	28
2021	37	17	4	10	3	0	30	31	14	7	12	7	1	28
2022	37	17	4	10	3	0	30	31	14	7	12	7	1	28
VARDAR REGION								*SOUTHEAST REGION*						
1950-1995	32	2	0	17	3	3	43	32	2	0	17	3	3	43
1996	32	3	0	17	3	2	42	31	3	0	17	3	2	43
1997	32	3	1	17	3	2	41	31	4	1	17	3	2	42
1998	32	4	1	17	3	2	41	31	4	1	17	3	2	42
1999	33	4	1	17	3	2	40	30	5	1	17	3	2	42
2000	33	5	2	17	3	2	39	30	5	2	17	3	2	42
2001	33	5	2	17	3	2	38	29	6	2	17	3	2	41
2002	33	6	2	16	3	2	37	29	7	2	16	3	2	41
2003	33	6	3	16	3	2	37	29	7	3	16	3	2	41
2004	34	7	3	16	3	2	36	28	8	3	16	3	2	40
2005	34	7	3	16	3	2	35	28	8	3	16	3	2	40
2006	34	8	3	16	3	1	34	27	9	3	16	3	1	40
2007	34	8	4	16	3	1	33	27	10	4	16	3	1	39
2008	34	9	4	16	3	1	33	27	10	4	16	3	1	39
2009	35	9	4	16	3	1	32	26	11	4	16	3	1	39
2010	35	10	5	16	3	1	31	26	11	5	16	3	1	39
2011	35	10	5	16	3	1	30	25	12	5	16	3	1	38
2012	35	11	5	15	3	1	29	25	13	5	15	3	1	38
2013	35	11	6	15	3	1	29	25	13	6	15	3	1	38
2014	36	12	6	15	3	1	28	24	14	6	15	3	1	37
2015	36	12	6	15	3	1	27	24	14	6	15	3	1	37
2016	37	14	6	14	3	1	25	24	15	5	14	3	1	37
2017	37	14	6	14	3	1	25	24	15	5	14	3	1	37
2018	37	14	6	14	3	1	25	24	15	5	14	3	1	37
2019	37	14	6	14	3	1	25	24	15	5	14	3	1	37
2020	37	14	6	14	3	1	25	24	15	5	14	3	1	37
2021	37	14	6	14	3	1	25	24	15	5	14	3	1	37
2022	37	14	6	14	3	1	25	24	15	5	14	3	1	37
PELAGONIA REGION								*POLOG REGION*						
1950-1995	32	2	0	17	3	3	43	32	2	0	17	3	3	43

1996	32	3	0	17	3	2	42	32	3	0	17	3	2	43
1997	32	4	1	17	3	2	42	32	4	1	16	3	2	42
1998	32	5	1	16	3	2	41	32	4	1	16	3	2	42
1999	32	5	1	16	3	2	40	32	5	1	15	3	2	41
2000	32	6	1	16	3	2	39	32	6	1	14	3	2	41
2001	32	7	2	16	3	2	39	32	6	2	14	3	2	41
2002	32	8	2	15	3	2	38	32	7	2	13	3	2	40
2003	32	8	2	15	3	2	37	33	7	2	13	4	2	40
2004	32	9	2	15	4	2	36	33	8	2	12	4	2	39
2005	32	10	3	15	4	2	36	33	9	3	12	4	2	39
2006	32	11	3	14	4	1	35	33	9	3	11	4	2	39
2007	33	11	3	14	4	1	34	33	10	3	11	4	1	38
2008	33	12	3	14	4	1	33	33	10	3	10	4	1	38
2009	33	13	4	13	4	1	33	33	11	4	10	4	1	37
2010	33	14	4	13	4	1	32	33	12	4	9	4	1	37
2011	33	14	4	13	4	1	31	33	12	4	9	4	1	36
2012	33	15	4	13	4	1	30	33	13	4	8	4	1	36
2013	33	16	4	12	4	1	30	34	14	5	8	4	1	36
2014	33	17	5	12	4	1	29	34	14	5	7	4	1	35
2015	33	17	5	12	4	1	28	34	15	5	7	4	1	35
2016	33	18	5	12	4	1	27	34	15	5	6	4	1	34
2017	33	18	5	12	4	1	27	34	15	5	6	4	1	34
2018	33	18	5	12	4	1	27	34	15	5	6	4	1	34
2019	33	18	5	12	4	1	27	34	15	5	6	4	1	34
2020	33	18	5	12	4	1	27	34	15	5	6	4	1	34
2021	33	18	5	12	4	1	27	34	15	5	6	4	1	34
2022	33	18	5	12	4	1	27	34	15	5	6	4	1	34
NORTHEAST REGION								*SKOPJE REGION*						
1950-1995	32	2	0	17	3	3	43	32	2	0	17	3	3	43
1996	32	3	0	17	3	2	43	32	3	0	17	3	2	43
1997	32	3	1	16	3	2	42	31	4	1	17	3	2	42
1998	33	4	1	16	3	2	42	31	4	1	17	3	2	42
1999	33	4	1	15	3	2	41	31	5	1	16	4	2	41
2000	33	5	1	15	3	2	41	31	5	2	16	4	2	41
2001	34	5	1	14	3	2	41	31	6	2	16	4	2	40
2002	34	5	2	14	4	2	40	30	7	2	16	4	2	40
2003	34	6	2	13	4	2	40	30	7	3	16	4	2	39
2004	34	6	2	13	4	1	39	30	8	3	15	4	2	39
2005	35	7	2	12	4	1	39	30	8	3	15	4	2	38
2006	35	7	2	12	4	1	39	30	9	3	15	4	1	38
2007	35	7	3	11	4	1	38	29	10	4	15	4	1	37
2008	36	8	3	11	4	1	38	29	10	4	15	4	1	37
2009	36	8	3	10	4	1	38	29	11	4	14	5	1	36
2010	36	9	3	10	4	1	37	29	11	5	14	5	1	36
2011	37	9	3	10	4	1	37	29	12	5	14	5	1	35
2012	37	10	4	9	4	1	36	28	13	5	14	5	1	35
2013	37	10	4	9	4	0	36	28	13	6	14	5	1	34
2014	37	10	4	8	4	0	36	28	14	6	13	5	1	34
2015	38	11	4	8	4	0	35	28	14	6	13	5	1	33
2016	38	11	4	7	4	0	35	28	14	6	14	5	1	32
2017	38	11	4	7	4	0	35	28	14	6	14	5	1	32
2018	38	11	4	7	4	0	35	28	14	6	14	5	1	32
2019	38	11	4	7	4	0	35	28	14	6	14	5	1	32
2020	38	11	4	7	4	0	35	28	14	6	14	5	1	32

2021	38	11	4	7	4	0	35	28	14	6	14	5	1	32
2022	38	11	4	7	4	0	35	28	14	6	14	5	1	32

Table 60. Additional data on solid waste

% of waste going to solid waste landfills	1950-2022	90%
% of waste that is burned	1950-2022	10%

Table 61. Total amount of waste annually treated in biological treatment plants (in Gg)

Biological treatment system	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Composting	0.95	0.74	0.44	1.95	2.81	2.24	1.12	0.75	0.03	0.44	0.17	0.12

Table 62. Data on waste incineration activity

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Medical waste (t)	115	231	249	255	324	377	336	325	379	444	492	599
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	
Medical waste (t)	678	727	712	962	1023	1064	971	996	1073	1154	1055	

ANNEX V Emission factors

12.6 Energy

Table 63. Emission factors used in the Energy sector (in kg/TJ)

Fuel	CO2	CH4	N2O
Coking coal	94,600	10	1.5
Other bituminous coal	94,600	10	1.5
Sub-bituminous coal	96,100	10	1.5
Lignite	107,879 (101,000)*	1(10)**	1.5
Crude oil	73,333		
Fuel oil	78,049***	3	0.6
Diesel and fuel for burning	74,100	3	0.6
Motor gasoline	69,300	3	0.6
Kerosene	71,500	0.5	2
LPG	63,100	1	0.1
Petroleum coke	97,500	3	0.6
Natural gas ****	55,066****	1	0.1
Biomass	112,000	30	4

* Country-specific emission factor (EF SZ) for lignite used in the Electricity Generation category, while the default EF 101,000 kg/TJ is used in the other categories.
** Standard EF for CH4 for lignite in Energy Industries is 1 kg/TJ, and in Manufacturing Industries and Construction is 10 kg/TJ
*** The specific emission factor for fuel oil in the table is used from 2014 onwards, in the period 2003 – 2013 the value for EF SZ is 78,467 kg/TJ, and in the period 1990 – 2002 the value is 77,400 kg/TJ.
**** The specific emission factor for natural gas in the table is used until 2016. After 2016, the EF SZ was updated with the following values: 55,521.7 kg/TJ (2017), 55,598.5 kg/TJ (2018) and 55,778.1 kg/TJ (from 2019 onwards)
Note: The standard IPCC EFs for CH4 and N2O are used. For some fuels, the values differ between different IPCC categories in the Energy sector (not all are included in the table above).

12.6.1 Industrial processes and product use

Table 64. Emission factors used in the Industrial Processes and Product Use sector

Categories		CO2	CH4	CF4	C2F6
		(t gas/t product)	(kg gas/t product)	(kg gas/t product)	(kg gas/t product)
Mineral industry					
Cement production		0.54			
Lime production	hydraulic	0.59			
	unquenched	0.75			
	extinguished	0.59			
Glass production	safely	0.20			
	insulating	0.20			
Other processes using carbonates					
Ceramics		0.44			
Other uses of soda ash		0.41			
Metal industry					
Iron and steel		0.09			
Ferroalloys	Silicomanganese	1.55			
	Ferromanganese	1.35			
	Ferrochrome	1.3			
	Silicochrome	1.4			
	Ferronickel	4.02			
	Ferrosilicon	4.18	1		

	Silicon metal	5	1.2		
Aluminium		1.60		1.60	0.40
Lead	cruel	0.52			
	refined raw	0.25			
Zinc		1.72			

12.6.2 Agriculture

Table 65. Emission factors used for the inventory of greenhouse gas emissions in livestock farming

Emission factor	BTR1	Comment
Livestock farming		
Dairy cows (enteric - CH4)	kg/head/year	
1_0	52,138	HM=250 kg, without grazing
1_1	50,022	Weight=250 kg, 5 months grazing
1_2	93,494	Weight=250 kg, 7 months grazing
2_0	94,417	Livestock weight=600 kg, without grazing
2_1	143,770	BW=600 kg, 5 months grazing
2_2	113,328	Weight=600 kg, 7 months grazing
3_0	102,703	HM=550 kg, without grazing
3_1	66,669	Weight=550 kg, 5 months grazing
3_2	122,492	Weight=550 kg, 7 months grazing
4_0	108,371	Livestock weight = 650 kg, without grazing
4_1	135,943	Weight=650 kg, 5 months grazing
4_2	145,964	Weight=650 kg, 7 months grazing
5_0	91,182	Livestock=500 kg, without grazing
5_1	116,473	BW=500 kg, 5 months grazing
5_2	130,426	BW=500 kg, 7 months grazing
Other cattle (enteric - CH4)	58	
Sheep (enteric - CH4)	5	40kg weight
Sheep < 1 year (enteric - CH4)	5	Sheep < 1 year with 28 kg of live weight
Goats (enteric - CH4)	5	30 kg of fat
Goats < 1 year (enteric - CH4)	5	Goats < 1 year with 20 kg body weight
Horses (enteric - CH4)	18	
Pigs (enteric - CH4)	kg/head/year	
Fatteners	1,865	Large farms (ADFI=1,541 kg/day)
Fatteners	1,636	Small farms (ADFI=1,352 kg/day)
Sows	3,993	Large farms (FI=3.3 kg/day)
Sows	3,993	Small farms (ADFI=3.3 kg/day)
Dairy cows (manure - CH4)	20	Dairy cows
	0.35 kg/1000 kg of live weight/day	
	18% liquid (40% N loss);	
	67% solid (40% N loss);	
	1% daily spread (22% N loss)	
	13% pasture	
	0.005 direct N2O - N	
Dairy cows (manure - CH4)	kg/head/year	
1_0	4,663	HM=250 kg, without grazing
1_1	3,859	Weight=250 kg, 5 months grazing
1_2	7,082	Weight=250 kg, 7 months grazing
2_0	7,822	Livestock weight=600 kg, without grazing

2_1	10,144	BW=600 kg, 5 months grazing
2_2	6,397	Weight=600 kg, 7 months grazing
3_0	35,098	HM=550 kg, without grazing
3_1	4,764	Weight=550 kg, 5 months grazing
3_2	7,561	Weight=550 kg, 7 months grazing
4_0	8,528	Livestock weight = 650 kg, without grazing
4_1	9,591	Weight=650 kg, 5 months grazing
4_2	9,001	Weight=650 kg, 7 months grazing
5_0	3,805	Livestock=500 kg, without grazing
5_1	7,965	BW=500 kg, 5 months grazing
5_2	8,051	BW=500 kg, 7 months grazing
Other cattle (manure - CH_4)	9 kg/head/year	
Dairy cows (manure - N_2O)	Annual N excretion (kg N/head/year)	0.005 direct N_2O - N
Firmly	53,294	HM=250 kg, without grazing
	59,423	Weight=250 kg, 5 months grazing
	95,474	Weight=250 kg, 7 months grazing
	98,346	Livestock weight=600 kg, without grazing
	138,294	BW=600 kg, 5 months grazing
	108,474	Weight=600 kg, 7 months grazing
	102,199	HM=550 kg, without grazing
	82,763	Weight=550 kg, 5 months grazing
	116,395	Weight=550 kg, 7 months grazing
	106,476	Livestock weight = 650 kg, without grazing
	135,302	Weight=650 kg, 5 months grazing
	136,629	Weight=650 kg, 7 months grazing
	92,061	Livestock=500 kg, without grazing
	111,993	BW=500 kg, 5 months grazing
	124,231	BW=500 kg, 7 months grazing
Liquid/paste	98,346	LW=600 kg, without grazing
	102,199	LW=550 kg, without grazing
Anaerobic digester	98,346	LW=600 kg, without grazing (0.000 direct N_2O – N)
Other cattle (manure - N_2O)	0.35 kg/1000 kg of live weight/day	
	18% liquid (40% N loss);	
	67% solid (40% N loss);	
	1% daily spread (22% N loss)	
	13% pasture	
	0.005 direct N_2O - N	
Sheep (manure - CH_4)	0.15 kg/head/year	40 kg weight
Sheep (garbage - N_2O)	0.9 kg/1000 kg/day	40 kg weight
	20% solid	
	80% pasture	
	0.005 direct emission N_2O - N	
Sheep < 1 year (manure - CH_4)	0.15 kg/head/year	Sheep < 1 year with 28kg body weight
Sheep < 1 year (manure - N_2O)	0.9 kg/1000 kg/day	Sheep < 1 year with 28kg body weight
	20% solid	
	80% pasture	
	0.005 direct emission N_2O - N	
Goats (manure - CH_4)	0.17 kg/head/year	30 kg of fat
Goats (garbage - N_2O)	1.28 kg/1000 kg/day	20 kg of fat
	20% solid	

	80% pasture 0.005 direct emission N2O - N	
Goats < 1 year (manure - CH4)	0.17 kg/head/year	Sheep < 1 year with 28kg body weight
Goats < 1 year (manure - N2O)	1.28 kg/1000 kg/day 20% solid 80% pasture 0.005 direct emission N2O - N	Sheep < 1 year with 28kg body weight
Horses (manure - CH4)	1.64 kg/head/year	
Horses (garbage - N2O)	0.3 kg/1000 kg of live weight/day	100% pasture
Pigs (manure - CH4)	kg CH4/head/year	
Fatteners	14,044	Large farms (FI=1,541 kg/day)
Fatteners	2,918	Small farms (FI=1,352 kg/day)
Sows	46,893	Large farms (FI=3.3 kg/day)
Sows	9,896	Small farms (FI=3.3 kg/day)
Pigs (garbage - N2O)	(year N excretion kg N/head/year)	Direct N2O – N Dry 0.02; liquid- 0.005; Uncovered lagoon – 0.000; Under the floor – 0.002; Anaerobic digester – 0.000,
Fatteners	197.1	
Sows	248.2	
Poultry (manure - CH4)	-	1.8 kg of fat
Poultry (garbage - N2O)	-	1.8 kg of fat
Laying hens (garbage - CH4)	0.2 kg/head/year	1.8 kg of fat
Laying eggs (garbage - N2O)	0.82 kg/1000 kg/day 100% poultry manure (50% N loss); 0.001 Direct N2O - N	1.8 kg of fat
Broilers (manure - CH4)	0.2 kg/head/year	0.9 kg of fat
Broilers (garbage - N2O)	1.1 kg/1000 kg/day 100% poultry manure (50% N loss); 0.001 Direct N2O - N	0.9 kg bw, specific factors for broilers
Turkeys (garbage - CH4)	0.9 kg/head/year	6.8 kg bw, specific factors for turkeys
Turkeys (garbage - N2O)	0.74 kg/1000 kg/day 100% poultry manure (50% N loss); 0.001 Direct N2O - N	6.8 kg bw, specific factors for turkeys
Other (garbage - CH4)	0.2 kg/head/year	1.8 kg of fat
Other (garbage - N2O)	0.82 kg/1000 kg/day 100% poultry manure (50% N loss); 0.001 Direct N2O - N	1.8 kg of fat

12.6.3 Forestry and land use

Table 66. Emission factors used for the inventory of greenhouse gas emissions in agriculture

Emission factors	NC4	Comment
1. Cropland Remaining Cropland		
1a. Carbon content in biomass	• 2.1 t/ha annual biomass accumulation in perennial plantations (first 20 years) -ΔCG, • 63 t/ha biomass loss due to digging up perennial plantations -ΔCL	IPCC Handbook – Chapter 5, Table 5.1 and 5.3
1.b Dead organic matter		In the Tier 1 methodology, Dead Organic Matter is not calculated.
1.c Soil organic carbon	0.9 t/ha factor for changing contents due to land use change 1.0 t/ha factor for change of contents due to change of management FMG (management) 1.0 t/ha factor for changing contents due to changes in inputs FI (input)	IPCC Handbook – Chapter 5, Table 5.5
1.1. Forest Land converted to Cropland	120 t/ha biomass loss through deforestation during conversion	IPCC Handbook – Chapter 4, Table 4.7 to 4.12
1.2. Grassland converted to Cropland	6.5 t/ha biomass loss through clearing due to change of use (conversion)	IPCC Handbook – Chapter 6, Table 6.4
2. Grassland Remaining Grassland		
2.a Carbon content in biomass		In pastures where there is no change in the type or intensity of management, biomass will be in a stable state.
2.b Dead organic matter		In the Tier 1 methodology, it is assumed that dead wood and foliage are in equilibrium and is not calculated.
2.c. Soil organic carbon	1.0 t/ha factor for changing contents due to land use change 0.95 t/ha factor for change of contents due to change of management FMG (management) 1.0 t/ha factor for changing contents due to changes in inputs FI (input)	IPCC Handbook – Chapter 6, Table 6.2
2.1 Forest Land converted to Grassland	120 t/ha biomass loss with deforestation due to use (conversion)	IPCC Handbook – Chapter 4, Table 4.7 to 4.12
2.2 Cropland converted to Grassland	10.0 t/ha biomass loss through clearing due to change of use (conversion)	IPCC Handbook – Chapter 5, Table 5.1
3. Application of urea	0.2 evaporation/leaching factor	IPCC Handbook – Chapter 11, Table 11.3
3. Rice fields	1.3 CH4 emission factor from permanently flooded rice fields	IPCC Handbook – Chapter 11, Table 11.3

12.6.4 Waste

Figure 110. Parameters used to calculate methane from solid waste landfills

Waste Type Parameters

Waste Category	Waste Type / Industry Type			Degradable organic carbon	Degradable organic carbon which decomposes in SWDS	Methane generation rate constant (k)
	Class of decomposability	Type	Use in calculations	DOC (Fraction of wet weight)	DOCf (Fraction)	k
Industrial Waste	Bulk waste	Bulk Industrial Waste	☑	0.15	0.55	0.05
	Highly decomposable waste	Food, beverages and tobacco	☑	0.15	0.7	
	Less decomposable waste	Construction and demolition	☑	0.04	0.5	
		Wood and wood products	☑	0.43	0.5	
	Moderately decomposable w...	Pulp and paper	☑	0.4	0.5	
		Textile	☑	0.24	0.5	
Municipal Waste	Bulk waste	Bulk Municipal Waste	☑	0.18	0.5	0.05
	Highly decomposable waste	Food waste	☑	0.15	0.55	0.06
		Garden and park	☑	0.2	0.55	0.05
	Less decomposable waste	Wood	☑	0.43	0.55	0.02
	Moderately decomposable w...	Disposable nappies	☑	0.24	0.55	0.05
		Paper and cardboard	☑	0.4	0.55	0.04
		Textile	☑	0.24	0.55	0.04
Other waste	Bulk waste	Clinical waste	☑	0.15	0.5	
		Hazardous waste	☑		0.5	
Sludge	Highly decomposable waste	Industrial sewage sludge	☑	0.09	0.5	
		Municipal sewage sludge	☑	0.05	0.55	0.06

Table 67. Distribution of waste by type of solid waste landfills (%)

	Eastern region				Southwestern region				Vardar region				Southeast region			
	Unmanaged - Shallow	Unmanaged - deep	Managed - anaerobic	Uncategorized	Unmanaged - Shallow	Unmanaged - deep	Managed - anaerobic	Uncategorized	Unmanaged - Shallow	Unmanaged - deep	Managed - anaerobic	Uncategorized	Unmanaged - Shallow	Unmanaged - deep	Managed - anaerobic	Uncategorized
1950-1979				100				100				100				100
1980	0			100				100				100				100
1981	1			99				100				100				100
1982	2			98				100				100				100
1983	3			97				100				100				100
1984	4			96				100				100				100
1985	5			95				100	0			100				100
1986	6			94				100	1			99				100
1987	7			93				100	2			98				100
1988	8			92				100	2			98				100
1989	9			91				100	3			97				100
1990	10			90				100	4			96	0			100
1991	11			89				100	5			95	2			98
1992	12			88				100	6			94	4			96
1993	13			87				100	6			94	5			95
1994	14			86				100	7			93	7			93
1995	15			85				100	8			92	9			91
1996	16			84				100	9			91	11			89
1997	17			83				100	9			91	13			87
1998	18			82				100	10			90	15			85
1999	19			81	4			96	11			89	16			84
2000	20	6		74	9			91	12			88	18			82

2001	21	13		66	13			87	13	8		79	20			80
2002	22	19		59	17			83	13	16		70	22			78
2003	23	26		51	21			79	14	24		62	24			76
2004	24	32		44	26			74	15	32		53	26			74
2005	25	39		36	30			70	16	40		44	27	7		65
2006	26	45		29	34			66	17	48		35	29	15		56
2007	27	51		22	39			61	17	56		26	31	22		47
2008	28	50		22	43	22		35	18	64		17	33	29		38
2009	31	48		21	48	24		28	19	65		16	33	27		40
2010	35	49		17	42	21		37	19	64		17	35	28		37
2011	37	48		14	36	18		46	20	64		17	25	19		57
2012	28	57		15	39	18		43	13	40		48	38	29		33
2013	19	66		15	20	36		44	13	39		48	39	28		33
2014	21	69		10	3	55		42	22	67		11	22	16		62
2015	17	56		27	3	47		50	11	70		18	42	30		28
2016	21	65		14	3	45		52	12	71		18	31	39		30
2017	22	68		10	3	49		48	11	65		24	32	41		27
2018	20	61		18	3	47		51	3	52		45	33	41		26
2019	19	58		22	1	25		73	3	62		34	25	53		23
2020	20	60		19	2	29		69	3	64		32	23	49		29
2021	21	62		17	2	28		70	3	65		32	25	54		21
2022	21	63		16	2	29		69	3	65		31	26	55		20
	Pelagonia region				*Polog region*				*Northeast region*				*Skopje region*			
	Unmanaged - Shallow	**Unmanaged - deep**	**Managed - anaerobic**	**Uncategorized**	**Unmanaged - Shallow**	**Unmanaged - deep**	**Managed - anaerobic**	**Uncategorized**	**Unmanaged - Shallow**	**Unmanaged - deep**	**Managed - anaerobic**	**Uncategorized**	**Unmanaged - Shallow**	**Unmanaged - deep**	**Managed - anaerobic**	**Uncategorized**
1950-1979				100				100				100				100
1980				100				100				100				100
1981				100				100				100				100
1982				100				100				100				100
1983				100				100				100				100
1984				100				100				100				100
1985				100				100	0			100				100
1986				100				100	0			100				100
1987		4		96				100	1			99				100
1988		7		93				100	1			99				100
1989		11		89				100	2			98				100
1990		14		86				100	2	4		94				100
1991		18		82				100	3	8		90				100
1992		21		79				100	3	11		86				100
1993		25		75				100	3	15		81				100
1994		29		71				100	4	19		77			87	13
1995	0	32		68				100	4	23		73			87	13
1996	1	35		64				100	5	27		69			87	13
1997	1	38		61				100	5	31		64			87	13
1998	2	41		57		0		100	6	34		60			87	13
1999	3	44		54		6		94	6	38		56			87	13
2000	3	47		50		12		88	6	42		52			87	13
2001	4	50		46		18		82	7	46		47			87	13
2002	5	52		43		24		76	7	50		43			87	13
2003	5	55		39		29		71	8	53		39			87	13
2004	6	58		36		35		65	8	57		35			87	13
2005	7	61		32		41		59	9	61		30			87	13
2006	7	64		29		47		53	9	65		26			87	13
2007	8	67		25		53		47	9	69		22			87	13

2008	9	70		21		59		41	10	68		22			87	13
2009	10	72		18		63		37	11	67		22			83	17
2010	10	74		16		57		43	13	71		16			87	13
2011	11	74		16		69		31	13	69		18			86	14
2012	4	81		15		57		43	13	60		27			86	14
2013	4	80		15		57		43	13	60		27			86	14
2014	4	74		22		61		39	8	76		16			91	9
2015	5	81		14		78		22	9	78		13			92	8
2016	5	83		12		72		28	8	69		22			88	12
2017	5	83		12		78		22	10	78		13			94	6
2018	5	73		22		76		24	8	57		35			97	3
2019	5	76		19		66		34	8	56		36			98	2
2020	6	77		17		67		33	3	60		37			99	1
2021	6	78		16		67		33	4	67		30			99	1
2022	6	79		16		68		32	3	58		39			99	1

Table 68. Emission factors used for biological treatment of solid waste

	CH4	**N2O**
Composting	10	0.6

Table 69. Parameters used for estimating emissions from waste incineration

Dry matter content - dm	(share)	0.65
Carbon content in dry matter - CF	(share)	0.6
Share of fossil carbon in total carbon - FCF	(share)	0.4
Oxidation factor – OF	(share)	1

Table 70. Parameters used to estimate emissions from open burning of waste

Dry matter content - dm	(share)	0.97
Carbon content in dry matter - CF	(share)	0.38
Share of fossil carbon in total carbon - FCF	(share)	0.1
Oxidation factor – OF	(share)	0.58
Emission factor for methane	(kg CH4/Gg water waste)	6500
Emission factor for sodium oxide	(kg N2O/Gg dry waste)	150

Table 71. Weighted emission factor for estimating emissions from wastewater treatment and discharge (kg CH4/kg BOD)

Year.	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
	0.123	0.123	0.123	0.123	0.123	0.123	0.123	0.123	0.123	0.123	0.123	0.123	0.123	0.122	0.121
Year.	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
	0.120	0.119	0.114	0.114	0.113	0.112	0.111	0.11	0.109	0.108	0.107	0.106	0.104	0.095	0.092
Year.	**2020**	**2021**	**2022**												
	0.091	0.09	0.089												