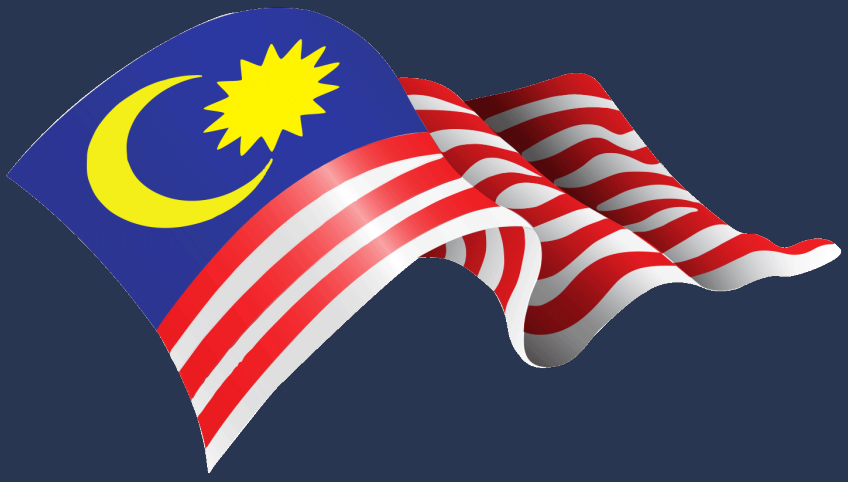

MALAYSIA

FOURTH BIENNIAL UPDATE REPORT

UNDER THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

MINISTRY OF NATURAL RESOURCES, ENVIRONMENT AND CLIMATE CHANGE, MALAYSIA

MALAYSIA

FOURTH BIENNAL UPDATE REPORT UNDER THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

This is Malaysia's Fourth Biennial Update Report submitted to the United Nations Framework Convention on Climate Change in December 2022

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FOREWORD

Malaysia is pleased to submit our Fourth Biennial Update Report (BUR4) under the United Nations Framework Convention on Climate Change (UNFCCC). The document among others, outlines the latest information on the anthropogenic GHG emission and removal estimations in four sectors, namely energy; Industrial Processes and Product Used (IPPU); Agriculture, Forestry and Other Land Use (AFOLU), and waste up to the year 2019. The report also covers a wider range of climate change mitigation actions compared to BUR3 and the support needed and received to implement its climate actions.

Although Malaysia's contribution to global anthropogenic GHG emissions is small, Malaysia is highly committed to supporting the call for enhanced climate actions. Thus, Malaysia's updated Nationally Determined Contribution (NDC) submitted in 2021 has reinforced the earlier NDC submission in 2016 and sets an unconditional target of 45% reduction in carbon intensity against GDP below 2005 levels, to be achieved in 2030. Malaysia will continue to promote the strong linkages between climate change and sustainable development whilst mainstreaming climate change into the national development agenda. We have successfully implemented mitigation actions across all sectors but a lot more is required to fully realise the NDC that the country has set under the Paris Agreement. In addition, Malaysia also aspires to achieve net-zero emission as early as 2050. In this regard, the information in this report also will help us in the preparation of our Long-Term Low Greenhouse Gas Emission Development Strategies and in our national policy planning.

As this document informs the global community on Malaysia's GHG emissions and removals and its climate change mitigation actions in several sectors such as energy, forestry, transport, industry, agriculture and waste, the Ministry has also intensified its efforts to enhance the transparency, accuracy, completeness, comparability and consistency of the information contained in our final BUR. This is part of its transition efforts to the Enhanced Transparency Framework referred to in Article 13 of the Paris Agreement.

The preparation of this report would not have been possible without the cooperation and commitment of numerous experts and stakeholders and the provision of valuable data from government ministries, agencies, research organisations, corporations, industry associations, universities and non-governmental organisations. I would like to take this opportunity to express my sincere gratitude to them, the National and Technical Steering Committees on Climate Change and the Technical and Sub-Working Groups for their hard work and dedication. I would also like to take this opportunity to thank the UNFCCC, Global Environment Facility (GEF) and United Nations Development Programme (UNDP) for facilitating the preparation of this report.

We look forward to a continued cooperation to ensure that Malaysia will be able to fulfil its obligation under the Paris Agreement.

YB TUAN NIK NAZMI BIN NIK AHMAD
Minister of Natural Resources, Environment and Climate Change

EXECUTIVE SUMMARY

Introduction

Malaysia's Fourth Biennial Update Report is developed according to the United Nations Framework on Climate Change (UNFCCC) Decision 2/CP.17. The report provides the updated information reported in the Third Biennial Update Report on national circumstances, greenhouse gas (GHG) inventory, progress in mitigation policies and actions, as well as on support received and needs.

1. National Circumstances

Malaysia has an equatorial climate with increasing temperature trends of 0.13 ^{o}C to 0.24 ^{o}C per decade. Rainfall distribution in Malaysia is influenced by topography and monsoon winds which can cause abundant annual rainfall that averages about 2,000 mm to 4,000 mm. Malaysia has consistently maintained more than 50% of its landmass as forest following its voluntary pledge at the Earth Summit in 1992. In 2019, 54.9% of the total land area of Malaysia was under forest cover. Terrestrial biodiversity is concentrated within these forests and the country is considered as one of the world's mega-diverse countries.

Malaysia's population was 32.5 million in 2019. Its GDP (constant 2015 price) was RM1,424.3 billion on the same year, with contributions from services (58.3%), manufacturing (22.5%), mining and quarrying (7.3%), agriculture, livestock, forestry and fishing (7.2%), and construction (4.7%). Malaysia's medium-term planning covers five years development plans (such as the 11th Malaysia Plan) and sets the economic growth targets as well as the allocation ceiling for the public sector development programme. In addition, it also outlines the role of the private sector.

The energy sector is anticipated to strengthen access to affordable, reliable and sustainable energy with the introduction of new policies focusing on new low carbon energy-related sectors. Such direction also supports the goal of reducing dependence on petroleum-based revenue and commodity trade whilst enhancing the resilience of the country's fiscal and economic position in the process. (Information provided on the National Circumstances Chapter reports up to the year 2019 where published information are available).

In December 2022 when this report was submitted, there was a change in the national focal point to the UNFCCC, from the Ministry of Environment and Water to the Ministry of Natural Resources, Environment and Climate Change. The changes made to the institutional arrangement of reporting will be reflected in the subsequent report.

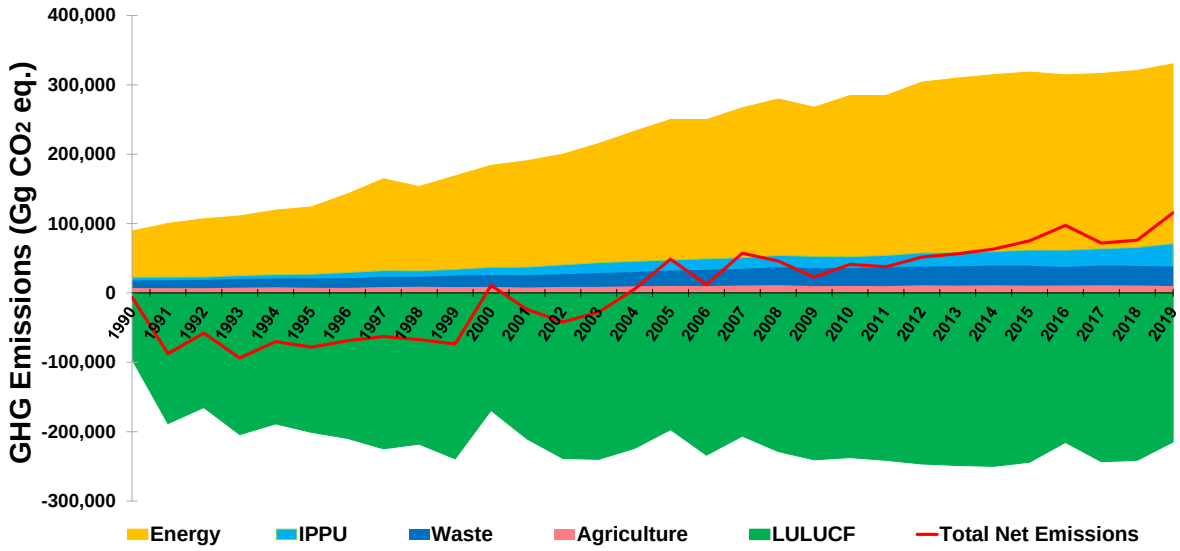
2. National Greenhouse Gas Inventory

The summary of Malaysia's GHG inventory in 2019 is as follows:

Sector	GHG Emission/Removal (Gg CO_2 eq.)
Energy	259,326.11
IPPU	32,853.80
AFOLU-Agriculture	9,921.71
AFOLU-LULUCF	-214,714.54
Waste	28,256.59
Total (Excluding LULUCF)	330,358.21
Total (Including LULUCF)	115,643.68

In 2019, the energy sector remained as the largest contributor of emissions where it accounted for 78% of the total emissions. This is followed by the IPPU and the waste sectors, both contributed to about 10% and 9% of the total emissions respectively. Meanwhile, the agriculture sector contributed the lowest emissions at 3%. The total GHG emissions recorded that year was 330,358.21 Gg CO_2 eq. Taking into account the LULUCF sector which shows a net sink of -214,714.54 Gg CO_2 eq., Malaysia's net GHG emissions was 115,643.68 Gg CO_2 eq.

The GHG emission time series from 1990 to 2019 is shown below. As part of the efforts to improve the GHG estimations to the extent possible, recalculations were undertaken and reported in all the sectors as data became available. The key category analysis, uncertainty assessment and improvement plan are also reported in Chapter 2.



3. Mitigation Actions and Their Effects

The summary to the mitigation actions in 2017 to 2019 is shown below:

Sector	Sub-Sector	Mitigation Actions	Emission Reductions Achieved (Gg CO_2 eq.)		
			2017	2018	2019
Energy	Renewable Energy	RE Implementation through Feed-in Tariff mechanism	507.51	676.59	908.98
		• *Biomass*	115.48	129.88	151.28
		• *Biogas*	100.20	169.09	232.88
		• *Small Hydropower*	47.26	44.99	170.39
		• *Solar Photovoltaic*	244.57	332.64	354.42
		Other RE from Public and Private Licensees	233.19	378.19	292.33
		• *Biomass*	225.00	312.10	243.94
		• *Biogas*	7.96	9.37	39.59
		• *Solar Photovoltaic*	0.23	56.71	8.80
		Net Energy Metering	-	5.54	5.53
		Large Scale Solar	-	99.46	733.14
		Hydropower Generation	9,316.10	8,348.13	8,194.71
		• *Large Hydro*	9,299.34	8,236.92	8,065.23
		• *Small Hydro*	16.76	111.21	129.48
	Energy Efficiency	National Energy Efficiency Action Plan (NEEAP)	1,284.18	2,144.26	3,164.66
	Transportation	Rail based public transport	179.32	200.26	269.61
		Use of energy-efficient vehicles	119.23	114.71	140.15
		Use of palm-based biodiesel in blended petroleum diesel	1,174.30	1,174.30	1,677.57
		Use of natural gas in vehicles	81.66	66.76	54.07
	Oil & Gas	Reduction of venting and flaring	2,940.00	3,760.00	4,910.00
Waste		Paper recycling	3,937.76	4,398.87	4,746.94
		Biogas recovery from palm oil mill effluent	3,115.12	3,367.78	3,749.19
IPPU		Material substitution in cement production	1,554.27	1,585.17	1,548.09
Agriculture		MyOrganic Certification Program	7.68	7.76	7.80

Sector	Sub-Sector	Mitigation Actions	Emission Reductions Achieved (Gg CO_2 eq.)		
			2017	2018	2019
LULUCF		Reducing Deforestation, Sustainable Management of Forest and Conservation of Carbon Stocks	46,292.97	44,187.32	17,637.78
Total (without LULUCF)			24,450.33	26,327.76	30,402.76
Total (with LULUCF)			70,743.30	70,515.08	48,040.54

The details of the mitigation actions in all the sectors are reported in Chapter 3. The GHG emission reductions from mitigation actions in the oil and gas industry (energy sector), cement industry (IPPU sector) and organic farming programme (agriculture sector) are quantified for the first time in this report.

4. Level of Support Received, Constraints, Gaps and Needs

Malaysia continues to face challenges in implementing its commitments to address climate change. This ranges from availability of finance in light of competing needs with other development programmes, recovery from the covid-19 pandemic, technology as well as technical and human capacity. Apart from the annual Government allocation to enhance a wide range of actions to address climate change, these actions are further complemented by the international communities in terms of capacity building, technical and financial support to fulfil the country's obligations under the Convention.

The Global Environment Facility (GEF) was the main source of funding for climate change activities. The support received has been primarily used to develop the country's institutional and technical capacity on reporting obligations to the UNFCCC as well as the implementation of mitigation actions. Sectors that have also received financial support for mitigation projects were transport, energy, forestry (including peatland), low carbon cities and community empowerment projects. The United Nations Development Programme (UNDP), the United Nations Industrial Development Organisation (UNIDO) and International Fund for Agricultural Development (IFAD) have facilitated these actions.

The updated information on the financial support received from various sources, and capacity building assistance since those reported in the Third BUR are also provided in this report. Similar to the previous BURs, Malaysia also reported its constraints, gaps and needs for fulfilling its reporting obligation and climate change actions. In terms of reporting to the UNFCCC, an improvement plan has been developed considering the recommendations provided during the International Consultation and Analysis process of the Third BUR, as well as recommendations of a number of workshops held within the past couple of years.

1. NATIONAL CIRCUMSTANCES

1.1 Introduction

This chapter provides information on Malaysia's national circumstances up to the year 2019 where relevant geography, natural resources, social and economic published statistics are available. It also communicates the status of key climate-related sectors and their respective policies and strategic measures.

1.2 Geography: Location and Topography

Malaysia lies between 0º 51' N and 7º 33' N, and 98º 01' E and 119º 30' E and is located in the Southeast Asia region. It has a land area of 330,241 km^2 with about 8,840 km of coastline and over 879 islands. It consists of thirteen states and three Federal Territories. Eleven of the states and two of the Federal Territories (Kuala Lumpur and Putrajaya) are located in Peninsular Malaysia (Figure 1.1). The states of Sabah and Sarawak are located on the Borneo Island and are separated from Peninsular Malaysia by the South China Sea. The Federal Territory of Labuan with an area of 92 km^2 and with 81.5 km coastline is located off the coast of western Sabah.

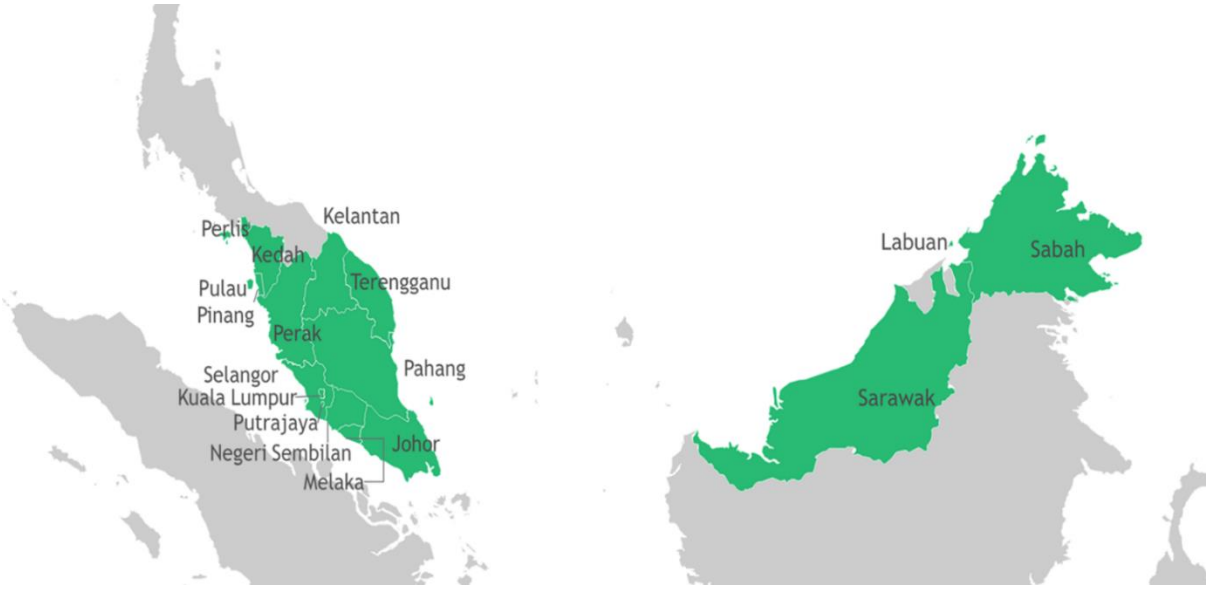


Figure 1.1: Map of Malaysia

The topography of Peninsular Malaysia ranges from coastal plains to mountainous terrains. It has a land area of approximately 132,078 km^2 and a coast length of about 3,771.5 km. Its north-south extent is about 746 km and its maximum east-west width is about 315 km. It is also divided into the east and west coasts by the central mountainous region known as the Titiwangsa Range which extends from north to south for about 617 km in length with the highest point reaching 2,183 m above sea level. It is also the headwater of the Pahang River, which at 482 km is the longest river in Peninsular Malaysia and the third longest river in Malaysia.

Sabah which lies on the north-eastern part of Borneo Island has a land area of approximately 73,621 km^2. Its coastline runs the length of approximately 3,753 km. Sabah's topography is primarily mountainous, especially in the western flank with undulating lowland basins in the eastern part. The Crocker Range divides the western coastal plains from the hinterland of Sabah. At 4,095 m above sea level, Low's Peak on the Kinabalu plateau of the Crocker Range is the highest point in Malaysia. The Kinabatangan River is the longest river in Sabah at 568 km and is the second longest in Malaysia.

Sarawak has a land area of approximately 124,450 km^2 and lies on the north central and western part of Borneo Island. Sarawak's coastline is about 1,234 km. Its topography features coastal plains followed by a narrow belt of hills before sharply rising into a mountainous region towards the Kalimantan border with Indonesia. Mount Murud at 2,422 m is the highest mountain in Sarawak. The second highest peak Mount Mulu (2,377m) has the largest natural limestone cave system in the world. The Rajang River at 780 km is the longest river in Sarawak as well as in Malaysia.

1.3 Governance and Climate Change

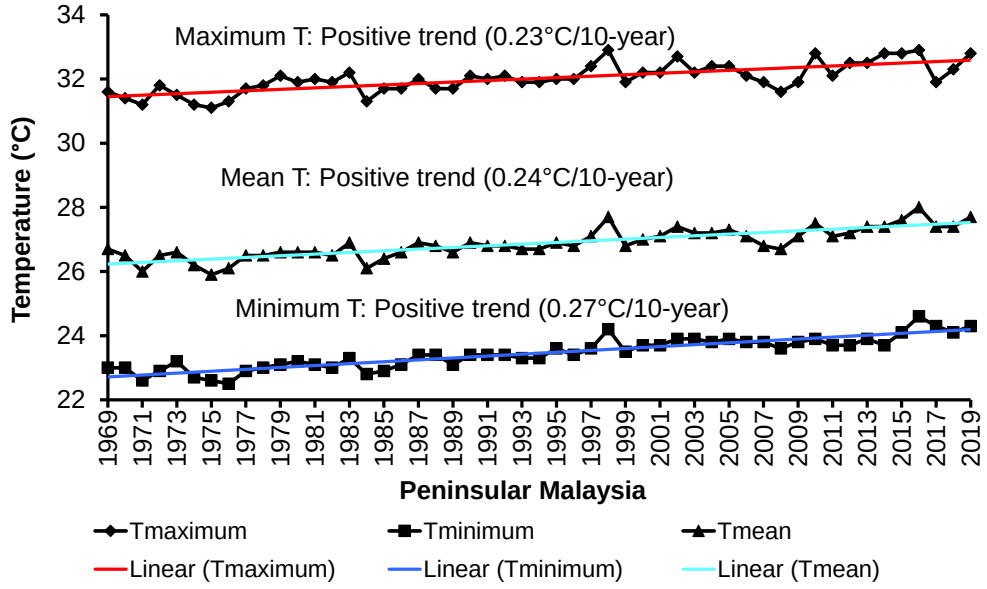
The Government of Malaysia is led by a Prime Minister and a constitutional monarchy, which employs a Parliamentary system. It has three branches of government – the Executive, the Legislature and the Judiciary. Its legislative power is divided between its federal and state legislatures. The Malaysian Parliament is made up of His Majesty Yang di-Pertuan Agong, the Senate (Upper House) with 70 members and the House of Representatives (Lower House) with 222 members. Out of the 70 senators in the Senate, 44 are appointed by His Majesty Yang di-Pertuan Agong while 26 are elected by the State legislatures. The general election for the 222 members of the Lower House must be held every five years.

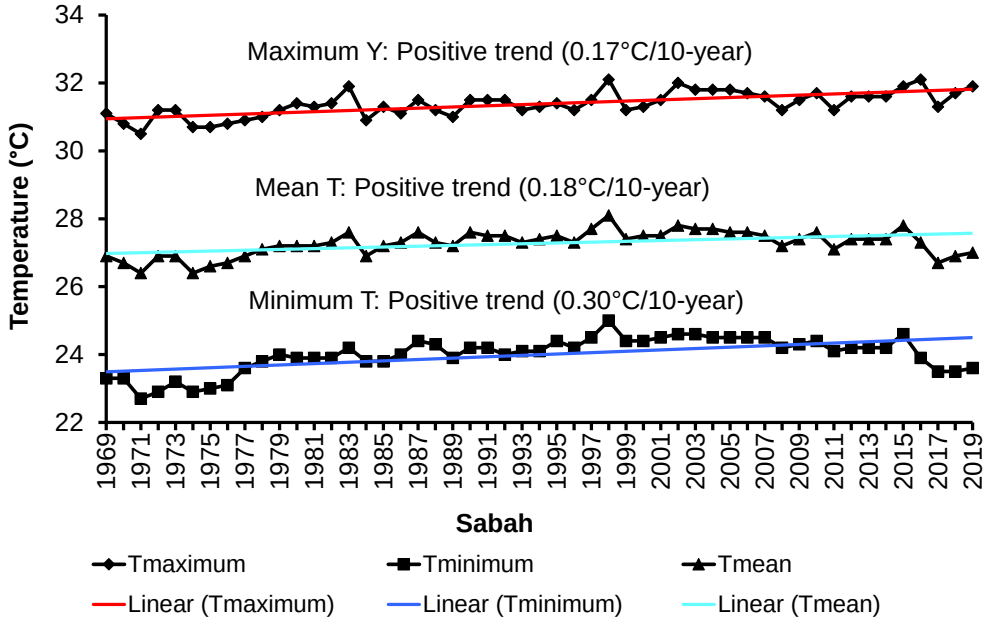
The federal legislature and the executive arm of the government have the responsibility for developing and implementing policies and drafting national laws to enable the country to fulfil its international obligations in addressing climate change. The Ministry of Environment and Water is the focal ministry for climate change. Nevertheless, the respective states have jurisdiction over the management of natural resources, especially land, forest and water.

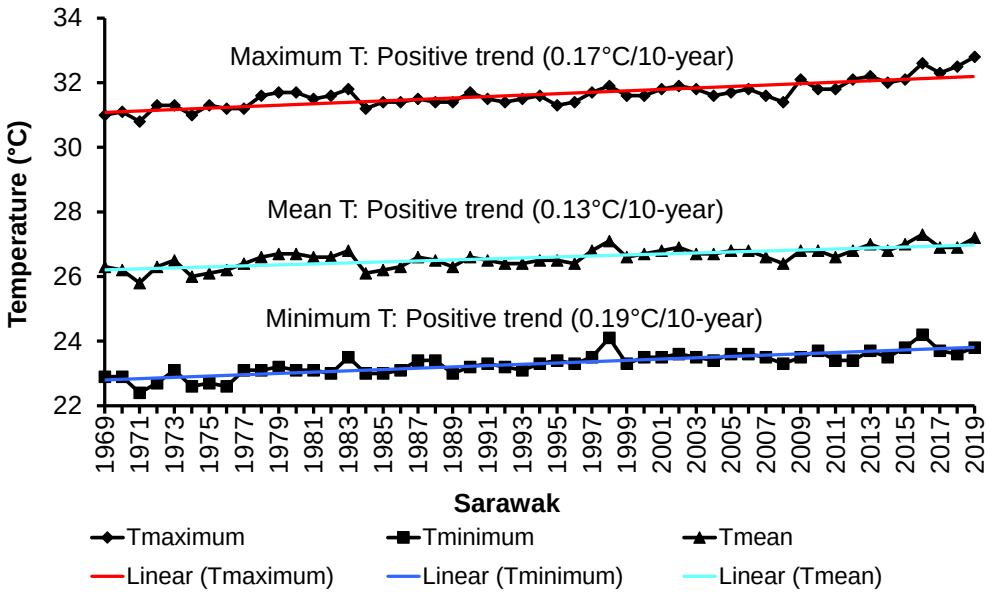
1.4 Climate

1.4.1 Annual Temperature Trends for Malaysia

Malaysia has an equatorial climate with a uniform daily variation of temperatures throughout the year. The daily mean temperature lies between 26 ºC and 28 ºC. In the past 50 years, there has been a positive trend in temperature increase. Figure 1.2 shows the annual trends of temperature for Peninsular Malaysia, Sarawak and Sabah from 1970 to 2019 respectively. The surface mean temperature increased by 0.13 ºC to 0.24 ºC per decade. The surface maximum temperature increased by 0.17 ºC to 0.23 ºC per decade while minimum temperature increased by 0.19 ºC to 0.30 ºC per decade.


Maximum T: Positive trend (0.23°C/10-year)
Mean T: Positive trend (0.24°C/10-year)
Minimum T: Positive trend (0.27°C/10-year)
Temperature (°C)
Peninsular Malaysia
Tmaximum
Tminimum
Tmean
Linear (Tmaximum)
Linear (Tminimum)
Linear (Tmean)


Maximum Y: Positive trend (0.17°C/10-year)
Mean T: Positive trend (0.18°C/10-year)
Minimum T: Positive trend (0.30°C/10-year)
Temperature (°C)
Sabah
Tmaximum
Tminimum
Tmean
Linear (Tmaximum)
Linear (Tminimum)
Linear (Tmean)

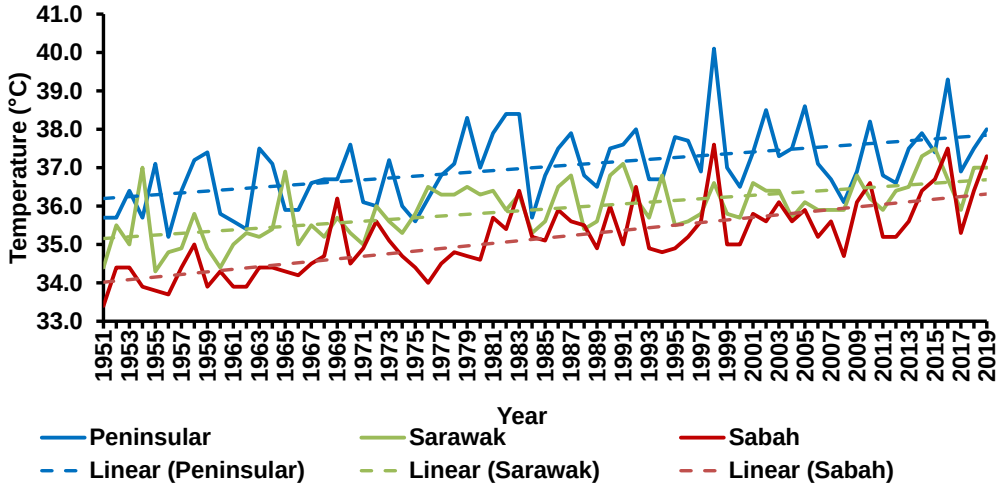


Source: Malaysian Meteorological Department

Figure 1.2: Annual Temperature Trend: Peninsular Malaysia, Sabah and Sarawak

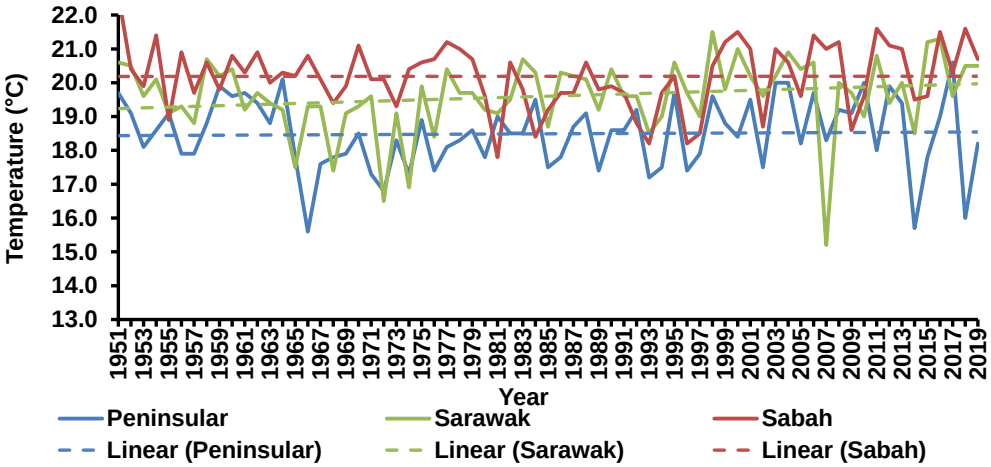
Malaysia's climate can be characterised by two monsoons which are separated by two shorter inter-monsoon periods. North-eastern winds are strong during the boreal winter monsoon which usually occurs from November to March. The boreal summer monsoon occurs between May to September with south-westerly winds prevailing during this period. During inter-monsoonal periods, occurrence of heavy rain and thunderstorms in the late afternoons and evenings are relatively common.

The highest daily maximum and lowest daily minimum temperatures for each year from 1951 to 2019 according to data collected from the various meteorological stations across Malaysia are shown below in Figure 1.3 and Figure 1.4. The highest daily maximum temperature shows an increasing trend with the highest daily maximum temperature over in Peninsular Malaysia, followed by Sarawak and Sabah.



Source: Malaysian Meteorological Department

Figure 1.3: Highest Daily Maximum Temperature for Peninsular Malaysia, Sabah and Sarawak

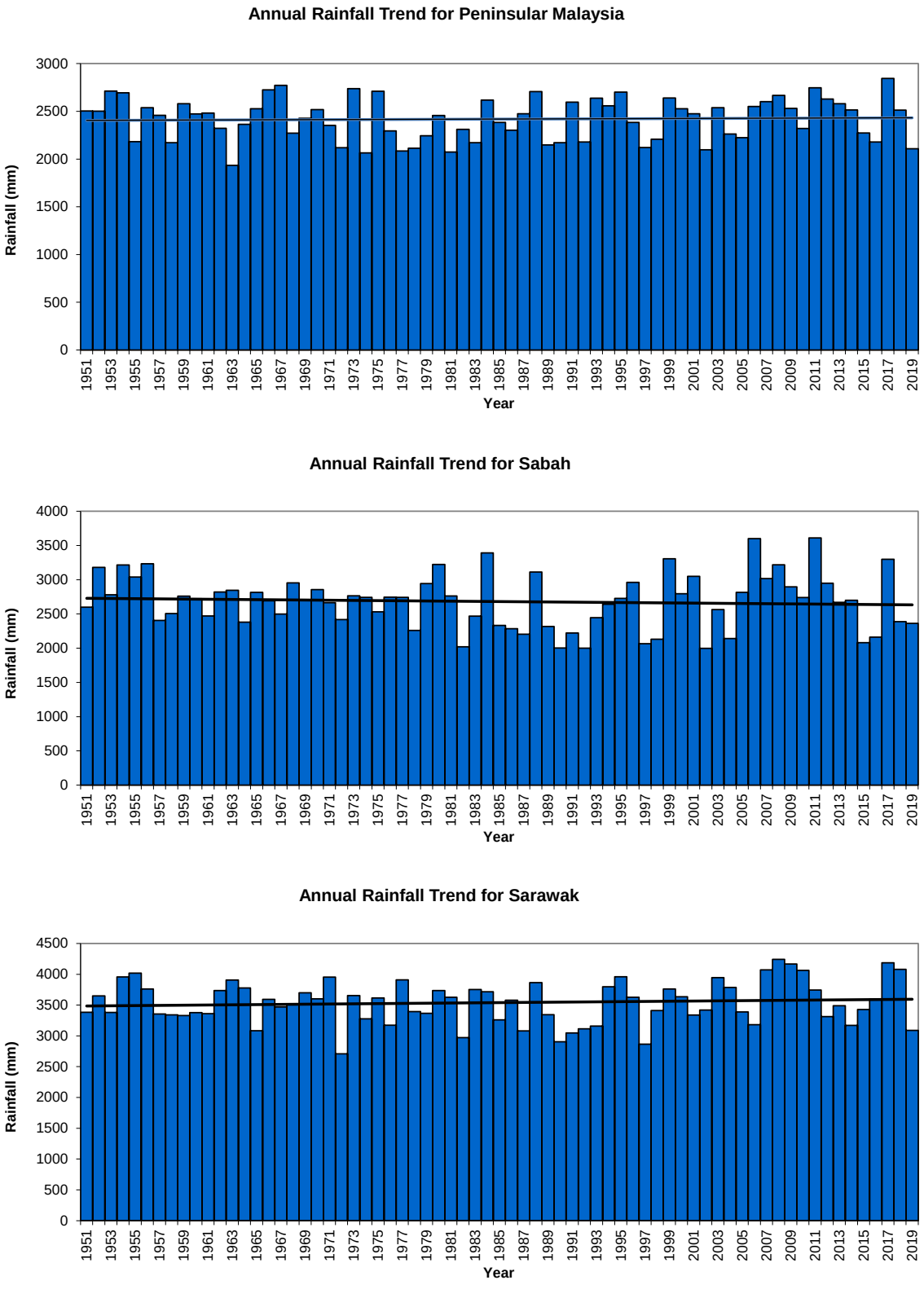


Source: Malaysian Meteorological Department

Figure 1.4: Lowest Daily Minimum Temperature for Peninsular Malaysia, Sabah and Sarawak

1.4.2 Annual Rainfall Distribution

Rainfall distribution in Malaysia is influenced by topography and monsoon winds. As a result, Malaysia has abundant annual rainfall that averages about 2,000 mm to 4,000 mm. During the northeast monsoon, the east coast of Peninsular Malaysia, northeast of Sabah and southern Sarawak sometimes experience spells of heavy rain lasting about three days, which can cause severe floodings. In contrast, the southwest monsoon will see lower rainfall. During the inter-monsoon periods, heavy rain from convective showers and thunderstorms occurs in the late afternoons and evenings. Figure 1.5 shows the annual rainfall for Peninsular Malaysia, Sabah and Sarawak from 1951 to 2019. The drier years are mainly because of strong El Niño and the Indian Ocean Dipole events.



Source: Malaysian Meteorological Department

Figure 1.5: Annual Rainfall Trend in Peninsular Malaysia, Sabah and Sarawak

1.5 Forest and Biodiversity

1.5.1 Forests

Malaysia's forests are comprised of complex ecosystems and are home to a wide range of species. Malaysia has consistently maintained more than 50% of its landmass as forest following its voluntary pledge at the Earth Summit in 1992. This includes Permanent Reserved Forests (PRFs), state land forests (SLF) and Totally Protected Areas (TPA/PA). In 2019, 18.14 million ha, or approximately 54.9% of the total land area of Malaysia was under forest cover. The remaining land area comprised of agricultural and commodity crops, settlements, wetlands and grasslands. Table 1.1 below presents a breakdown of the total forested areas in Malaysia according to the three regions.

Table 1.1: Total Forested Areas

	Forested area (million ha)			
Year	Peninsular Malaysia	Sabah	Sarawak	Total
2005	5.83	4.36	7.62	17.82
2015	5.79	4.56	8.05	18.39
2016	5.77	4.56	7.91	18.24
2017	5.77	4.77	7.80	18.34
2018	5.76	4.77	7.75	18.27
2019	5.73	4.68	7.72	18.14

Source: Ministry of Energy and Natural Resources

1.6 Biodiversity

Malaysia is rich in biodiversity in terms of estimated species in the respective flora and fauna groups as shown in Table 1.2.

Table 1.2: Summary of Malaysia's Overall Biodiversity Richness

Group	Estimated Species
Mammals	306
Birds	742
Reptiles	567
Amphibians	242
Marine Fishes	1,619
Freshwater Fishes	449
Invertebrates	150,000
Vascular Plants	15,000
Fungi	>4,000
Mosses	522
Hard corals	612

Source: Sixth National Report (of Malaysia) *to the Convention on Biological Diversity*

Malaysia's terrestrial biodiversity is concentrated within tropical rainforests that extend from coastal plains to mountainous areas and wetlands, such as lakes and rivers. Marine biodiversity is primarily located among islands and coastal ecosystems, especially in mangrove/tidal mudflats, coral reefs and seagrass meadows. Agricultural biodiversity is conserved in plantations, rice fields, fruit orchards, and farms. Table 1.3 below represents an overview of different ecosystems across Malaysia.

Table 1.3: Overview of Ecosystems

Thematic Area	Ecosystem
Forest Biodiversity	• Lowland dipterocarp forest • Heath forest • Limestone forest • Mixed dipterocarp forest • Hill dipterocarp forest • Hill mixed dipterocarp forest
Mountain Biodiversity	• Montane forest • Subalpine forest
Inland Waters Biodiversity	• Peat swamp forest • Freshwater swamp forest • Riparian forest • Rivers, ponds, lakes
Marine and Coastal Biodiversity	• Coastal hill dipterocarp forest • Mangrove forests • Mudflats • Coral reef • Sea grass
Agricultural Biodiversity	• Plantations • Rice fields • Fruit orchards and vegetable farms • Livestock rearing and aquaculture farms

Source: Sixth National Report (of Malaysia) to the Convention on Biological Diversity

1.7 Water Resources

Malaysia relies on rainfall as its main water source that feeds its 2,986 river basins of which 189 are major ones and to recharge its groundwater reservoirs. The country receives about 973 billion cm^3 of water from rainfall annually according to the National Water Resources Study (2000-2050). From this, the total surface runoff is estimated to be 496 billion cm^3 per year. On a yearly basis, about 414 billion cm^3 return to the atmosphere through evapotranspiration process and 63 billion cm^3 as groundwater recharge.

Rainfall is unevenly distributed with some states receiving more rain than others. High intensity and prolonged periods of rainfall results in flooding in low-lying and coastal areas where rivers are short and catchment areas are small. Areas with smaller water catchments are likely to be more susceptible to water stress in the future.

The National Water Resources Policy launched in 2012 under the 10th Malaysia Plan outlined clear directions and strategies for water resources management, including collaborative governance to ensure water security and sustainability. The 11th Malaysia Plan continued the policy direction and emphasised that stronger protection and conservation of water resources needs to be carried out. Alternative water supply initiatives such as rainwater harvesting, tube wells and gravity feed systems are being implemented as supplementary sources to serve remote areas.

1.8 National Physical Planning

For the period until 2020, national physical development in Peninsular Malaysia is guided by three physical planning documents, the National Physical Plan-3 (NPP-3), the Second National Urbanisation Policy (NUP-2) and the National Rural Physical Plan 2030 (NRPP 2030). Due to constitutional arrangements, the states of Sabah and Sarawak have autonomy in the development control process and are governed by separate planning systems. Thus, NPP-3, NUP-2 and NRPP 2030 only applies to Peninsular Malaysia.

The NPP-3 is the highest-ranking planning document in the national development framework which translates strategic and sectoral policies into spatial and physical dimensions. Emphasis is placed on sustainability and resilience towards climate change in three strategic directions:

(a) Sustainable management of natural, food and heritage resources;
(b) Holistic land use planning; and
(c) Low carbon cities and sustainable infrastructure.

The three strategic directions are being implemented through 15 strategies and 44 actions. The 15 strategies are:

(a) improving preservation and conservation of national ecological assets;
(b) managing and controlling development in environmentally sensitive areas;
(c) enhancing security and sustainability of water resources;
(d) managing mineral resource exploration;
(e) promoting food security;
(f) strengthening protection and preservation of national archaeological and natural heritage sites;
(g) optimising land use and availability;
(h) managing natural disaster risk areas;
(i) managing development growth and sprawl;
(j) promoting integrated rural development;
(k) creating low carbon cities development;
(l) promoting use of sustainable energy sources;
(m) implementing integrated water cycle management;
(n) promoting green mobility; and
(o) strengthening integrated and sustainable solid waste management.

The NUP-2 provides guidance on sustainable urban planning and development with an emphasis for balanced development physically, environmentally, socially and economically. The NRPP 2030 is the first spatial rural development document that outlines policy statements, strategies and implementation measures towards materialising the rural development vision.

1.9 Population

1.9.1 Population and Population Density

The total population of Malaysia in 2019 was 32.5 million. Malaysia's population has been growing quite steadily in the past 15 years. The population density of the country registered an increase from 79 person per km^2 in 2005 to 99 person per km^2 in 2019. Table 1.4 provides a summary of Malaysia's population and population density since 2005.

Table 1.4: Population and Population Density

Year	Population (million)	Population Density (population/km^2)
2005	26.0	79
2015	31.2	94
2016	31.6	96
2017	32.0	97
2018	32.4	98
2019	32.5	99

Source: Department of Statistics Malaysia

1.9.2 Urbanisation

The national urbanisation rate grew from 51.4% in 1990 to 76.2% in 2019. Table 1.5 provides a summary of Malaysia's urbanisation rate by state.

Table 1.5: Urbanisation Rate by State

State	Urbanisation Rate (%)									
	1990	1995	2000	2005	2010	2015	2016	2017	2018	2019
Johor	50.1	56.2	64.8	68.4	71.8	75.6	77.1	77.7	78.3	78.9
Kedah	32.9	35.6	39.1	51.4	64.7	68.0	68.6	70.9	71.6	72.3
Kelantan	33.0	33.5	33.5	37.8	42.3	47.0	47.9	48.7	49.7	50.6
Melaka	38.8	51.0	67.5	77.3	86.4	91.9	92.7	93.4	94.0	94.6
Negeri Sembilan	42.9	47.9	54.9	60.4	66.4	72.0	73.0	73.3	73.6	74.4
Pahang	31.5	35.5	42.0	46.2	50.4	55.1	56.0	56.0	56.9	57.9
Perak	53.9	56.1	59.0	64.3	69.7	74.4	75.3	75.4	75.5	75.8
Perlis	26.5	29.7	34.0	42.3	51.1	59.9	61.5	61.7	63.0	64.3
Pulau Pinang	75.2	77.3	79.7	85.2	90.9	93.9	94.4	94.6	95.0	95.3
Sabah	33.5	38.8	48.1	51.2	54.3	57.9	58.2	58.8	59.5	60.3
Sarawak	37.9	42.4	48.1	51.0	53.8	57.1	57.8	57.8	58.5	59.2

State	Urbanisation Rate (%)									
	1990	1995	2000	2005	2010	2015	2016	2017	2018	2019
Selangor	75.9	82.1	87.7	89.7	91.3	93.0	93.3	93.3	93.3	93.4
Terengganu	44.1	46.3	49.4	54.0	59.1	63.4	64.3	65.0	65.7	66.4
Federal Territory of Kuala Lumpur	100	100	100	100	100	100	100	100	100	100
Federal Territory of Labuan	-	64.2	76.3	79.5	82.9	84.5	84.7	84.8	84.9	83.7
Federal Territory of Putrajaya	-	-	-	-	100	100	100	100	100	100
Malaysia	**51.4**	**56.0**	**62.0**	**66.5**	**71.0**	**74.3**	**74.8**	**75.2**	**75.6**	**76.2**

Source: Department of Statistics Malaysia

1.9.3 Age Distribution

In 2019, 23.5% of the population was under 15 years old, 69.8% were between the ages of 15 and 64, and a smaller percentage of 6.7% were over 65 years old. Table 1.6 highlights the changing composition of ages within the Malaysian population.

Table 1.6: Population by Age Group

Year	Less than 15 years (%)	15 to 64 years (%)	65 years and above (%)
2005	30.9	64.6	4.4
2015	24.9	69.2	5.9
2016	24.5	69.5	6.0
2017	24.1	69.6	6.3
2018	23.8	69.7	6.5
2019	23.5	69.8	6.7

Source: Department of Statistics Malaysia

1.9.4 Life Expectancy

The average life expectancy at birth has increased marginally from 73.6 years in 2005 to 74.8 years in 2019. Female life expectancy has increased to 77.4 years in 2019 from 76.0 years in 2005 while male life expectancy increased marginally from 71.4 years in 2005 to 72.5 years in 2019. Table 1.7 shows a summary of the change in life expectancy at birth.

Table 1.7: Summary of Average Life Expectancy at Birth

Year	Female	Male	Overall
2005	76.0	71.4	73.6
2015	77.1	72.5	74.6
2016	77.0	72.1	74.4
2017	77.1	72.1	74.4
2018	77.2	72.3	74.6
2019	77.4	72.5	74.8

Source: Department of Statistics Malaysia

The health and wellbeing of the people are an essential part of an improved standard of living that Malaysia strives to achieve. In the mid-term review of the 11th Malaysia Plan (2016-2020), the Malaysian government set the goal of creating a sustainable healthcare system and the first step it took in that direction was with the introduction of the Malaysia National Health Policy (MNHP). This policy focuses on population health as well as the sustainability of the healthcare system.

The Ministry of Health (MOH) is the main provider of healthcare services. An extensive network of primary healthcare services is delivered by Government health facilities together with private medical and dental clinics. This network is supported by secondary and tertiary services provided by both the Government and private sector. Table 1.8 presents a summary of the health care facilities in the country for 2011, 2015, 2017 and 2019.

Table 1.8: Summary of Healthcare Facilities

Year	2011		2015		2017		2019	
	Number	Beds (Official)	Number	Beds (Official)	Number	Beds (Official)	Number	Beds (Official)
Primary Health Care Facilities – Ministry of Health								
Health Clinics [a]	985	-	1,061	-	1,085	-	1,114	-
Rural Clinics	1,864	-	1,808	-	1,796	-	1,771	-
Mobile Health Clinics (Teams)	184	-	203	-	217	-	230	-
Flying Doctor Services	5 [b]	12 [c]	6 [b]	12 [c]	6 [b]	12 [c]	5 [b]	11 [c]
Standalone Dental Clinics	51	459 [d]	56	493 [d]	54	492 [d]	61	542 [d]
Dental Clinics in Health Clinics [e]	-	-	583	1,446 [d]	586	1,442 [d]	577	1,581 [d]
Dental Clinics in Hospitals	-	-	66	353 [d]	69	407 [d]	74	481 [d]

Year	2011		2015		2017		2019	
	Number	Beds (Official)	Number	Beds (Official)	Number	Beds (Official)	Number	Beds (Official)
Dental Clinics in Other Institutes	-	-	16	17 [d]	20	17 [d]	21	21 [d]
School Dental Clinics	-	-	925	843 [d]	923	832 [d]	920	810 [d]
Mobile Dental Clinics	27	27 [d]	28	44 [d]	35	53 [d]	34	56 [d]
Sub-total	3,116	498	3,162	549	3,193	557	3,215	609
Registered Private Entities								
Private Medical Clinics	6,589	-	7,146	-	7,571	-	7,988	-
Private Dental Clinics	1,576	-	1,867	-	2,137	-	2,507	-
Sub-total	8,165	-	9,013	-	9,708	-	10,495	-
Secondary and Tertiary Services – Ministry of Health								
Hospitals	132	33,812	134	36,447	135	37,470	135	38,131
Special Medical Institutions	6	4,582	9	4,942	9	4,832	9	4,805
Sub-total	138	38394	143	41389	144	42302	144	42,936
Non-Ministry of Health								
Hospitals	8	3,322	9	3,698	10	3,892	10	4,052
Licensed Private Facilities								
Hospitals	220	13,568	183	12,963	240	15,566	208	16,469
Maternity Homes	25	105	14	50			18	52
Nursing Homes	14	362	16	539			21	775
Hospice	4	38	3	22			3	29
Sub-total	263	14,073	216	13,574	240	15,566	250	17,505
Grand Total	11,805	56,297	12,886	59,228	13,648	61,790	14,109	64,504

Note:
[a] Health clinics include Maternal and Child Health Clinics
[b] Number of helicopters
[c] Number of teams of Air Land Force
[d] Number of dental chairs
[e] Includes dental clinics in Maternal and Child Health Clinics
Source: Health Facts 2012, 2016, 2018, 2020, Ministry of Health

1.10 Economy

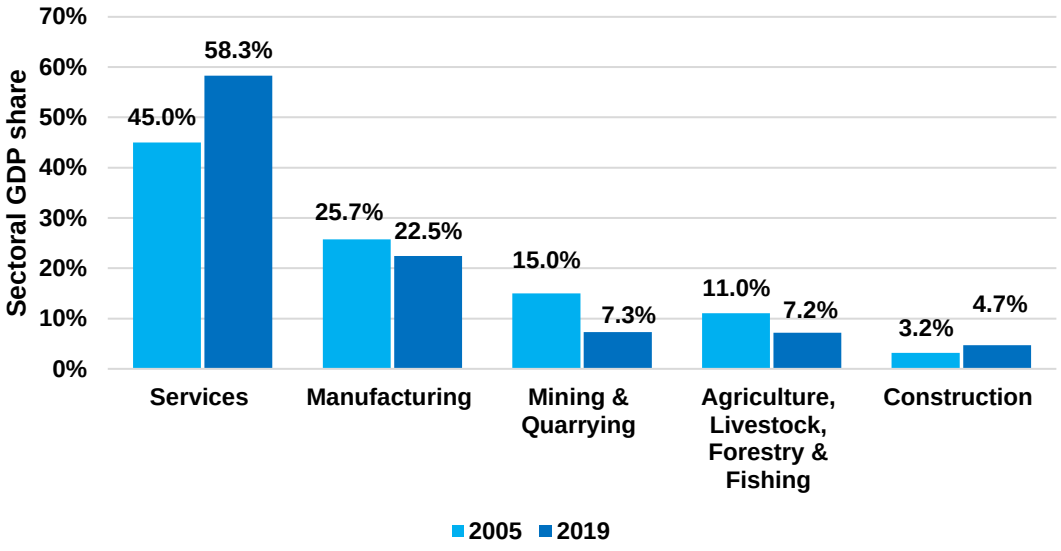
1.10.1 Gross Domestic Product and Gross National Income

Table 1.9 shows a summary of the GDP and GNI of Malaysia while Figure 1.6 shows the sectoral contributions to GDP in 2005 and 2019.

Table 1.9: GDP and GNI at Current and Constant Prices

Year	Gross Domestic Product (GDP)		Gross National Income (GNI)		GDP per capita	GNI per capita
	RM Billion				RM	
	Current Prices	Constant Prices (2015 = 100)	Current Prices	Constant Prices (2015 = 100)	Constant Prices (2015 = 100)	Constant Prices (2015 = 100)
2005	543.578	729.851*	519.635	735.823*	28,022*	28,251*
2015	1,176.941	1,176.941	1,144.829	1,155.866	37,739	37,063
2016	1,249.698	1,229.312	1,215.105	1,211.301	38,861	38,292
2017	1,372.310	1,300.769	1,333.652	1,281.719	40,620	40,025
2018	1,447.760	1,363.766	1,402.677	1,335.058	42,115	41,228
2019	1,512.738	1,424.310	1,473.242	1,402.096	43,783	43,111

Sources: Department of Statistics Malaysia, *calculated by KASA



Note:
Contribution before adding import duties; GDP is at Constant Prices 2015
Source: Economics Planning Unit, Prime Minister's Department

Figure 1.6: Sectoral contribution share to GDP for 2005 and 2019

1.10.2 International Trade

Trade is an essential part of the Malaysian economy with Malaysia practising an open trade regime. In 2019, the Malaysian economy had a net balance of trade of RM145 billion, with exports totalling to RM995 billion and imports of RM849 billion. Table 1.10 shows Malaysia's annual trade for the selected years.

Table 1.10: Summary of Malaysia's Annual Trade

Year	(RM Million)			
	Gross Exports	Gross Imports	Total Trade	Balance of Trade
2005	536,234	432,871	969,104	103,363
2015	777,355	685,778	1,463,134	91,577
2016	786,964	698,819	1,485,783	88,145
2017	934,927	836,422	1,771,349	98,505
2018	1,003,587	879,804	1,883,391	123,783
2019	995,072	849,411	1,884,483	145,661

Source: Economic Planning Unit, Prime Minister's Department

In 2019, manufactured goods formed the backbone of the export economy at 84.5% with electrical and electronic products accounting for 37.5% of the total export share. Primary industries goods made up 14.8% of export consisting mainly of palm oil and palm oil-based agriculture products (4.4%), liquified natural gas (4.3%) and crude petroleum (2.6%). Import-wise, intermediate goods made up 55%, followed by capital goods at 11.8% and consumption goods at 8.7%.

1.10.3 Unemployment

The unemployment rate decreased marginally from 3.5% in 2005 to 3.3% in 2019. Table 1.11 shows the changes in unemployment rate from 2005.

Table 1.11: Unemployment Rate

Year	Unemployment Rate (%)
2005	3.5
2015	3.1
2016	3.4
2017	3.4
2018	3.3
2019	3.3

Source: Department of Statistics Malaysia

1.11 Energy

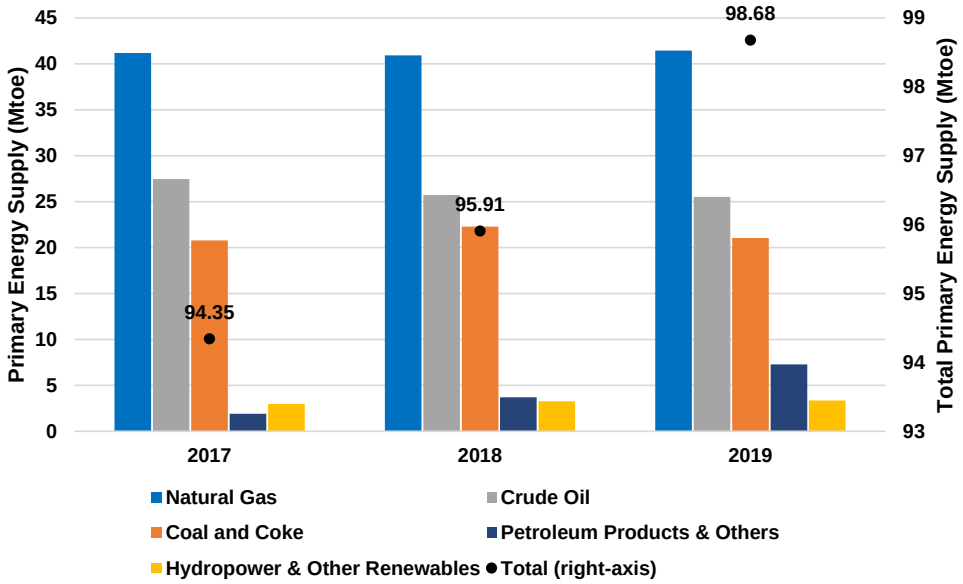
1.11.1 Policies

The energy sector is anticipated to strengthen access to affordable, reliable and sustainable energy, in line with Sustainable Development Goal 7 of the 2030 Agenda for Sustainable Development. The National Energy Policy 2022 – 2040, introduced in September 2022 underscores the commitment towards energy transformation with a focus to shift from fossil-based systems of production and consumption to renewable

energy. The policy aligns the energy sector to the country's long-term plan of Shared Prosperity Vision 2030 and its five Key Economic Growth Activities which are directly related to the energy sector (such as sustainable mobility, renewable energy and green economy). The policy aims to spur new energy-related sectors which will also support the goal of reducing dependence on petroleum-based revenue and commodity trade, enhancing the resilience of the country's fiscal and economic position in the process. The policy also sets the directive towards Low Carbon Nation Aspiration 2040 from the improvement of primary energy mix intensity through increased penetration of clean and renewable sources of energy. This is in line with the Government's target to reach 31% of RE installed capacity mix by 2025.

1.11.2 Energy Balance

Figure 1.7 shows a summary of Malaysia's primary energy supply in 2019 and Table 1.12 shows the breakdown in selected years from 2005 to 2019.



Source: National Energy Balance 2019, Energy Commission

Figure 1.7: Primary Energy Supply Breakdown for 2017, 2018 and 2019

Table 1.12: Primary Energy Supply Breakdown in selected years

Year	Primary Energy Supply Breakdown (ktoe)				
	Natural Gas	Crude Oil and Petroleum Products	Coal and Coke	Renewable Energy	Total
2005	33,913	24,096	6,889	446	65,344
2015	41,853	29,165	17,406	2,017	90,441
2016	41,257	31,327	18,744	2,420	93,748
2017	41,200	29,380	20,771	2,994	94,345
2018	40,939	29,429	22,280	3,261	95,909
2019	41,461	32,813	21,057	3,349	98,680

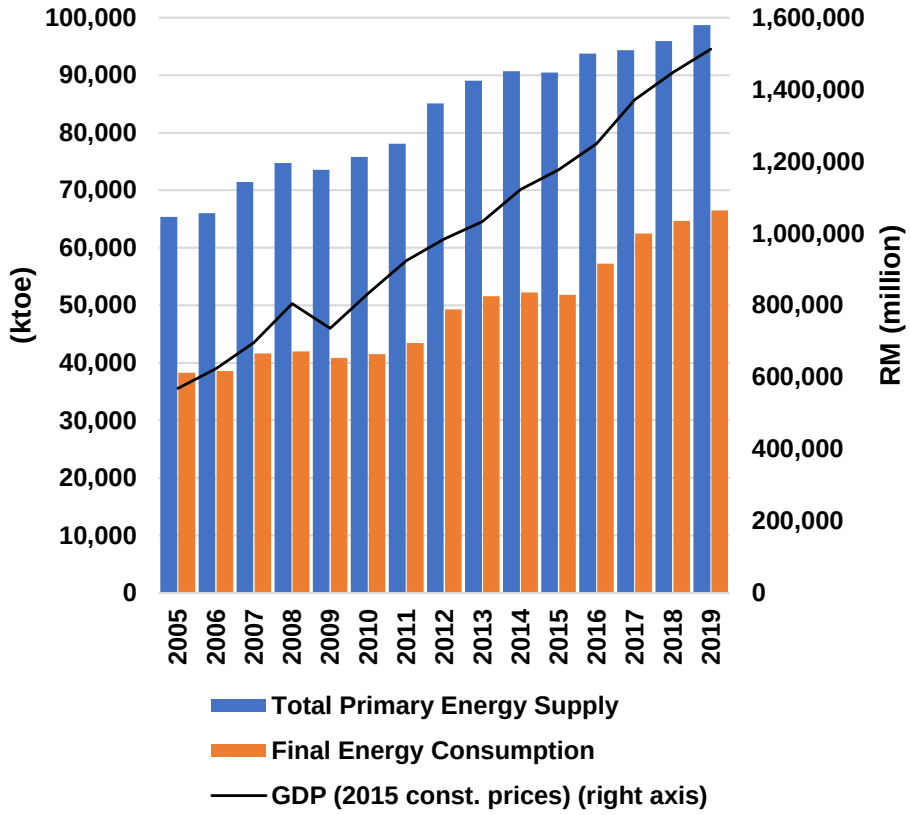
Source: National Energy Balance 2019

Malaysia's final energy consumption according to sectors is shown in Table 1.13 while the trends in GDP, primary energy supply and final energy consumption is shown in Figure 1.8. In terms of GDP per capita and final energy consumption per capita, the trends are shown in Figure 1.9.

Table 1.13: Final energy consumption by sector

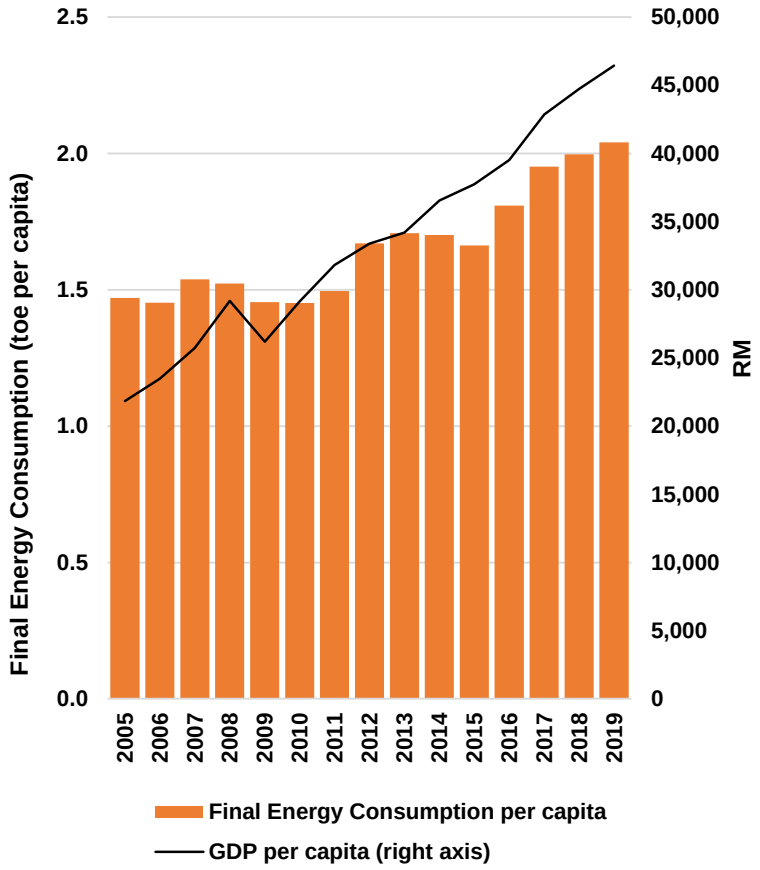
Year	Final Energy Consumption (ktoe)					
	Transport	Industry	Residential and Commercial	Non-energy use	Agriculture	Total
2005	15,293	15,583	5,134	2,173	101	38,284
2015	23,435	13,971	7,600	5,928	895	51,829
2016	24,004	16,019	8,051	8,729	415	57,218
2017	24,039	17,463	7,796	12,517	674	62,489
2018	23,555	19,046	7,773	13,262	1,021	64,657
2019	25,004	18,921	8,000	13,631	927	66,483

Note: Transport sector final energy use included international civil aviation fuel.
Source: National Energy Balance 2019



Sources: National Energy Balance 2019 Energy Commission and Economic Planning Unit Prime Minister's Department

Figure 1.8: Trends in GDP, Primary Energy Supply and Final Energy Consumption



Sources: National Energy Balance 2019, Energy Commission and Department of Statistics

Figure 1.9: Trends in Final Energy Consumption per capita and GDP per capita

1.11.3 Renewable Energy

BUR3 has provided detailed information on its policy and implementation. The update of the FiT programme is highlighted in Table 1.14 and Table 1.15.

Table 1.14: Cumulative Installed Capacities of Grid-connected FiT Renewable Energy Projects

Year	Capacity (MW)				
	Biogas	Biomass	Small Hydro	Solar PV	Total
2015	20.23	76.70	18.30	263.87	379.10
2016	35.69	87.90	30.30	341.69	495.58
2017	61.79	95.55	30.30	378.41	566.05
2018	69.94	70.65	50.30	384.62	575.51
2019	102.76	70.65	70.30	386.93	630.64

Source: SEDA Annual Report 2020

Table 1.15: Annual Power Generation of Commissioned FiT Renewable Energy Installations

Year	Power Generated (GWh)				
	Biogas	Biomass	Small Hydro	Solar PV	Total
2015	63.34	246.73	56.66	277.50	644.23
2016	107.11	248.48	50.28	359.54	765.41
2017	216.33	247.21	75.55	424.16	963.25
2018	251.78	226.09	89.67	467.89	1,035.43
2019	314.29	225.22	220.60	471.90	1,232.01

Source: SEDA Annual Report 2020

1.12 Transport

The Land Public Transport Agency (APAD) replaced the Land Public Transport Commission (SPAD) in June 2018, taking over its function of developing Malaysia's land public transport system including the mass rail transit (MRT), light rail transit (LRT), rail transportation and bus systems. The Agency is tasked with 'spearheading the transformation of an integrated, efficient and safe transportation system'. A National Transport Policy (2019-2030) was launched to increase the public transport modal share (40% by 2030) in urban areas while also implementing sustainable measures across all transport modes.

1.12.1 Roads

The length of roads has increased substantially from 90,016 km in 2005 to 258,511 km in 2019.This is primarily due to extensive expansion of state roads in the past decade leading to greater intra-state and interstate accessibility. Table 1.16 highlights the historical changes in lengths of roads.

Table 1.16: Length of Roads

Year	Length of roads (km)			
	State Roads	Federal Roads	Toll Highways	Total
2005	70,749	17,764	1,503	90,016
2015	197,015	19,822	1,984	218,821
2016	218,988	19,802	1,988	240,778
2017	217,072	19,950	2,001	239,023
2018	227,646	19,809	1,960	249,415
2019	236,581	19,912	2,018	258,511

Source: Public Works Department, Ministry of Works and Malaysia Highway Authority

1.12.2 Motor-vehicle

Motor-vehicle registration has more than doubled from 2005 to 2019. Total registrations in 2019 were 31,214,772 compared to 14,816,407 in 2005. Table 1.17 shows the increase in motor-vehicle registration on a yearly basis.

Table 1.17: Motor-Vehicle Registration

Year	Motorcars	Motorcycles	Taxi & Hired Cars	Buses	Goods Vehicles	Others*	Total
2005	6,473,261	7,008,051	79,130	57,370	805,157	393,438	14,816,407
2015	11,871,696	12,094,790	172,034	66,999	1,197,987	898,446	26,301,952
2016	13,000,358	12,677,220	124,020	59,969	1,190,664	561,028	27,613,259
2017	13,582,636	13,173,069	122,172	61,059	1,223,396	575,844	28,738,176
2018	14,191,338	13,725,946	123,395	62,003	1,261,598	592,194	29,956,474
2019	14,695,664	14,322,226	120,134	62,966	1,295,486	718,296	31,214,772

Note:
*Including Government motorcars, trailers, and driving school vehicles
Source: Ministry of Transport and Land Public Transport Agency

1.12.3 Urban Rail Transit

The rail network is crucial to the Malaysia's transport system as it enables greater domestic mobility. By the end of 2016, there were five urban rail network lines serving the Greater Kuala Lumpur namely KTM Komuter, LRT Ampang Line, LRT Kelana Jaya Line, KL Monorail and the MRT. The total ridership of rail transit and commuter trains is shown in Table 1.18.

The KTM Komuter service was first introduced in 1995 and was intended to serve interstate and within Greater Kuala Lumpur's radial corridors. Both the LRT Ampang Line (27 km) and the LRT Kelana Jaya Line (29 km) commenced operations in the city on 16 December 1996 and on 1 September 1998 respectively. The 8.6 km KL Monorail was built over an elevated track and commenced operations on 31 August 2003. In 2002, the KLIA Ekspres and the KLIA Transit were launched. The KLIA Ekspres is a high-speed, non-stop rail connection between KLIA, KLIA2 and the KL Sentral, providing a mass rail transportation option in support of the civil aviation industry. On the other hand, the KLIA Transit is a commuter service that stops at three intermediate stations. To accommodate the highly populated areas, both LRT lines – Ampang and Kelana Jaya – were extended to 45 km in total length for LRT Ampang and 46 km for LRT Kelana Jaya. The extended length went into operation on 30 June 2016.

The first MRT line – the 46 km Kajang Line - commenced service in July 2017. Phase One of the 57.7 km second line (Putrajaya Line) began operation on 16 June 2022. Phase Two of the Putrajaya Line is due for completion in the first quarter of 2023.

Table 1.18: Total Ridership of Rail Transit and Commuter Trains

	2005	2015	2016	2017	2018	2019
LRT Kelana Jaya Line	60,290,467	82,144,674	79,002,839	83,585,412	87,216,597	94,657,974
LRT Ampang Line	45,636,997	62,809,412	59,192,907	59,462,032	60,960,445	65,147,222
KL Monorail	16,206,441	25,067,866	21,990,242	16,841,630	12,594,377	12,535,738
KTM-Komuter	30,934,651	49,690,000	41,407,104	37,235,410	32,036,271	30,327,420
ERL KLIA Express*	2,075,105	3,470,710	2,419,883	2,275,650	2,195,353	2,155,855
ERL KLIA Transit	2,331,741	6,496,617	6,485,272	6,443,667	6,541,505	6,788,121
MRT**	N.A.	N.A.	N.A.	22,350,508	51,314,240	63,952,805

Note:
* Started operation in 2002.
**Started operation in December 2016.
Source: Ministry of Transport and Public Land Transport Agency

1.12.4 Inter-city Railway Statistics

Malaysia has expanded its total railway route length from 1,665 km to 1,799 km during the period of 2005 to 2019. At the same time, it has also increased the length of electrified railway tracks. The Electric Train Service (ETS) provides intercity train service. These infrastructures are in Peninsular Malaysia while a single track of 134 km operates in the state of Sabah in Borneo. There are no railway services in the state of Sarawak. Table 1.19 summarises the railway statistics for Peninsular Malaysia up to 2019.

Table 1.19: Railway statistics for Peninsular Malaysia

	Unit	2005	2015	2016	2017	2018	2019
Total Railway Route Length	km	1,665	1,641	1,705	1,833	1,799	1,799
Electrified Track Railway Route Length	km	151	774	955	1,014	1,014	1,014
Total Number of Rail Passenger*	million	3.68	2.01	2.79	3.09	3.53	3.75
Rail-passenger kilometre	million	1,181	407	272	180	178	183
ETS** passenger	million	N.A	2.06	3.57	4.15	3.93	3.90
ETS** passenger kilometre	million	N.A	441	996	1,189	1,127	1,112
Freight	million tonne	4.03	6.21	5.99	5.62	5.94	5.97
Freight-kilometre	million tonne km	1,178	1,474	1,349	1,234	1,314	1,141

Note:
*KTM intercity ridership only
** connotes that this commuter service started operations in August 2010
Source: Ministry of Transport and Land Public Transport Agency

1.12.5 Stage Bus Services

Table 1.20 provides information on the ridership of stage buses in selected capital cities. Annual ridership of stage buses has been declining since 2017 in most cities except Georgetown and Kota Bahru.

Table 1.20: Stage Bus Annual Ridership in Selected Capital Cities

Cities	2015	2016	2017	2018**	2019
Kangar	212	285	404	361	350
Alor Setar	1,469	1,198	999	682	488
Georgetown	18,947	13,075	12,363	15,604	16,165
Ipoh	5,657	4,733	4,189	3,224	3,500
Shah Alam	12,238	N/A	N/A	N/A	N/A
Seremban	3,886	4,008	4,265	3,274	2,979
Melaka	4,887	4,455	3,319	2,078	1,402
Johor Bahru	21,000	18,051	15,418	1,248	1,222
Kuantan	4,486	4,298	3,799	3,403	2,932
Kuala Terengganu	187	312	183	281	273
Kota Bharu	3,047	2,281	1,976	1,739	1,921
Total Annual Ridership	76,016	52,696*	46,915*	31,894*	31,232*

Note:
* connotes exclusion of ridership figures for Shah Alam in 2016, 2017, 2018 and 2019
**Some ridership figures for non-SBST programme reported for Jan-Nov 2018
Sources: Ministry of Transport and Public Land Transport Agency

1.12.6 Air Traffic Statistics

Between 2005 and 2019, there has been a general increase of air traffic passengers for both domestic and international air travel. The total number of domestic embarked and disembarked passengers increased from 22.4 million in 2005 to 55.5 million in 2019. The number of international embarked and disembarked international passengers increased from 16.6 million to 53.8 million for the same period. Table 1.21 summarises the trend in air travel.

Table 1.21: Yearly Total Number of Domestic and International Passengers Handled by Airports

Year	Domestic			International		
	Embarked	Dis-embarked	Total	Embarked	Dis-embarked	Total
2005	10,456,749	11,954,473	22,411,222	8,267,880	8,298,555	16,566,435
2015	22,975,852	22,955,192	45,931,044	20,177,309	19,839,826	40,017,135
2016	13,995,425	23,970,410	37,965,835	22,026,087	21,464,612	43,490,699
2017	24,878,045	24,861,535	49,739,580	25,196,175	24,588,035	49,784,210
2018	25,080,393	25,105,859	50,186,252	26,371,319	25, 875,483	52,246,802
2019	27,730,091	27,792,327	55,522,418	27,358,552	26,482,106	53,840,658

Note: *connotes that information is from Malaysia Airports Holdings Berhad
Sources: Ministry of Transport, Malaysia Airports Holdings Berhad

Between 2005 and 2019, domestic cargo handled has increased from 119,685 tonnes to 189,400 tonnes while international cargo handled has shrunk from 775,313 tonnes to 753,227 tonnes. Table 1.22 reflects the changes.

Table 1.22: Yearly Total Domestic and International Cargo Handled by Airports

Year	Domestic (tonnes)			International (tonnes)		
	Loaded	Unloaded	Total	Loaded	Unloaded	Total
2005	61,705	57,979	119,685	421,790	353,523	775,313
2015	99,674	92,876	192,550	373,795	392,698	766,493
2016	95,968	92,981	188,949	331,350	353,134	684,485
2017	97,945	91,346	189,291	367,061	391,839	758,900
2018	104,624	92,741	197,365	361,090	407,345	768,435
2019	99,702	89,698	189,400	347,667	405,559	753,226

Sources: Ministry of Transport, Malaysia Airports Holdings Berhad

1.13 Agriculture

In 2011, policies on food production and agro-commodities were separated and developed under two distinct policy documents, namely the National Agrofood Policy (2011-2020) and the National Commodity Policy (2011-2020). Sustainable development is a key principle in both policies besides strengthening the two subsectors' contributions to food security and socio-economic development.

1.13.1 Agricultural Crops

The agriculture area consists of primarily commodity crops such as oil palm, rubber and cocoa. Paddy is also an important agricultural crop and the planted areas involved double cropping. Table 1.23 reflects the planted areas of major agricultural crops in selected years between 2005 and 2019.

Table 1.23: Planted Areas of Major Agricultural Crops

Year	Crops ('000 ha)			
	Rubber	Oil Palm	Cocoa	Paddy
2005	1,271.3	4,051.4	34.0	666.8
2015	1,074.5	5,642.9	18.1	681.6
2016	1,078.0	5,738.0	17.4	688.8
2017	1,081.7	5,811.1	17.5	685.5
2018	1,127.0	5,849.3	15.6	699.9
2019	1,131.9	5,900.1	5.9	672.1

Sources: Ministry of Agriculture and Food Industries; Ministry of Plantation Industries and Commodities

1.13.2 Livestock

Livestock population size fluctuation across all animal types has largely remain stable between 2015 and 2019. Table 1.24 shows the livestock population from 2005 to 2019.

Table 1.24: Selected livestock populations

Year	Livestock							
	Buffalo	Cattle	Goat	Sheep	Swine	Horse*	Chicken	Duck
2005	133,232	790,065	287,670	115,922	2,035,647	2,367	174,694,165	8,052,997
2015	118,569	742,338	431,651	147,033	1,886,823	3,608	286,620,834	9,897,115
2016	119,133	737,827	416,529	138,479	1,654,381	4,145	289,666,002	9,633,185
2017	114,013	703,832	385,304	130,658	1,849,351	4,306	293,301,558	9,283,900
2018	106,988	676,686	359,200	128,298	1,967,538	4,204	260,826,321	9,780,573
2019	101,695	657,407	312,571	121,677	1,888,460	3,095	285,063,636	9,376,456

Sources: Agrofood Statistics 2020, Ministry of Agriculture and Food Industries; Department of Veterinary Services (DVS) Livestock Statistics, (*) FAOSTAT

1.13.3 Fisheries and Aquaculture

Landings of marine fish in Malaysia has had a slight increase from 1.21 million tonnes in 2005 to 1.45 million tonnes in 2019. Table 1.25 below summarises the change in landings of marine fish.

Table 1.25: Landings of Marine Fish

Year	Landings of Marine Fish ('000 tonnes)
2005*	1,210
2015	1,486
2016	1,574
2017	1,465
2018	1,453
2019	1,455

Sources: Agrofood Statistics 2020, Ministry of Agriculture and Food Industries and *Annual Fisheries Statistics, Department of Fisheries

Aquaculture production in Malaysia increased from 207,000 tonnes in 2005 to 412,000 tonnes in 2019. Fresh water aquaculture activities carried out in ponds, ex-mining pools, cages, cement tanks as well as pen cultures contributed 105,000 tonnes, while brackish water/marine aquaculture cultivated in ponds, cages and water tanks contributed 307,000 tonnes. Table 1.26 shows the growth of aquaculture according to the two production systems.

Table 1.26: Aquaculture production – Brackish and Coastal Areas

Year	Freshwater ('000 tonnes)	Brackish Water/Marine ('000 tonnes)	Total ('000 tonnes)
2005*	62	145	207
2015	112	394	506
2016	103	304	407
2017	103	324	427
2017	101	290	391
2019	105	307	412

Sources: Agrofood Statistics 2020, Ministry of Agriculture and Food Industries and *Annual Fisheries Statistics, Department of Fisheries

1.14 Solid Waste

Waste generation increases in tandem with population growth. Table 1.27 provides a breakdown of average daily waste generation by region while Table 1.28 presents the number of both sanitary and non-sanitary landfills according to states in 2019.

Table 1.27: Average Waste Generations Per Day in 2007 and 2012

Region	Year	
	2007	2012
Peninsular Malaysia (tonnes/day)	20,500	27,802
Sabah (tonnes/day)	1,210	2,984
Sarawak (tonnes/day)	1,988	2,344
Total (tonnes/day)	23,698	33,130

Source: Survey on Solid Waste Composition, Characteristics and Existing Practice of Solid Waste Recycling in Malaysia 2012, National Solid Waste Management Department

Table 1.28: Number of Landfills in Malaysia in 2019

State	Landfills in operation		Total
	Sanitary	Non-Sanitary	
Johor	1	8	9
Kedah	2	2	4
Kelantan	0	10	10
Melaka	1	0	1
Negeri Sembilan	1	2	3
Pahang	2	8	10
Perak	1	15	16
Perlis	1	0	1
Pulau Pinang	1	0	2*

State	Landfills in operation		Total
	Sanitary	Non-Sanitary	
Sabah	1	21	22
Sarawak	3	43	46
Selangor	3	2	8*
Terengganu	1	8	9
WP Labuan	1	0	1
WP KL/Putrajaya	0	0	0
Total	19	119	142*

Note: *Including inert landfill site(s); 1 in Pulau Pinang, 3 in Selangor
Source: National Solid Waste Management Department

The solid waste composition of Malaysia for the years 2004 and 2012 (latest date of last survey of the Solid Waste sector) is shown in Table 1.29.

Table 1.29: Solid Waste Composition

Composition	Percentage (%)	
	2004 (JICA Study)	2012
Food waste	49.3	44.5
Garden Waste	6.6	5.8
Paper	17.1	8.5
Wood	0.2	1.4
Textiles	3.7	5.2
Diapers	5.1	12.1
Plastic and Other Inerts	18.1	22.2

Note: JICA – Japan International Cooperation Agency
Source: Survey on Solid Waste Composition, Characteristics and Existing Practice of Solid Waste Recycling in Malaysia 2012, National Solid Waste Management Department

1.15 Institutional Arrangements

The institutional arrangements support three key areas of climate change action: policy making, development planning and implementation, and guidance and reporting.

1.15.1 Policy Making

The Malaysia Climate Change Action Council (MyCAC) was established to address the policy direction of climate change in December 2020. It is chaired by the Prime Minister and has key Cabinet Ministers and state leaders as members.

The Cabinet is the highest policy decision-making body in the country on climate change matters under the purview of the Minister of Environment and Water. Any decisions taken at the MyCAC and other bodies require a final endorsement by the Cabinet.

1.15.2 Development Planning and Implementation

Development planning and implementation is coordinated by the Economic Planning Unit (EPU) under the Prime Minister's Department in consultation with other Ministries. These are carried out through the five-year development plans and include climate change mitigation and adaptation programmes. Table 1.30 shows the coordinating Ministries and their respective implementing agencies for key sectors.

Table 1.30: Coordinating Ministries and Their Respective Agencies Responsible for Climate Actions

Area	Sector/Area	Coordinating Ministries	Associated Implementing Ministries/State Ministries/Agencies
Greenhouse Gas Inventory	All IPCC Sectors	Ministry of Environment and Water	Ministry of Energy and Natural Resources (Energy and LULUCF sectors) Ministry of Plantation Industries and Commodities (Agriculture, LULUCF and waste sectors) Ministry of Agriculture and Food Industries (Agriculture sector) Energy Commission (Energy sector) Forest Research Institute Malaysia (LULUCF sector) Department of Environment (Waste sector) Malaysia Agriculture Research and Development Institute (Agriculture sector) Department of Statistics Malaysia Institute of Energy Policy and Research, Universiti Tenaga Nasional (Energy and Industrial Processes and Product Use sectors)
Mitigation	Energy	Economic Planning Unit and Ministry of Energy and Natural Resources	Energy Commission Sustainable Energy Development Authority Sabah State Economic Planning Unit Ministry of Energy and Environmental Sustainability Sarawak Sabah Electricity Sendirian Berhad Sarawak Energy Berhad PETRONAS

Area	Sector/Area	Coordinating Ministries	Associated Implementing Ministries/State Ministries/Agencies
	Transport	Ministry of Transport	Land Public Transport Agency Marine Department Malaysia Civil Aviation Authority of Malaysia Ministry of Plantation Industries and Commodities
	Industries	Ministry of International Trade and Industry	Malaysia Investment Development Authority SME Corporation Malaysia Malaysia Automotive Institute Ministry of Domestic Trade and Consumer Affairs Sabah State Economic Planning Unit Economic Planning Unit Sarawak
	Agriculture	Ministry of Agriculture and Food Industries Ministry of Plantation Industries and Commodities	Department of Agriculture (Peninsular Malaysia, Sabah and Sarawak) Department of Veterinary Services (Peninsular Malaysia, Sabah and Sarawak) Malaysian Agriculture Research and Development Institute Malaysian Palm Oil Board Malaysian Rubber Board Malaysian Cocoa Board
	Forestry	Ministry of Energy and Natural Resources	Forestry Department Peninsular Malaysia Sarawak Forest Department Sabah Forestry Department Department of Wildlife and National Parks Peninsular Malaysia Sabah Parks Sabah Wildlife Department Sarawak Forestry Corporation
	Waste	Ministry of Housing and Local Government Ministry of Environment and Water	National Solid Waste Management Department Solid Waste Management and Public Cleansing Management Corporation Sewerage Service Department Department of Environment Malaysian Palm Oil Board

Area	Sector/Area	Coordinating Ministries	Associated Implementing Ministries/State Ministries/Agencies
			Ministry of Local Government and Housing Sabah Ministry of Public Health, Housing and Local Government Sarawak State governments (Selangor, Pulau Pinang, Perak, Kelantan and Terengganu)
Adaptation	Water Resources	Ministry of Environment and Water Ministry of Energy and Natural Resources	Department of Irrigation and Drainage National Water Services Commission National Hydraulic Research Institute of Malaysia Department of Mineral and Geoscience Ministry of Utility and Telecommunication Sarawak Sabah State Water Department
	Coastal Resources	Ministry of Environment and Water Ministry or Energy and Natural Resources	Department of Irrigation and Drainage National Hydraulic Research Institute of Malaysia
	Agriculture	Ministry of Agriculture and Food Industries Ministry of Plantation Industries and Commodities	Department of Agriculture (Peninsular Malaysia, Sabah and Sarawak) Department of Veterinary Services (Peninsular Malaysia, Sabah and Sarawak) Department of Fisheries (Peninsular Malaysia and Sabah) Department of Marine Fisheries Sarawak Malaysian Agriculture Research and Development Institute Malaysian Palm Oil Board Malaysian Rubber Board Malaysian Cocoa Board
	Forestry and Biodiversity	Ministry of Environment and Water	Forestry Department Peninsular Malaysia Department of Fisheries Malaysia Department of Wildlife and National Parks Peninsular Malaysia

Area	Sector/Area	Coordinating Ministries	Associated Implementing Ministries/State Ministries/Agencies
			Sabah Forestry Department Sabah Wildlife Department Sabah Parks Sarawak Forest Department Sarawak Forestry Corporation Ministry of Agriculture and Food Industries (Division of Marine Parks)
	Infrastructure and Housing	Ministry of Works Ministry of Housing and Local Government Ministry of Environment and Water	Public Works Department Local Government Department National Housing Department Federal Department of Town and Country Planning Sewerage Service Department Ministry of Local Government and Housing Sabah Ministry of Public Health, Housing and Local Government Sarawak
	Energy	Economic Planning Unit and Ministry of Energy and Natural Resources	Energy Commission Sustainable Energy Development Authority PETRONAS
	Health	Ministry of Health	Institute for Medical Research Disease Control Division

Note: A new Federal Government was formed in November 2022 which involved the restructuring of several Ministries. The changes will be reflected in the subsequent report.

1.16 Guidance and Reporting

1.16.1 The National Steering Committee on Climate Change (NSCCC)

Operational matters on climate change are guided and endorsed by the National Steering Committee on Climate Change (NSCCC) chaired by the Secretary General of the Ministry of Environment and Water. The coordination for the preparation of national communications (NCs) and biennial update reports (BURs) is under the Technical Committee on Climate Change (TCCC) which reports to the NSCCC.

The secretariat to these committees is the Climate Change Division of Ministry of Environment and Water which is also the national focal point for climate change to the UNFCCC. The technical work of the NCs and BURs is carried out through six Technical Working Groups (TWGs) established under the TCCC. Figure 1.10 shows the institutional arrangement and thematic groupings to address climate change and NC/BUR reporting.

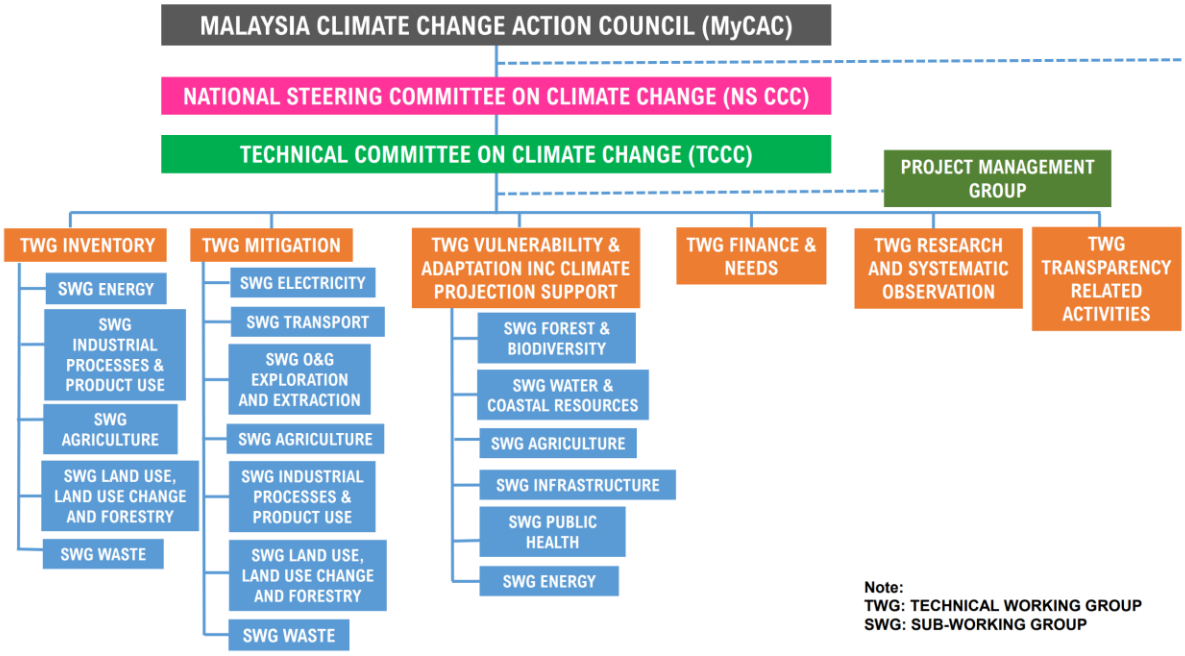


Figure 1.10: Institutional Arrangement and Thematic Working Groups for Climate Change

1.16.2 The National Steering Committee and Technical Working Committee for REDD Plus

At the national level, the National Steering Committee on REDD Plus (NSCREDD) was established in 2011 to formulate the directions and strategies for REDD plus implementation. The NSCREDD is chaired by the Secretary General of the Ministry of Energy and Natural Resources with membership from State Economic Planning Units, Forestry Departments and relevant Ministries. NSCREDD is supported by the Technical Working Committee on REDD Plus. The roles of this Technical Working Committee include providing methodological guidance on REDD plus implementation and formulating national action plans.

1.16.3 The National Committee on Clean Development Mechanism

The National Clean Development Mechanism (CDM) Committee was established in 1994 to guide CDM implementation. It is chaired by the Deputy Secretary-General of the Ministry of Environment and Water with the Secretary General being the Designated National Authority.

1.17 Summary of Key Statistics

Table 1.31 provides a summary of key statistics for 2005 and 2019.

Table 1.31: Key Statistics for 2005 and 2019

Year	2005	2019
Latitude	0° 51' N - 7° 33' N	
Longitude	98° 01' E – 119° 30' E	
Area	330,241 km^2	
Coastline	8,840 km	
Mean daily temperature	26 – 28 °C	
Average annual rainfall	2,000 – 4,000 mm	
Average daily direct sunlight	6 hours	
Forest Cover as % of total land area	53.9% (estimate)	54.9% (estimate)
Population	26.0 million	32.5 million
Population density	79 per km^2	99 per km^2
Female life expectancy	76.0 years	77.4 years
Male life expectancy	71.4 years	72.5 years
Age Profile	Below 15 years old – 30.9% 15 to 64 years old – 64.6% Above 65 years old – 4.5%	Below 15 years old – 23.5% 15 to 64 years old – 69.8% Above 65 years old – 6.7%
Urbanisation Rate	66.5%	76.2%
GDP (at 2015 constant prices)	RM 729,851 million	RM 1,424,310 million
GNI/capita (at 2015 constant prices)	RM 28,251	RM 43,111
Primary Energy Supply	65,344 ktoe	98,680 ktoe
Final Energy Demand	38,284 ktoe	66,483 ktoe
Total Electricity Consumption	80,705 GWh	158,603 GWh
Length of roads (Federal, State and Toll Highways)	90,016 km	258,511 km
Motor vehicle registration	14,816,407	31,214,772
Annual Ridership on urban rail network in Greater Kuala Lumpur/ Klang Valley (passenger journeys)	157,475,402	275,565,135
Annual ridership on Stages Buses (11 towns and cities) (passenger journeys)	-	31,232
Solid Waste	-	33,130 tonnes/day (2012)

2. GHG INVENTORY

2.1 Background, Cross-Cutting Information and Institutional Arrangement

This chapter describes the national greenhouse gas (GHG) inventory for the year 2019. Estimations of anthropogenic emissions and removals were carried out for four sectors, namely the Energy, Industrial Processes and Product Used (IPPU), Agriculture, Forestry and Other Land Use (AFOLU) and Waste sectors. However, in the description in this chapter, the AFOLU sector would be divided into AFOLU-Agriculture (IPCC Category 3A and 3C) and AFOLU-LULUCF (IPCC Category 3B). The inventory also contains time series estimates from 1990 to 2019 for each of these sectors. The corresponding reporting tables following the 2006 IPCC Guidelines for National Greenhouse Gas Inventories are provided in the Technical Annex.

This chapter also includes information on the methodology used, data sources, emission factors, gasses covered, and assumptions used for each of the sectors. Additionally, key category analysis by level and trend as well as uncertainty assessment are also provided.

The institutional structure for the preparation of the national GHG inventory is shown in Figure 1.10 of chapter 1 (National Circumstances). The GHG inventory preparation is coordinated by the Climate Change Division under the Ministry of Environment and Water (KASA). The preparation of the inventory is steered by a GHG Inventory Technical Working Group (TWG) supported by five thematic Sub Working Groups (SWG), namely for the Energy, IPPU, Agriculture, Land Use, Land-use Change and Forestry (LULUCF) and Waste sectors.

The TWG on GHG Inventory meets regularly to provide methodological guidance to ensure transparency, accuracy, completeness, consistency and comparability of the GHG inventory work carried out by the five sectoral SWGs. The TWG scope of work consists of the following five work areas:

(a) Update Malaysia's national greenhouse gas inventory biennially;

(b) Continuous improvement system: This work area manages the quality assurance and quality control system (QA/QC) by means of an improvement plan based on IPCC good practice guidelines for national greenhouse gas inventories. It seeks to guarantee the quality of national inventory results by ensuring their transparency, completeness, consistency, comparability and accuracy. This system also includes the review of the inventory by international experts when required;

(c) Building and maintaining capacities: This work area builds and maintains the capacities of each GHG inventory sector team through continual training. This is done through attending locally organized training workshops as well as those organised overseas by United Nations agencies and other regional and international cooperation initiatives;

(d) Institutionalisation: This area involves institutionalisation of the greenhouse gas inventory processes by ensuring effective inter-institution coordination and forging collaboration agreements with participating institutions through defined responsibilities, timeframes and budgets. The Terms of Reference (TOR) for the inventory compilers includes information of its preparation, timeframes of the GHG inventory, methodologies, activity data, emission factors and assumptions used and results;

(e) Archiving, documentation and dissemination: Under this work area, an archiving and documentation system of the national greenhouse gas inventory is maintained at the Climate Change Division of the Ministry of Environment and Water (KASA); and

(f) Approval process: The final approval of the GHG inventory results is by the National Steering Committee on Climate Change (NSCCC) based on the recommendation of the Technical Committee on Climate Change (TCCC).

2.2 Methods

2.2.1 Methodology and Parameters

The 2006 IPCC Guidelines for National Greenhouse Gas Inventories and 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands were used to estimate the GHG emissions and removals. Time series were recalculated to reflect the updated methodologies, activity data and emission factors in accordance with the guidelines. The methodological tier and type of emission factors used to generate the estimates is reflected in Table A – 1 of the Technical Annex.

The IPCC Inventory Software was used to generate the GHG inventory estimates. External spreadsheets as provided in the 2006 IPCC Guidelines were also created as a check on the calculations from the software. For the energy sector, estimates were calculated for both reference and sectoral approaches.

Geographic Coverage

The geographic coverage of the GHG inventory is complete. It covered the entire territorial boundary of Malaysia.

Sectors and Gases

All significant sources and removals of direct GHG gases that were outlined in the 2006 IPCC Guidelines, and which were associated with activities occurring in Malaysia were covered in the inventory. For the AFOLU sector, land use category definition is shown in Table 2.1.

Table 2.1: Land Use Definition

Land use	Definition
Forest Land	Includes land under the jurisdiction of the National Forestry Act with thresholds used to define Forest Land as listed below: • Minimum Mapping Unit (MMU) is 0.5 ha; • Minimum crown cover is 30%; and • Minimum height at maturity is 5 m.
Cropland	Include perennials like oil palm, rubber, cocoa and kenaf as commodities and fruit trees and annual crops like vegetables, spices and herbs. It also included abandoned agricultural area that is considered as unmanaged.
Grassland	Pasture land
Wetland	Land that is covered or saturated by water for all or part of the year and that does not fall into the forest land, cropland, grassland or settlements categories. It also included reservoirs, natural rivers and lakes as unmanaged sub-divisions.
Settlement	These included all built areas, including roads, highways and other transport infrastructure, human settlements of any size, industrial and commercial zones. It also included unmanaged areas due to abandoned development projects.

Gases

Estimation for the three major direct gases consisting of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) was carried under this inventory for the whole time series. Calculations were also carried out for the hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6) and nitrogen trifluoride (NF_3) gases for the IPPU sector. The Global Warming Potential (GWP) values from the IPCC Fourth Assessment Report (AR4) were used in the CO_2 equivalent calculations, and these are as shown in Table 2.2.

Table 2.2: Global Warming Potential Used

Gas	Chemical Formula	GWP
Methane	CH_4	25
Nitrous oxide	N_2O	298
Hydrofluorocarbons	HFCs	1,430 – 14,800*
Perfluorocarbons	PFCs	7,390 – 12,200*
Sulphur hexafluoride	SF_6	22,800
Nitrogen trifluoride	NF_3	17,200

Note:
*Range is for the gases emitted in Malaysia

Indirect Gases

Estimation for the precursor gases namely the nitrogen oxides (NO_x), carbon monoxide (CO), non-methane volatile organic compounds (NMVOCs) and sulphur dioxide (SO_2) was also carried out for the 2019 inventory for activities where the emission factors are available from the 2006 IPCC Guidelines for National GHG Inventories.

2.2.2 Description of Data Sources and Assumptions

The summary of emission factors, and summary of assumptions and activity data sources for each of the sectors are shown in Table A – 2 and Table A – 3 of the Technical Annex respectively.

Most of the activity data for the calculations of the GHG inventory were derived from annual national publications. Where required, additional activity data were obtained from departmental publications or specific sectoral reports. International data were used when data at national level were not available. Consistency check was also undertaken between Malaysia activity data reported at national level and international databases.

For the Energy sector, the data was sourced from the National Energy Balance (NEB). Additional information for the energy data is obtained from the Energy Commission (the custodian of the NEB). Additional activity data from other government agencies and the private sectors were obtained through official requests by KASA to those entities.

For the IPPU sector, data was obtained from official annual industry publications. For those sub-sectors without annual industry publications, data was obtained from the industries through official requests by KASA to those entities. Where activity data over certain periods were unavailable, extrapolation following the IPCC Guidelines was carried out. This consisted of historical data for dolomite from 1990-1996, lime from 1990-1999, glass production from 1990-2002, nitric acid production from 1990-1999, carbide and carbon black production from 1990 to 1999, SF_6 use in electrical equipment from 1990 to 2000, N_2O emissions from medical equipment from 1990-2010 and emissions from the electronic industry from 2000 to 2011.

For the Agriculture sector, activity data was obtained from the Livestock Statistics published annually by the Department of Veterinary Services (DVS), Agrofood Statistics produced by the Ministry of Agriculture and Food Industries (MAFI), the Paddy Statistics of Malaysia produced by the Department of Agriculture (DOA), Malaysian Oil Palm Statistics produced by the Malaysian Palm Oil Board (MPOB), PETRONAS Annual Report and the FAO Statistics website. Additional data was sourced from the relevant government agencies and industries.

For the LULUCF sector, the forestry activity data was obtained from the Ministry of Energy and Natural Resources (KeTSA), annual publications of the relevant forestry departments and through requests to those departments. Cropland information was obtained from the Commodity Statistics published by the Ministry of Plantation Industries and Commodities (MPIC), MAFI and the respective agriculture departments

of Peninsular Malaysia, Sabah and Sarawak. This activity data was obtained from gazette and license issued. Additionally, geospatial imageries were used to monitor changes in the forest.

For the Waste sector, activity data was obtained from the Department of Statistics Malaysia (DOSM), annual publications from MPOB, Malaysian Rubber Board (MRB), the NEB, Indah Water Konsortium Sdn. Bhd. (IWK), Sewage Services Department (JPP) Sabah and JPP Sarawak. Additional information was sourced from the relevant government agencies and industries.

2.2.3 Archiving and Documentation

For each year of GHG inventory calculation, each of the sector's compilers generate a set of activity data, the database in the IPCC Inventory software, external 2006 IPCC Guidelines spreadsheets and a sectoral report.

For the archiving of the GHG Inventory, the IPCC Inventory Software database and a flat file system for the external 2006 IPCC Guidelines spreadsheets were used for each of the five sectors (Energy, IPPU, Agriculture, LULUCF and Waste). This consists of three levels of files, which is the raw data file, the analysis files and the sectoral report file. These are deposited with the GHG Inventory and Reporting Unit of Climate Change Division in KASA. The agency heading each sectoral GHG inventory group also keeps a copy of their sectoral data files, analysis spreadsheets, sectoral reports as a second level backup.

2.2.4 Key Category Analysis

Approach 1 Level Assessment and Approach 1 Trend Assessment as outlined in the 2006 IPCC Guidelines was used for the analysis of the key categories and trend of the 2019 GHG inventory. These were carried out for the inventory including LULUCF and excluding LULUCF.

2.2.5 Uncertainty Assessment

Similarly, the Approach 1 uncertainty assessment following the 2006 IPCC Guidelines was used for the uncertainty assessment.

2.2.6 Assessment of Completeness

Efforts had been taken to ensure completeness of the 2019 inventory and the 1990 – 2019 time series to the extent possible. However, there are still sub-categories where emissions have not been estimated due to the lack of activity data and/or emissions factors. The assessment of completeness is reflected using the notation keys in the Technical Annexes.

2.2.7 QA/QC Process

The Quality Assurance and Quality Control (QA/QC) arrangements for the preparation of this GHG inventory report is illustrated schematically in Figure 2.1. The sector coordinators were charged with ensuring that adequate QA/QC procedures

were performed for the inventory, its supporting documents, calculation spreadsheets and usage of the IPCC GHG inventory software. This was undertaken through the following:

(a) Creating a checklist of QA/QC procedures;
(b) Collecting and reviewing checklists for completeness, and following up when necessary to ensure that the required QA/QC procedures were observed;
(c) Delivering all documentations to the GHG Inventory and Reporting Unit under the Ministry of Environment and Water; and
(d) Facilitating all technical reviews at the national and international levels.

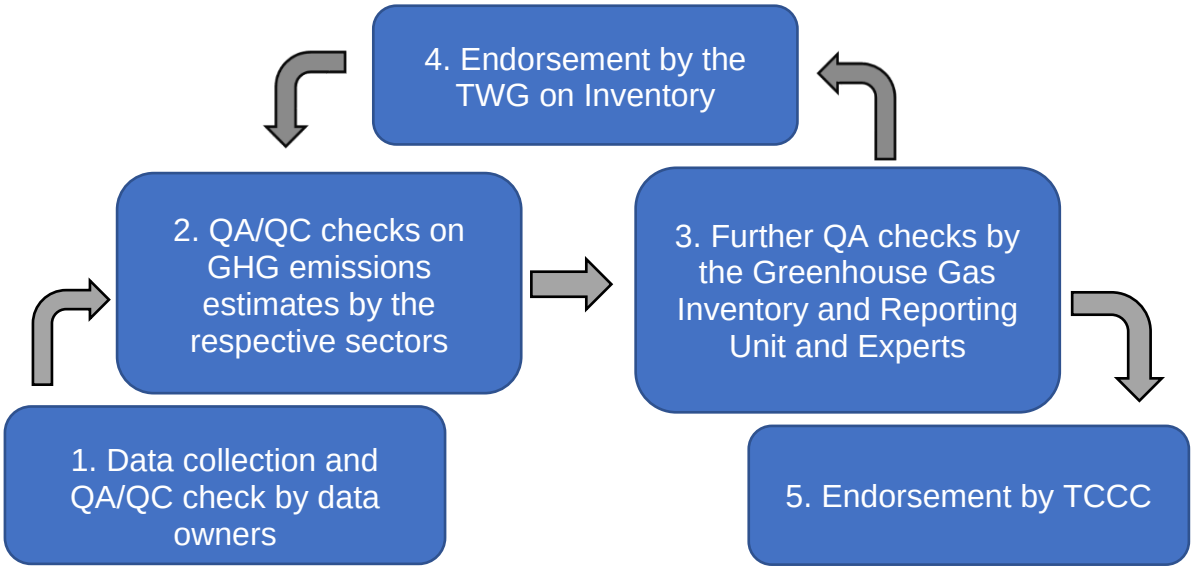


Figure 2.1: Schematic Diagram showing Quality Assurance and Quality Control Arrangement for Greenhouse Gas Inventory

Further QA checks were carried out by the GHG Inventory and Reporting Unit of the Ministry of Environment and Water during the merging of the sectoral GHG inventory reports into this National GHG Inventory Report and GHG Inventory Technical Annex. This process was undertaken through workshops conducted by the GHG Inventory Unit with the sectoral leads of the GHG Inventory team and members of the GHG Inventory TWG. These outputs were then tabled to the TCCC for endorsement that the MRV process for the GHG inventory estimation is complete, accurate to the extent possible and transparent. The QC procedures undertaken to develop the national GHG inventory are as shown in Table 2.3.

Table 2.3: QC Procedures Undertaken in Developing the National Greenhouse Gas Inventory

QC procedures	Task	Responsibilities
Internal consistency and accuracy	Ensured that the total GHG emissions equalled the sum of the individual emission from the sectors and categories.	Inventory compilers
	Ensured that the total GHG emissions equalled the sum of the emissions by gas.	
	Compared data in tables to calculation spreadsheets and to the text in order to ensure that all reported the same estimates.	
	Ensured that parameters used in multiple categories (e.g., population) were consistent across categories.	
	Ensured that the emissions data is reported in a manner consistent with the reporting tables specified in the Non-Annex I National Communications and Biennial Update Reports Reporting Guidelines (Decision 17/CP.8 and Decision 2/CP.17 respectively). Ensured that the selection and application of the estimation methods were consistent with IPCC guidelines.	
Documentation	Created back-ups of all documentations in hard and soft copies and uploaded files in a central storage facility online.	Inventory compilers
	Moved all files and documentations to a GHG database.	GHG Inventory and Reporting Unit, Ministry of Environment and Water
	Reviewed, approved and harmonized sector files to ensure consistency in filing.	Inventory compilers

2.3 GHG Emissions and Removals by Sector: 2019

2.3.1 Key Summary

For 2019, the total GHG emission excluding LULUCF was 330,358.21 Gg CO_2 eq. The total GHG emission excluding LULUCF consists of 259,326.11 Gg CO_2 eq. from the energy sector, 32,853.80 Gg CO_2 eq. from the IPPU sector, 28,256.59 Gg CO_2 eq. from the waste sector and 9,921.71 Gg CO_2 eq. from the agriculture sector as shown in Table 2.4. The total GHG emission including LULUCF was 115,643.68 Gg CO_2 eq. where the net emissions from the LULUCF sector was -214,714.54 Gg CO_2 eq.

Table 2.4: Summary of GHG Inventory for 2019

Sector	GHG Emission/Removal (Gg CO_2 eq.)
Energy	259,326.11
IPPU	32,853.80
AFOLU-Agriculture[1]	9,921.71
AFOLU-LULUCF[2]	-214,714.54
Waste	28,256.59
Total (Excluding LULUCF)	**330,358.21**
Total (Including LULUCF)	**115,643.68**

Note:
[1]IPCC Category 3A and 3C
[2]IPCC Category 3B

The Short Summary and Summary Tables for the GHG inventory for 2019 are presented in Table A – 7 and A – 8 in the Technical Annex respectively. In addition, the Sectoral Tables and Background Tables for all the sectors are presented respectively in Tables A – 9 to A – 12 and Table A – 13(a) to A – 16(c). The Cross Sectoral Table for Indirect Emissions of N_2O is also reported in Table 17 and the trends of gaseous (C_2O, CH4, N_2O, HFCs, PFCs, SF_6 and NF_3) are presented in Table A – 17 to A – 24.

2.3.2 Energy

Based on the sectoral approach, the total GHG emissions from the energy sector for 2019 was 259,326.11 Gg CO_2 eq. as shown in Table 2.5. The GHG emissions of this sector increased by 27.95% in 2019 compared to the 2005 base year emissions.

Under this sector, emissions from the energy industries constituted the highest sub-category with emissions of about 50.80% (131,735.68 Gg CO_2 eq.) of the total energy sector. The breakdown of the emissions is 42.33% from the electricity and heat production (109,768.85 Gg CO_2 eq.), 5.30% from the production of liquified natural gas (13,737.62 Gg CO_2 eq.), and 3.17% from petroleum refining (8,229.21 Gg CO_2 eq.).

The emissions from the transport sector were recorded as the second highest sub-category amounting to 25.05% (64,973.10 Gg CO_2 eq.) of the total energy sector's

emissions. The emissions consist among others, 21.40% from road transport (55,486.57 Gg CO_2 eq.) and 2.20% from domestic water-borne navigation (5,709.17 Gg CO_2 eq.).

The manufacturing and construction sub-category contributed to the third highest emissions or 12.95% of the total energy sector's emissions (33,578.18 Gg CO_2 eq.). The breakdown of this sub-category includes among others, 3.65% from iron and steel industries (9,461.08 Gg CO_2 eq.), followed by 3.08% from non-metallic mineral industries (7,997.87 Gg CO_2 eq.) and 2.44% from food processing, beverage and tobacco (6,330.61 Gg CO_2 eq.).

Table 2.5: Summary of Total GHG Emissions for Energy Sector in 2019

Sub-sector	2019 Emissions (Gg)			Gg CO_2 eq. (Gg)
	CO_2	CH_4	N_2O	
GWP	1	25	298	
1A Fuel Combustion Activities	**234,858.0538**	**25.1257**	**4.5582**	**236,844.49**
1A1 Energy Industries	**131,274.3400**	**2.2897**	**1.3560**	**131,735.68**
1A1a Main Activity Electricity and Heat Production	109,349.3055	1.7094	1.2645	109,768.85
1A1b Petroleum Refining	8,200.8157	0.3356	0.0671	8,229.21
1A1c Manufacture of Solid Fuels and Other Energy Industries (Liquified Natural Gas)	13,724.2187	0.2446	0.0245	13,737.62
1A Manufacturing Ind. & Construct.	**33,482.5353**	**1.3718**	**0.2059**	**33,578.18**
1A2a Iron and Steel	9,446.9336	0.2136	0.0295	9,461.08
1A2b Non-Ferrous Metal	311.6555	0.0056	0.0006	311.96
1A2c Chemicals	3,625.7166	0.0917	0.0141	3,632.20
1A2d Pulp, Paper and Print	982.9332	0.0277	0.0046	984.99
1A2e Food Processing, Beverage and Tobacco	6,323.6818	0.1197	0.0132	6,330.61
1A2f Non-Metallic Minerals	7,945.6393	0.7462	0.1127	7,997.87
1A2g Transport Equipment	2,729.5128	0.1052	0.0206	2,738.28
1A2h Machinery	256.4741	0.0103	0.0020	257.34
1A2i Mining (excluding fuels) and Quarrying	IE, NE	IE, NE	IE, NE	IE, NE
1A2j Wood and Wood Products	487.3545	0.0179	0.0034	488.83
1A2k Construction	IE, NE	IE, NE	IE, NE	IE, NE
1A2l Textile and Leather	852.2770	0.0207	0.0031	853.71
1A2m Non-specified Industry	520.3570	0.0133	0.0021	521.31
1A3 Transport	**63,576.3871**	**20.7518**	**2.9460**	**64,973.10**
1A3aii Domestic Aviation	1,276.2314	0.0089	0.0357	1,287.09
1A3b Road Transportation	54,225.9502	19.0746	2.6301	55,486.57
1A3c Railways	46.6926	0.0026	0.0180	52.13
1A3dii Domestic Water-borne Navigation	5,650.3769	0.5338	0.1525	5,709.17
1A3eii Off-road	2,377.1359	1.1320	0.1098	2,438.15
1A4 Other Sectors	**6,036.9806**	**0.6983**	**0.0352**	**6,064.92**
1A4a Commercial/ Institutional	1,700.3609	0.21	0.0106	1,708.56
1A4b Residential	1,650.0776	0.12	0.0028	1,654.21

Sub-sector	2019 Emissions (Gg)			Gg CO_2 eq. (Gg)
	CO_2	CH_4	N_2O	
GWP	1	25	298	
1A4c Agriculture/ Forestry/ Fishing/ Fish Farms	2,686.5422	0.30	0.0218	2,702.15
1A5 Non-Specified	**487.7608**	**0.01**	**0.0150**	**492.59**
1A5b Mobile	487.7608	0.01	0.0150	492.59
1B Fugitive Emission from Fuels	**4,600.2451**	**714.6263**	**0.0528**	**22,481.62**
1B1 Solid Fuels	0.0000	0.9500		23.75
1B1a Coal Mining & Handling	0.0000	0.9500		23.75
1B2 Oil and Natural Gas	4,600.2451	713.6763	0.0528	22,457.87
1B2a Oil	4,335.7036	430.0363	0.0498	15,101.46
1B2b Natural Gas	264.5415	283.6400	0.0029	7,356.41
Total	**239,458.2489**	**739.7520**	**4.6109**	**259,326.11**

2.3.2.1 Comparison between Reference and Sectoral Approach: 2019

The CO_2 emissions based on the reference and sectoral approaches for the energy sector were 239,553.42 Gg CO_2 eq. and 234,858.05 Gg CO_2 eq. respectively, giving a 1.96% difference between the two approaches. The comparison between the reference and sectoral approach estimation from the year 1990 to 2019 can be found in section 2.4.7.1 of the report.

2.3.3 IPPU

The total IPPU emissions for 2019 was 32,853.80 Gg CO_2 eq. The metal industry contributed 13,081.31 Gg CO_2 eq. (39.82%) of the emissions, followed by 10,085.04 Gg CO_2 eq. (30.70%) emissions from the mineral industry, 5,760.42 Gg CO_2 eq. (17.53%) from the chemical industry, 2,790.47 Gg CO_2 eq. (8.49%) from the electronics industry, 929.77 Gg CO_2 eq. (2.83%) from product uses as substitutes for ozone depleting substances and 206.80 Gg CO_2 eq. (0.63%) from other product manufacture and use. In terms of detailed sub-sectors, the highest five emission was from cement production (9,120.65 Gg CO_2 eq. (27.76%)), followed by iron and steel production (7,553.50 Gg CO_2 eq. (22.99%)), petrochemical and carbon black production (4,498.25 Gg CO_2 eq. (13.69%)), aluminium production (3,833.44 Gg CO_2 eq. (11.67%)) and integrated circuit or semiconductor (1,857.52 Gg CO_2 eq. (5.65%)). Compared to base year 2005, the GHG emissions had increased by 118% mainly due to increase in emissions from the metal industry. The summary of GHG emissions for this sector by sub-sector and gas for 2019 is as shown in Table 2.6.

Table 2.6: Summary of Total GHG Emissions for IPPU Sector in 2019

Sub-sector	Gas	Emission (Gg)	GWP	CO_2 eq. (Gg)
2A Mineral Industry				
2A1 Cement production	CO_2	9,120.6500	1	9,120.65
2A2 Lime Production	CO_2	128.9601	1	128.96
2A3 Glass Production	CO_2	340.5225	1	340.52

Sub-sector		Gas	Emission (Gg)	GWP	CO_2 eq. (Gg)
2A4	Other Process Uses of Carbonates	CO_2	494.9038	1	494.90
2B Chemical Industry					
2B1	Ammonia Production	CO_2	1,224.1588	1	1,224.16
2B5	Carbide Production	CO_2	38.0160	1	38.02
2B8	Petrochemicals and Carbon Black Production	CO_2	4,170.4751	1	4,170.48
		CH_4	13.1106	25	327.77
2C Metal Industry					
2C1	Iron and Steel Production	CO_2	7,543.2362	1	7,543.24
		CH_4	0.4105	25	10.26
2C2	Ferroalloy Production	CO_2	1,680.4273	1	1,680.43
		CH_4	0.5577	25	13.94
2C3	Aluminium Production	CO_2	1,216.0000	1	1,216.00
		PFC-14 (CF_4)	0.3040	7,390	2,246.56
		PFC-116 ($C_2F_{6)}$	0.0304	12,200	370.88
2E Electronics Industry					
2E1	Integrated circuit or Semiconductor	PFC-14 (CF_4)	0.0665	7,390	491.57
		PFC-116 (C_2F_6)	0.0739	12,200	901.69
		HFC-23 (CHF_3)	0.0030	14,800	43.75
		PFC-218 (C_3F_8)	0.0037	8,830	32.63
		SF_6	0.0148	22,800	337.03
		NF_3	0.0030	17,200	50.85
2E3	Photovoltaics	PFC-14 (CF_4)	0.1184	7,390	875.15
		PFC-116 (C_2F_6)	0.0047	12,200	57.79
2F Product Uses as Substitutes for Ozone Depleting Substances					
2F1b	Mobile Air Conditioning	HFC-134a	0.6502	1,430	929.77
2G Other Product Manufacture and Use					
2G1b	Use of Electrical Equipment	SF_6	0.0064	22,800	146.74
2G3a	Medical Applications	N_2O	0.2016	298	60.07
Total					**32,853.80**

2.3.4 Agriculture

For the agriculture sector, GHG emissions were estimated from livestock, biomass burning, liming, urea application, direct and indirect emissions of N_2O from managed soils and rice cultivation. The gases covered were CO_2, CH_4 and N_2O.

In 2019, the GHG emissions from the agriculture sector was 9,921.71 Gg CO_2 eq. (Table 2.7). The highest contributor was from direct N_2O emissions from managed

soils with 3,736.73 Gg CO_2 eq. (37.66%) followed by rice cultivations sub-sector with 2,268.98 Gg CO_2 eq. (22.87%). Emissions from enteric fermentation contributed 1,224.46 Gg CO_2 eq. (12.34%) followed by indirect N_2O emissions from managed soils with 1,053.28 Gg CO_2 eq. (10.62%); emissions from manure management with 660.10 Gg CO_2 eq. (6.65%); indirect N_2O emissions from manure management with 541.90 Gg CO_2 eq. (5.46%) and emissions from urea application with 389.89 Gg CO_2 eq. (3.93%). Emission from liming (21.67 Gg CO_2 eq.) and biomass burning (24.70 Gg CO_2 eq.) contributed less than one percent of the total emissions.

Compared to the base year of 2005, GHG emissions from the agriculture sector in 2019 was 3.34% lower. This is mainly due to lower non-dairy cattle and buffalo population and fertiliser usage in 2019.

Table 2.7: Summary of Total GHG Emissions for Agriculture Sector in 2019

Sub-sector		Gas	Emission (Gg)	GWP	CO_2 eq. (Gg)
			A	B	C= (A x B)
3A1	Enteric Fermentation	CH_4	48.9784	25	1,224.46
3A2	Manure Management	CH_4	21.5796	25	539.49
		N_2O	0.4047	298	120.61
3C1a	Biomass Burning in Forest Land	CH_4	0.4352	25	10.88
		N_2O	0.0128	298	3.81
3C1b	Biomass Burning in Cropland	CH_4	0.3057	25	7.64
		N_2O	0.0079	298	2.36
3C2	Liming	CO_2	21.6718	1	21.67
3C3	Urea Application	CO_2	389.8949	1	389.89
3C4	Direct N_2O Emissions from Managed Soils	N_2O	12.5394	298	3,736.73
3C5	Indirect N_2O Emissions from Managed Soils	N_2O	3.5345	298	1,053.28
3C6	Indirect N_2O Emissions from Manure Management	N_2O	1.8185	298	541.90
3C7	Rice Cultivations	CH_4	90.7592	25	2,268.98
Total					**9,921.71**

2.3.5 LULUCF

The summary of the GHG emissions and removals for the LULUCF sector for year 2019 is as shown in Table 2.8. The emission and removal from LULUCF were calculated from the following categories, i.e. Forest Land Remaining Forest Land (3B1a), Cropland Remaining Cropland (2B2a), Land Converted to Cropland (3B2b), Grassland Remaining Grassland (3B3a), Wetlands Remaining Wetlands (3B4a), Settlements Remaining Settlements (3B5a) and Land Converted to Settlements (3B5b). The total CO_2 emissions/removals from C stocks changes for each land use category consisted of the sum of all subcategories taking into account the three carbon pools: (i) above-ground biomass, (ii) below-ground biomass, and (iii) soil organic carbon. The total net removals for 2019 was 214,714.54 Gg CO_2 eq.

The net LULUCF sinks increased by 8.95% for year 2019 when compared against 2005 base year due to the increase in forest land areas. In addition, the logging harvest also reduced during this period. However, there was a significant increase in Land Converted to Settlements due to mega development projects being undertaken during the 11th Malaysian Plan period (2016 to 2020) primarily in Sabah and Sarawak.

Table 2.8: Summary of Total GHG Emissions for LULUCF Sector in 2019

Sub-sector		Gas	Emission (Gg)	GWP	CO_2 eq. (Gg)
3B1 Forest Land					
3B1a	Forest Land Remaining Forest Land	CO_2	-237,008.3940	1	-237,008.39
3B1b	Land Converted to Forest Land	CO_2	NO	1	NO
3B2 Crop Land					
3B2a	Cropland Remaining Cropland	CO_2	-18,662.5760	1	-18,662.58
3B2b	Land Converted to Cropland	CO_2	101.4910	1	101.49
3B3 Grassland					
3B3a	Grassland Remaining Grassland	CO_2	0	1	0
3B3b	Land converted to Grassland	CO_2	NO	1	NO
3B4 Wetlands					
3B4a	Wetlands remaining Wetlands	CO_2	NO, IE	1	NO, IE
3B5 Settlements					
3B5a	Settlements Remaining Settlements	CO_2	0	1	0
3B5b	Land converted to Settlements	CO_2	40,854.9400	1	40,854.94
3B5bi	Forest Land Converted to Settlements	CO_2	35,564.0340	1	35,564.03
3B5bii	Cropland Converted to Settlements	CO_2	5,290.9060	1	5,290.91
Total Emissions					**-214,714.54**

2.3.6 Waste

The total emissions in 2019 from the waste sector was 28,256.59 Gg CO_2 eq. as shown in Table 2.9. The highest emissions were from industrial wastewater treatment and discharge at 14,462.46 Gg CO_2 eq. (51.18%) followed by solid waste disposal sites at 11,681.20 Gg CO_2 eq. (41.34%) and 2,065.22 Gg CO_2 eq. (7.31%) from domestic wastewater treatment and discharge. Compared to the 2005 base year, GHG emissions for the waste sector increased by 28.43% and this was mainly contributed by the increase in emissions from solid waste disposal sites.

Table 2.9: Summary of Total GHG Emissions for Waste Sector in 2019

Sub-sector		Gas	Emission (Gg)	GWP	CO_2 eq. (Gg)
4A	Solid Waste Disposal Sites	CH_4	467.2481	25	11,681.20
4B	Biological Treatment of Solid Waste	CH_4	0.0097	25	0.24
		N_2O	0.0006	298	0.17
4C1	Waste Incineration	CO_2	42.0900	1	42.09
		CH_4	-	25	-
		N_2O	0.0081	298	2.42
4C2	Open Burning of Waste	CO_2	0.6800	1	0.68
		CH_4	0.0751	25	1.88
		N_2O	0.0007	298	0.22
4D1	Domestic Wastewater Treatment and Discharge	CH_4	67.4831	25	1,687.08
		N_2O	1.2689	298	378.14
4D2	Industrial Waste Treatment and Discharge	CH_4	577.3956	25	14,462.46
Total					**28,256.59**

2.4 Sectoral Time Series: 1990 – 2019

2.4.1 Key Summary

The GHG emission time series from 1990 to 2019 is shown in Figure 2.2. Excluding LULUCF, the energy sector was the main contributor to the emissions, accounting an average of annual emissions of 80.55% from 2005 to 2019. The updated total GHG emissions for previous reporting years are as shown in Table 2.10.

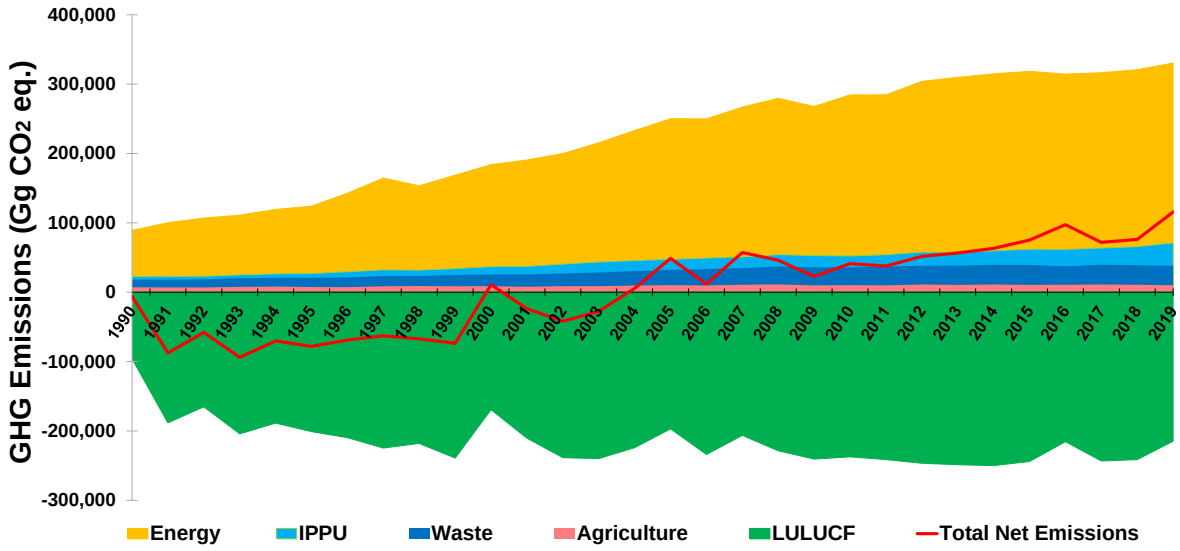


Figure 2.2: GHG Emission Time Series from 1990 to 2019

Table 2.10: GHG Emissions for the Years 1994, 2000, 2005, 2011, 2014, 2016 and 2019

Sector	Emissions/Removals (Gg CO_2 eq.)						
	1994	2000	2005	2011	2014	2016	2019
Energy	92,977.76	146,926.37	202,676.41	230,603.00	255,079.75	253,156.64	259,326.11
IPPU	5,678.85	11,531.89	15,101.60	17,042.27	20,235.40	23,746.04	32,853.80
Agriculture	8,184.72	8,752.57	10,265.04	9,906.28	11,095.67	10,711.36	9,921.71
LULUCF	-188,627.10	-169,397.24	-197,076.76	-241,252.18	-249,952.54	-215,375.05	-214,714.54
Waste	12,612.60	16,717.25	22,000.75	27,081.76	28,377.66	26,565.41	28,256.59
Total (Excluding LULUCF)	**119,453.92**	**183,928.08**	**250,043.80**	**284,633.31**	**314,788.47**	**314,179.45**	**330,358.21**
Total (Including LULUCF)	**-69,173.17**	**14,530.85**	**52,967.03**	**43,381.13**	**64,853.93**	**98,804.40**	**115,643.68**

2.4.2 Energy

The GHG emission time series for the energy sector from 1990 to 2019 is shown in Figure 2.3. For the period of 2005 to 2019, the GHG emissions for the energy sector increased at an average rate of 1.84% per year. The highest emissions were from the energy industries with an average emissions annual growth rate of 2.70% for the same period. Meanwhile, the second highest emissions were from the transport sector with an average emissions annual growth rate of 3.44% for the same period. From 2016 onwards, there was an increase in emissions from the manufacturing industries and construction's energy use due to increase in energy intensive industries. Fugitive emissions from the oil and gas industries, however, showed -1.57% growth rate during the same period.

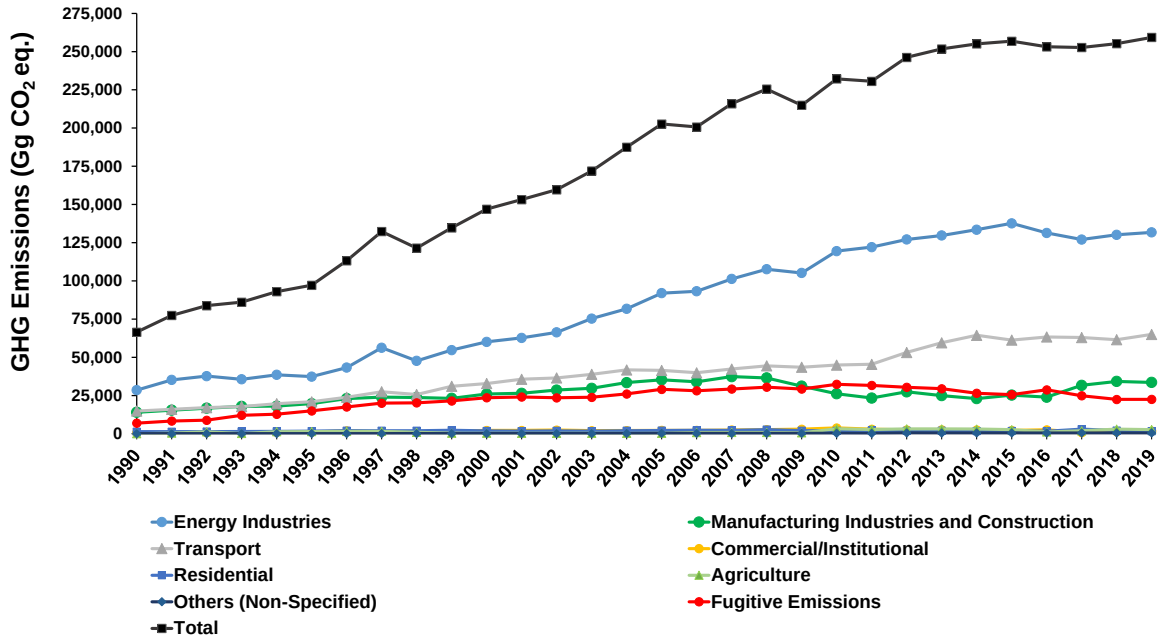


Figure 2.3: GHG Emission Time Series from 1990 to 2019 for Energy Sector

2.4.3 IPPU

The GHG emission time series for the IPPU sector from 1990 to 2019 is shown in Figure 2.4. The GHG emissions from the IPPU sector grew at an average rate of 5.92% per year from 2005 to 2019. During this period, the mineral industry contributed the highest emissions followed by the chemical, metal and electronics industries. In terms of annual average growth of emissions, the metal industry showed the highest at 21.03% followed by other product and manufacture use at 17.84% and the electronic industry at 7.51%. The emissions from the metal industry were mainly from the iron and steel production and aluminium production where there was a large increase in emissions from iron and steel production in 2019 due to the opening of a new iron and steel plant. The mineral industry while being the highest contributor in this sector, showed an average annual growth rate of 1.88%. The trend of emissions of this industry fluctuates from year to year depending on the demand for cement in the construction industry.

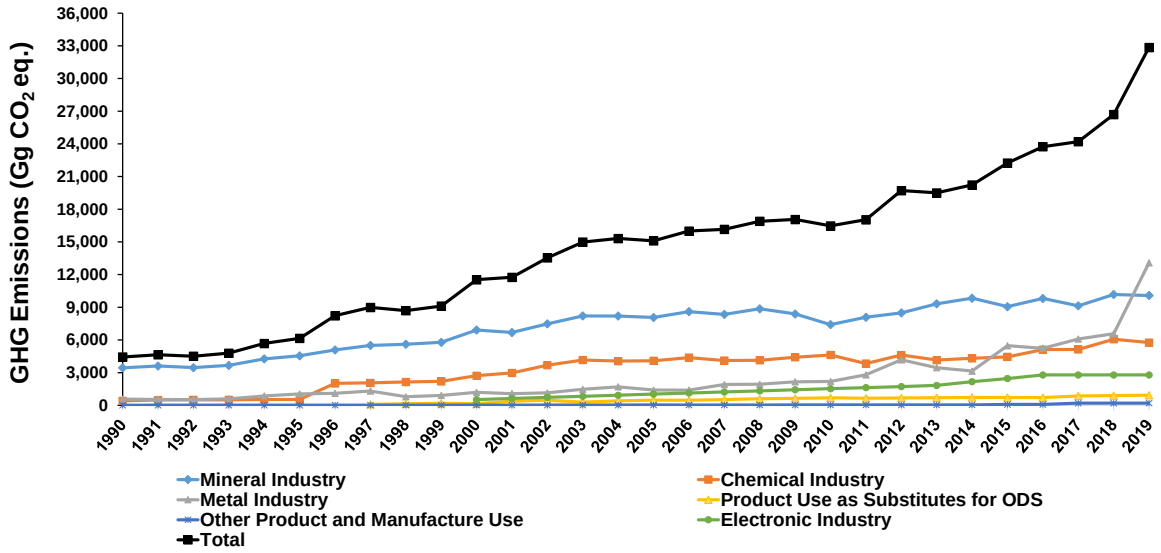


Figure 2.4: GHG Emission Time Series from 1990 to 2019 for IPPU Sector

2.4.4 Agriculture

The GHG emission time series for agriculture sector from 1990 to 2019 is shown in Figure 2.5. GHG emissions from the agriculture sector grew at an average rate of -0.03% per year from the period of 2005 to 2019. The GHG emissions growth rate fluctuated from year to year in tandem with the usage of fertiliser by the sector. Nitrous oxide emissions from managed agricultural soils were the largest source throughout the period of 2005 to 2019, contributing an average of 49.02% of the emissions. Of these, 37.84% was from direct N_2O emissions from managed agriculture soils and the remaining 11.18% were from indirect N_2O emissions from managed agriculture soils. The average annual growth rate for direct and indirect N_2O emissions from managed agricultural soils were 0.31% and -0.23% respectively for the same period. The second largest source was CH_4 emission from rice cultivation and this source contributed an annual average of 20.84% of the total agriculture sector GHG emissions over this period. Its average annual growth rate was relatively low at 0.51%. Methane emission from enteric fermentation was the third largest source and this contributed an annual average of 13.56% of the emissions from 2005 to 2019.

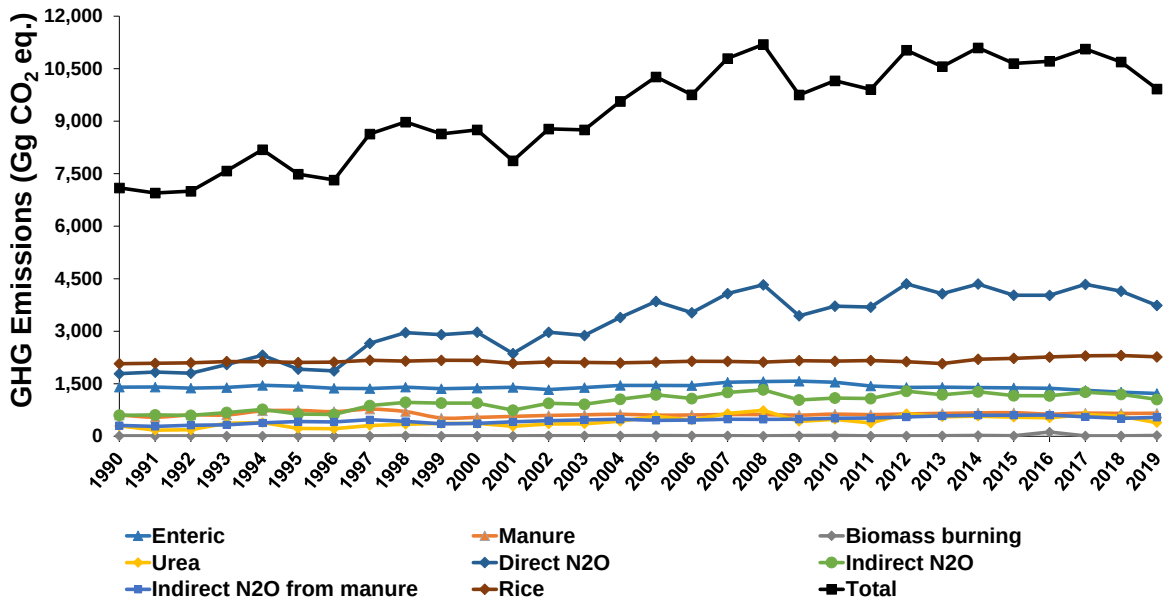


Figure 2.5: GHG Emission Time Series from 1990 to 2019 for Agriculture Sector

2.4.5 LULUCF

The GHG emission and removal time series for the LULUCF sector is as shown in Figure 2.6. Subsequent to the BUR3, Malaysia has made further enhancements to its land use change assessments. Malaysia is a highly dynamic country with frequent land-use changes within a short period of time. As such, land has been frequently converted within and between land-use categories more than once within a 20-year transition period. This may lead to potential over-estimates of greenhouse gas emissions and removals. By performing a series of checks, intermediate land-use changes were then corrected to ensure smoother transitions, such that each land-use change relates to a more realistic estimate of carbon stock changes. These were undertaken for years 1994 to 1997 and 2015 to 2019. In 1994, although forest land was degazetted but not deforested and became forest in 1996 to 1997. Likewise, new forest areas in State land forest between 2015 to 2019 are also in transition and not accounted.

The average annual net CO_2 removals for the LULUCF sector from 2005 to 2019 increased by 0.99% per year. The net sink had been more than 200,000 Gg CO_2 from 2005 onwards, where forest loss rates were the lowest and somewhat stabilised. There was an increase in deforestation in the period 2016 to 2019 for development purposes coupled with dynamic land use change categories over a short period of time.

For cropland, total removals are dependent on the productivity and commodity price. The total removals in cropland reduced from 1990 to 2019 due to increase in productivity. The National Commodities Policy outlined a strategic approach which focussed on enhancing productivity and limiting land expansion into forest areas.

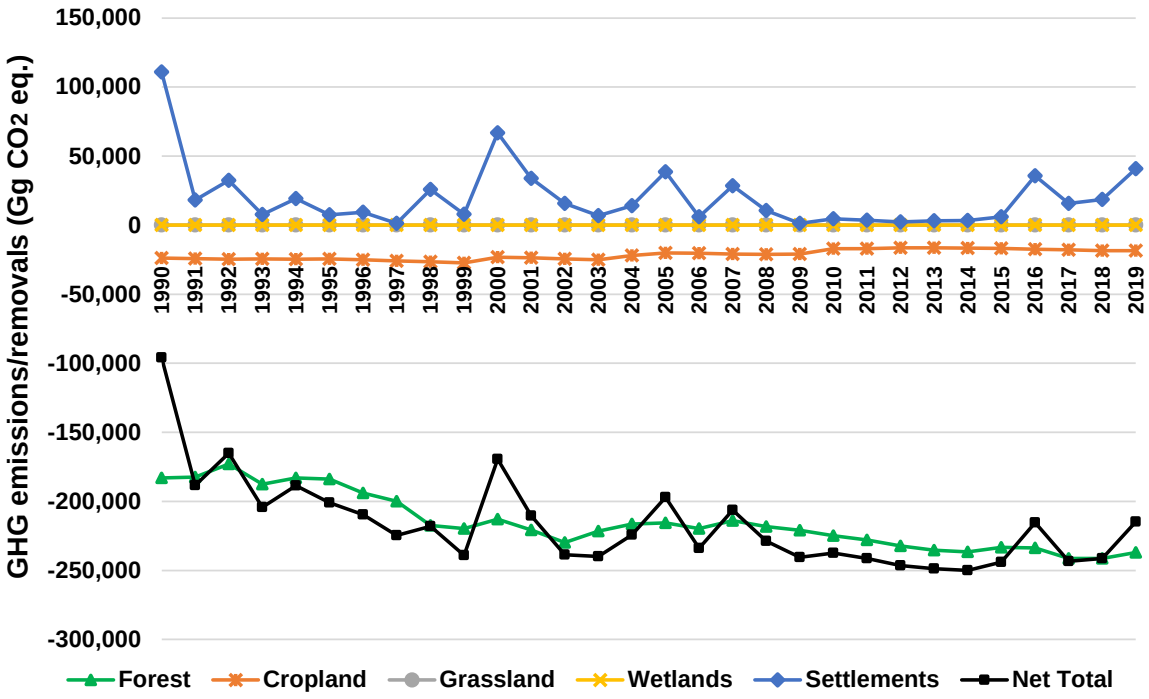


Figure 2.6: GHG Emission Time Series from 1990 to 2019 for LULUCF Sector

2.4.6 Waste

Figure 2.7 shows the GHG emission time series for the waste sector from 1990 to 2019. GHG emissions from the waste sector grew at an average rate of 1.89% per year over the period 2005 to 2019. Emissions from wastewater treatment and discharge was the largest source of emissions from 2005 to 2019 and this contributed to an average of 64.98% of the total emissions. Of these, emissions from industrial wastewater contributed 57.09% of the emissions and emissions from domestic wastewater contributed 7.89% of the total emissions. The average growth rate of emissions from industrial wastewater and domestic wastewater were 0.55% and 0.10% respectively during this period. The main source of emissions from the industrial wastewater was from palm oil mill effluent (POME). The second largest source of emissions was methane emissions from solid waste disposal sites and this source contributed an average of 34.87% of the annual emissions from 2005 to 2019. The average annual growth rate of emissions from solid waste disposal sites during this period was at 4.79%.

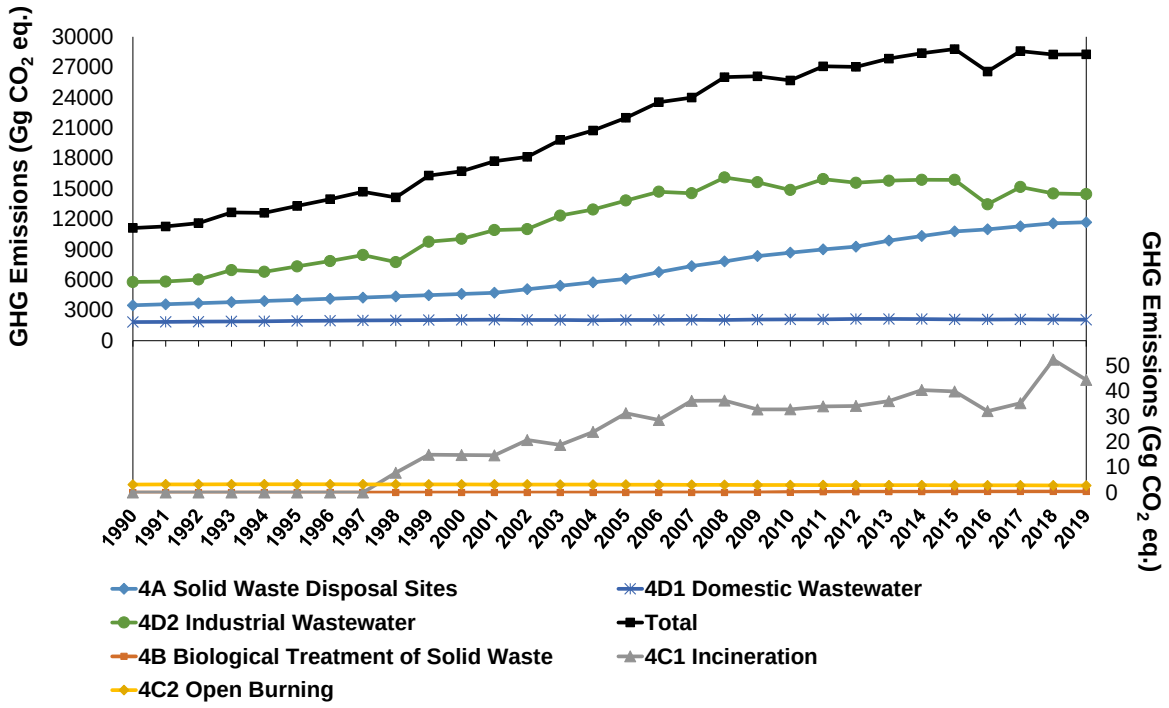


Figure 2.7: GHG Emission Time Series from 1990 to 2019 for Waste Sector

2.4.7 Recalculation of Time Series

As part of the efforts to improve the GHG estimations, recalculations were undertaken in all the sectors as additional historical data became available. Comparison of the time series by sector and by gas between the previous BUR (BUR3) and BUR4 is as shown in Table A – 4 and Table A – 5 respectively.

2.4.7.1 Energy Sector

Reference Approach

The time series for both approaches for the CO_2 emissions from 1990 to 2019 is shown in Figure 2.8. For comparison purposes, the energy sectoral and reference approach time series between BUR3 and BUR4 is shown in Table A – 6. The differences between both approaches ranged from -8.17% to 7.2% throughout the time series period. In general, the difference between the two approached had narrowed in the later years with the difference being less than 2% from 2017 to 2019.

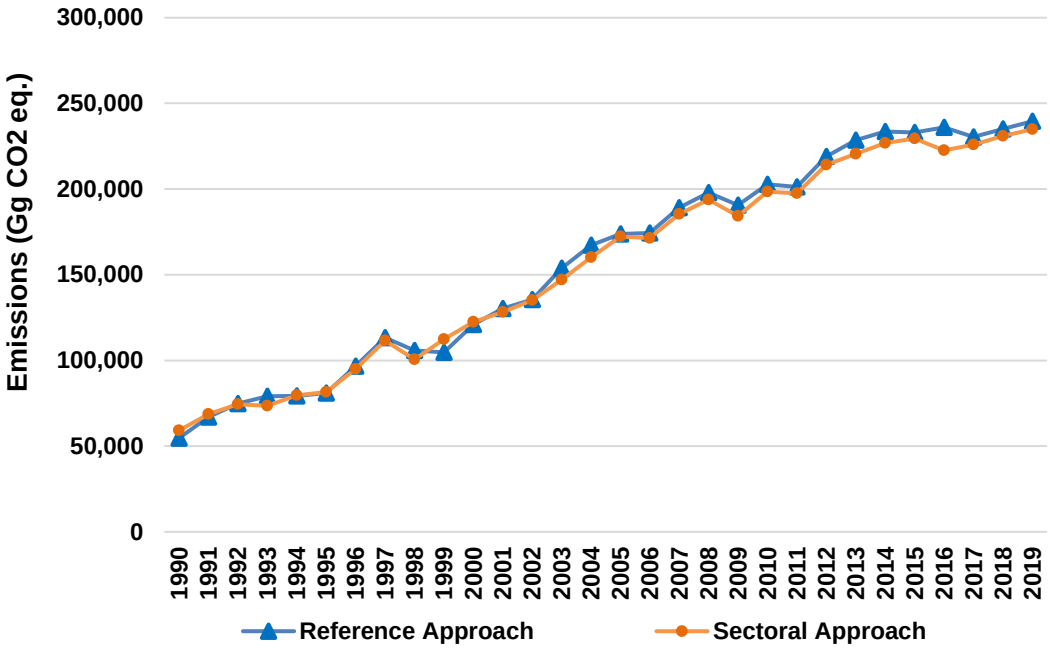


Figure 2.8: Comparison of the energy sector time-series analysis of CO_2 emission for the Reference and Sectoral approaches (1990-2019)

Sectoral Approach

For the energy sector, activity data information on petrol (gasoline) and diesel usage was only available in aggregated form for the whole transport sector in the National Energy Balance. Estimation of disaggregated data for road transport and domestic water-borne navigation in the past GHG inventory estimations was based on expert judgement. For this inventory, a recalculation was undertaken for the road transport sub-category as information on gasoline and diesel sold at petrol stations nationwide from 2017 to 2019 was made available to the compilers by the ministry responsible for domestic trade. The information for this period was also used to derive the consumption of gasoline and diesel for the years prior to 2017 through a ratio method.

A recalculation for fugitive emissions from fuels was also carried out where information on the total amount of gas vented and flared from the oil and gas fields from 2012 to 2019 was made available to the compilers by the Malaysia Petroleum Management. For the years prior to 2012, the activity data for amount of gas flared or vented was estimated based on the product of ratio of gas production in the year concerned and the average of the gas production from 2012 to 2014 and the amount vented or flared in the gas and oil fields. For all the other sub-categories under fugitive emission from oil and natural gas systems (apart from venting and flaring during production), the emission factor at the lower 10% of the default emission factor range of the developing countries in the 2006 IPCC Guidelines was used. This value was chosen based on discussion and information with PETRONAS that the fugitive emissions from their operations would be comparable to those of developed countries.

2.4.7.2 IPPU

For the IPPU sector, a minor recalculation was undertaken in the 'Other Process Uses of Carbonates' from 2011 to 2016 to remove double counting and incorrect interpretation of the activity data in 2016.

2.4.7.3 Agriculture

For the agriculture sector, a minor update was undertaken to take into account the updates in animal population.

2.4.7.4 LULUCF

For the LULUCF sector, recalculations were undertaken for forest land. This is due to the improvement in tracking land use change in the years 1994-1996 and 2015-2016, taking into to account the 20 years period in land use transition as explained in section 2.4.5. Recalculation for cropland category was also undertaken, where the total harvest for cocoa, oil palm and rubber have been updated, besides updating the total cultivated area for years 2011, 2012 and 2014 for cocoa. The differences between the net LULUCF emission/removal estimates between BUR3 and BUR4 is as shown in Figure 2.9.

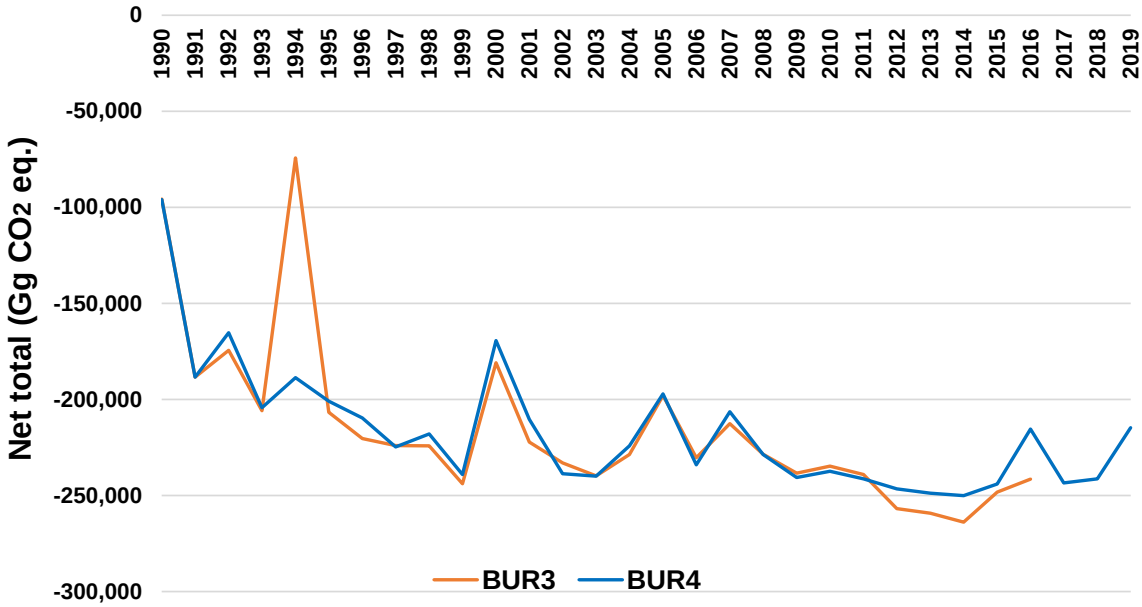


Figure 2.9: Comparison of net total LULUCF emissions estimated between BUR3 and BUR4

2.4.7.5 Waste

For the waste sector, a minor update was undertaken for 'Solid Waste Disposal' to correct the truncated value of 1.33 for CH_4/C that was used in BUR3 in the calculations. The recycling rate was also updated for 2014 to 2016. Recalculation was done on sub sector '4D1: Domestic Wastewater' due to new updates on data availability of the following:

(a) **Type of treatment system and discharge pathway:** In BUR3 reporting, for the sub sector 4D1: Domestic Wastewater, domestic wastewater data from the IWK database was used to represent the whole country as there was insufficient data from Sabah and Sarawak. In BUR4 reporting, for the sub sector 4D1: Domestic Wastewater, the type of treatment and discharge pathway or system was recalculated to reflect the availability of data from both JPP Sabah and JPP Sarawak. As for Sabah, the domestic wastewater data from 1990 to 2017 was obtained from GHG Data Inventory Improvement Study conducted by consultant (North Borneo Environmental Services Sdn. Bhd.) and data from 2017 to 2019 was extrapolated from the study data. As for Sarawak, the domestic wastewater data from 2007 to 2019 was obtained from JPP Sarawak database. Whereas the data from 1990 to 2007 was extrapolation from JPP Sarawak database. The domestic wastewater data was not available from 1990 to 2007 as JPP Sarawak was only established in 2007; and

(b) **Update on protein data:** The protein data was updated based on the updated data acquired from FAOSTAT.

2.5 Key Category Analysis

The Approach 1 Level Assessment for 2019 including and excluding LULUCF are shown in Table A – 25a and A – 25b respectively of the Technical Annex. The assessment was carried out for the whole inventory and the key categories are listed in descending order to 100% of the inventory, with the top 95% of the key categories highlighted in bold in these tables.

Overall, the key categories did not change much between those reported in NC2, NC3, BUR1, BUR2, BUR3 and the 2019 inventory reported in this report. Excluding LULUCF, the total contributions under the key categories were 78.50% for energy sector, followed by IPPU sector (9.94%), waste sector (8.55%) and agriculture sector (3.00%). The energy industries (gaseous, liquid and solid fuels) accounted for 39.88% of the key category emissions of which main activity electricity and heat production (gaseous, liquid and solid fuels) accounted for 33.23% the emissions. Transport contributed 19.67% of the emissions of which 16.80% was from road transport. Manufacturing Industries and Construction contributed 10.16% of the emissions. Fugitive emissions from fuels (solid fuels, oil and natural gas) contributed 6.81% of the emissions of which 6.80% is from oil and natural gas. Wastewater treatment and discharge (industrial and domestic) contributed 5.00% of the emissions. Solid waste disposal contributed 3.54% of the emissions. For the IPPU sector, cement production contributed 2.76% of the emissions and iron and steel production contributed 2.29% of the emissions.

Including LULUCF, the main bulk of the emissions/removals under the key categories were from the LULUCF sector (47.31%), followed by the energy sector (41.36%), IPPU sector (5.24%), waste sector (4.51%), and agriculture sector (1.58%). Forest land remaining forest land contributed the highest value at 37.80%.

Excluding LULUCF, the highest five key categories in descending order were CO_2 emissions from main activity electricity and heat production - solid fuels (22.29%), CO_2 emissions from road transportation – liquid fuels (16.34%), CO_2 emissions from main activity electricity and heat production – gaseous fuels (10.23%), CO_2 emissions from manufacturing industries and construction – gaseous fuels (5.48%) and CH_4 emissions from industrial wastewater treatment and discharge (4.38%).

Including LULUCF, the highest five key categories in descending order were from the following sectors: CO_2 removals from forest land remaining forest land (37.80%), CO_2 emissions from main activity electricity and heat production - solid fuels (11.75%), road transportation – liquid fuels (8.61%), CO_2 emissions from forest land converted to settlement (5.67%) and CO_2 emissions from main activity electricity and heat production – gaseous fuels (5.39%).

Approach 1 Trend Assessment was also carried out for the inventory excluding and including LULUCF, and these are presented in Table A – 26a and Table A – 26b respectively in the Technical Annex. Excluding LULUCF, the top three trends were from increase of CO_2 emissions from solid fuel usage in main electricity and heat production (28.33%) followed by decrease of CO_2 emissions from gaseous fuel usage in manufacturing of solid fuels and other energy industries (13.85%) and decrease of CO_2 emissions from liquid fuel usage in manufacturing industries and construction (9.17%). Including LULUCF, the highest trends occurred for increase in removals of CO_2 by forest land remaining forest land (43.30%). This was followed by decrease in CO_2 emissions from gaseous fuel usage in manufacturing of solid fuels and other energy industries (6.99%) and decrease of CO_2 emissions from forest land converted to settlements (6.89%).

2.6 Uncertainty Assessment

In this report, Approach 1 methodology based on error propagation was used to assess the uncertainty in individual categories in the inventory as a whole and in the trends of the inventory between 2019 and 2005 base year. The detailed results of this analysis for the 2019 inventory without LULUCF and with LULUCF can be found in Table A – 27a and Table A – 27b respectively of the Technical Annex. As summarised in Table 2.11, the 2019 uncertainty of the total inventory without LULUCF was ± 15.12% and the uncertainty in trend was ±12.70%. With LULUCF, the uncertainty of the total inventory was ± 57.47% and the uncertainty in trend was ±168.34%. In the assessment, the uncertainty range was assumed to be under a Gaussian distribution. For published data used in the inventory, the uncertainties indicated in those reports were assumed to be accurate and were used in the assessment. For emission factors, maximum range of uncertainties as indicated in the 2009 IPCC Guidelines for National Greenhouse Gas Inventories were used in the assessment.

Table 2.11: Estimated Uncertainty of 2019 Greenhouse Gas Inventory

2019 GHG Inventory	Uncertainty of Total Inventory (%)	Uncertainty in Trend (%)
Total Inventory excluding LULUCF	15.12	12.70
Total Inventory including LULUCF	57.47	168.34

2.7 GHG Emission Indices

Three approaches are presented in this section (Table 2.12). The first approach considered the emissions from four sectors (Energy, IPPU, Agriculture and Waste). The second approach considered emissions from all the sectors (Energy, IPPU, Agriculture and Waste and LULUCF) and the third approach considered emissions from the four sectors (Energy, IPPU, Agriculture and Waste) and the Net-Net emissions/removals with respect to year 2005 of the LULUCF sector in deriving the GHG emission intensity indices. The GHG intensity against GDP in the third approach follows the definition in Malaysia's Nationally Determined Contribution (NDC) (the implementation years for Malaysia's NDC is from 2021 to 2030). In 2019, Malaysia's GHG Intensity against GDP reduced by 35.90% compared to 2005 values.

Table 2.12: Greenhouse Gas Emission Indices for Malaysia

	Unit	2005	2016	2019	Difference between 2019 and 2005 values (%)
Population	million	26.0455	31.6335	32.5230	24.87
GDP at constant 2015 price	million RM	729,851	1,229,312	1,423,952	95.10
Excluding LULUCF					
Total GHG Emissions (CO_2 eq.)	mil tonnes	250.044	314.179	330.358	32.12
Emissions per capita	tonnes/capita	9.600	9.932	10.158	5.81
Emissions per GDP	kg/RM	0.3426	0.2556	0.2320	-32.28
Including LULUCF					
Total GHG Emissions (CO_2 eq.)	mil tonnes	52.967	98.804	115.644	118.33
Emissions per capita	tonnes/capita	2.034	3.123	3.556	74.85
Including LULUCF*					
Total GHG Emissions (CO_2 eq.)	mil tonne	250.044	295.881	312.720	25.07
Emissions per capita	tonne/capita	9.600	9.353	9.615	0.16
Emissions per GDP	kg/RM	0.3426	0.2407	0.2196	-35.90

Note: *The net-net accounting approach was applied for the LULUCF sector.

2.8 Improvement Plan

Improvement of the GHG inventory system follows a step wise approach. The institutional arrangement and the activity data collection, analysis and archiving system for GHG inventory is continually being reviewed and improved. The 2006 IPCC Guidelines for GHG Inventory would continue to be used for developing the next GHG Inventory. Efforts would be concentrated on improving the disaggregation and completeness of the activity data according to the 2006 IPCC Guidelines and developing country specific emission factors for key categories. A National GHG Inventory Improvement Plan for emission factors had been launched in 2021 under the 12th Malaysia Plan (2021-2025).

For the energy sector, efforts are being carried out to improve the emission factors and collection and disaggregation of activity data to enable higher tier calculations especially for the energy industries and road transport sub-categories. Efforts are also being carried out to improve the completeness of activity data and emission factors for fugitive emissions from the oil and gas sector. In the improvement, this sector has the highest priority as it contributed the highest amounts of emission and are among the highest ranking in the key categories.

For the IPPU sector, the activity data had depended on the willingness of the industries to publish or share information on production and emission factors. Further awareness programmes would be carried out to encourage industries to report on their GHG emissions annually through a voluntary carbon reporting programme. Efforts are being undertaken to collect the activity data for those sub-categories not yet reported, in particular for refrigeration and stationary air conditioning, and non-energy products from fuels and solvent use as well as improving the activity data for the electronics industry.

For the agriculture sector, efforts would be continued to develop the country specific emission factor for rice cultivation. Efforts are being carried out to improve the disaggregation of animal type population according to sex, age and weight categories for cattle to enable higher tier estimation of emissions from enteric fermentation.

For the LULUCF sector, the changes of land use activities are very dynamic in meeting development for rural community and country's economic growth. These changes require continuous assessment on land use and land use change especially for pre 2010 which is still ongoing. Malaysia may update its land use and land use change data once this exercise is completed. Assessment includes abandoned cropland, land use change transitions and alienated land. Planned improvement in developing country specific emission factors for soil organic carbon and dead organic matter in forests is ongoing. The project has been delayed due to the lock downs and has only started in 2022. Weather condition further delayed the data collection. Malaysia is also reviewing its approach taken to estimate biomass loss due to forest fires. Forest fires occurs primarily during the El Niño years. Malaysia plans to review its peatlands status, especially for those that have been cultivated and drained more than 50 years. Once the assessment is completed, Malaysia may review the emission factors used. Malaysia is also undertaking an assessment on how to include harvest

wood products estimates. Effort is being made to develop updated country specific emission factors for oil palm in peatlands.

For the waste sector, improvement of activity data and emission factors especially for the key categories would enable further improvement of accuracy of the emissions from the sector. A ‘Survey on Solid Waste Composition Characteristic and Existing Practice of Solid Waste Recycling in Malaysia’ would be conducted from November 2022 until June 2024 (18 months) by SWCorp, the national body responsible for management and enforcement of solid waste disposal and public cleansing regulations. The survey would cover all states throughout Malaysia which would provide an updated activity data information for the waste sector solid waste disposal GHG inventory estimation. For the industrial wastewater treatment and discharge sub-category, improvement on the estimation of biogas generated and captured from POME at each facility is being undertaken.

3. MITIGATION ACTIONS AND THEIR EFFECTS

3.1 Background, Cross-Cutting Information and Institutional Arrangement

This chapter describes the mitigation actions and their effects for the year 2017 to 2019. The institutional structure for the preparation of the mitigation action assessments is shown in Figure 1.10 of Chapter 1 (National Circumstances). The work is coordinated by the Climate Change Division under KASA. The preparation of the Mitigation Actions Assessment is steered by a Mitigation Technical Working Group supported by thematic Sub Working Groups. The Technical Working Group on Mitigation meets regularly to provide methodological guidance and data collection of the sectoral mitigation assessment carried out by seven sectoral Sub Working Groups. The Technical Working Group is organised around the following work areas:

(a) Updating Malaysia's mitigation actions assessment – includes data collection processes from all of the five sectors (Energy, Industrial Processes and Product Use (IPPU), Waste, Agriculture and Land Use, Land-use Change and Forestry (LULUCF)) and provide guidance on the methodological options to estimate the GHG emission reductions to the extent possible;

(b) Continuous improvement system – manages the quality assurance and quality control system (QA/QC) by means of an improvement plan focusing on those that have the most significant impact on GHG emissions or removals and those impacting key categories in the national GHG inventory;

(c) Building and maintaining capacities – builds and maintains the capacities of each sector team through training for the estimation of GHG emissions reductions, monitoring and tracking of mitigation policies and measures;

(d) Institutionalisation – institutionalise monitoring and evaluation of mitigation policies and measures especially for policy makers, industry players and stakeholders;

(e) Archiving, documentation and dissemination – archiving and documentation is maintained at the GHG Inventory and Reporting Unit of Climate Change Division in KASA. The agency heading each sectoral group also keeps a copy of the information and reports as a second level backup.

(f) Approval process – the final approval of the mitigation assessment results is by the NSCCC based on the recommendation of the TCCC.

3.1.1 Monitoring and Evaluation of Policies and Measures and the QA/QC Process

The Quality Assurance and Quality Control (QA/QC) arrangements for the monitoring and evaluation of mitigation policies and measures is illustrated schematically in Figure 3.1. The sector coordinators are tasked to ensure adequate QA/QC procedures for the monitoring and evaluation of mitigation policies and measures including maintaining supporting documents, calculation spreadsheets and information on the methodology adopted. This is undertaken through the following:

(a) Creating a checklist of QA/QC procedures. The QC procedures undertaken in the mitigation assessment are listed in Table 3.1;

(b) Collecting and reviewing checklists for completeness, and following up when necessary to ensure that the required QA/QC procedures were observed;

(c) Delivering all documentations to the GHG Inventory and Reporting Unit, KASA; and

(d) Facilitating all technical reviews at the national and international levels.

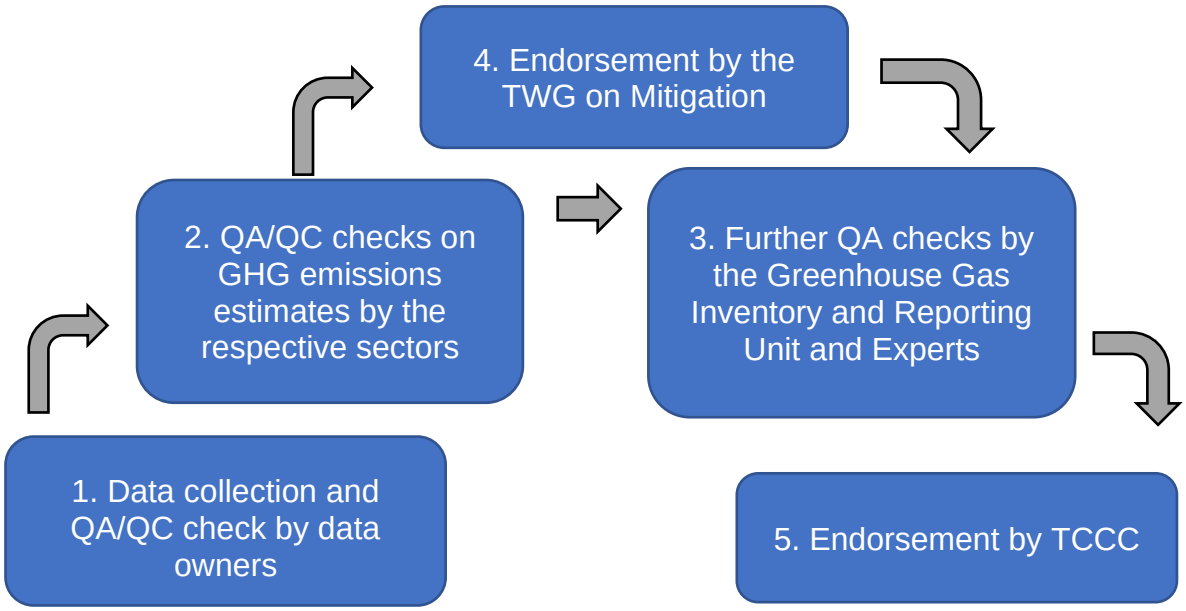


Figure 3.1: Schematic Diagram showing Quality Assurance and Quality Control Arrangement for the Estimation of GHG emission Reductions from Mitigation Actions

Table 3.1: QC Procedures Undertaken in the Mitigation Assessment

QC procedures	Task	Responsibilities
Internal consistency and accuracy	Ensure that the activity data from the respective sectors are verified	Sectoral SWG (Mitigation)
	Ensure that measuring units are accurate and uniformed	
	Compared data in tables and spreadsheets in order to ensure that estimates are within the range of previously reported data. Any major changes will be cross-referenced with any new mitigation policy development	
	Ensured that assumption and parameters used are consistent across categories.	
	Ensured that the mitigation assessment is reported in a manner consistent with reporting format in the Non-Annex 1 Biennial Update Reports Reporting Guidelines (Decision 2/CP.17).	
Documentation	Created back-ups of all documentations in hard and soft copies and uploaded files in a central storage facility online.	Sectoral SWG (Mitigation)
	Moved all files and documentations to a database.	GHG Inventory and Reporting Unit, KASA
	Reviewed, approved and harmonised sector files to ensure consistency in filing.	Sectoral SWG (Mitigation)

Further QA checks were carried out by the GHG Inventory and Reporting Unit, KASA during the overall assessment of the mitigation actions. This process was undertaken through workshops conducted with the sectoral leads of the SWG sectoral team and members of the TWG (Mitigation). The output was then tabled to the TCCC for endorsement.

3.1.2 Methodology and Assumptions

Information on the methodology and assumptions used in the quantification of emissions reductions for each of the sectoral mitigation actions is provided in Table B – 1 in the Technical Annex.

3.2 Mitigation Action Assessment

3.2.1 Key Summary

This section describes the summary of the mitigation actions and their effects in the year 2017, 2018 and 2019. Table 3.2 shows the summary of emissions reductions achieved from 16 mitigation actions across the energy, IPPU, agriculture, waste and LULUCF sectors. The total GHG emission reductions achieved (without LULUCF) are 24,450.33 Gg CO_2 eq., 26,327.76 Gg CO_2 eq. and 30,402.76 Gg CO_2 eq. for the year 2017, 2018 and 2019 respectively. Meanwhile, the total emission reductions achieved for the similar years including LULUCF mitigation efforts are 70,743.30 Gg CO_2 eq., 70,515.08 Gg CO_2 eq. and 48,040.54 Gg CO_2 eq. respectively.

Table 3.2: Summary of Emission Reductions Achieved in 2017, 2018, and 2019

Sector	Sub-Sector	Mitigation Actions	Emission Reductions Achieved (Gg CO_2 eq.)		
			2017	2018	2019
Energy	Renewable Energy	**RE Implementation through Feed-in Tariff mechanism**	**507.51**	**676.59**	**908.98**
		• *Biomass*	115.48	129.88	151.28
		• *Biogas*	100.20	169.09	232.88
		• *Small Hydropower*	47.26	44.99	170.39
		• *Solar Photovoltaic*	244.57	332.64	354.42
		Other RE from Public and Private Licensees	**233.19**	**378.19**	**292.33**
		• *Biomass*	225.00	312.10	243.94
		• *Biogas*	7.96	9.37	39.59
		• *Solar Photovoltaic*	0.23	56.71	8.80
		Net Energy Metering	**-**	**5.54**	**5.53**
		Large Scale Solar	**-**	**99.46**	**733.14**
		Hydropower Generation	**9,316.10**	**8,348.13**	**8,194.71**
		• *Large Hydro*	9,299.34	8,236.92	8,065.23
		• *Small Hydro*	16.76	111.21	129.48
	Energy Efficiency	**National Energy Efficiency Action Plan (NEEAP)**	**1,284.18**	**2,144.26**	**3,164.66**
	Transportation	**Rail based public transport**	**179.32**	**200.26**	**269.61**
		Use of energy-efficient vehicles	**119.23**	**114.71**	**140.15**
		Use of palm-based biodiesel in blended petroleum diesel	**1,174.30**	**1,174.30**	**1,677.57**
		Use of natural gas in vehicles	**81.66**	**66.76**	**54.07**
	Oil & Gas	**Reduction of venting and flaring**	**2,940.00**	**3,760.00**	**4,910.00**
Waste		**Paper recycling**	**3,937.76**	**4,398.87**	**4,746.94**
		Biogas recovery from palm oil mill effluent	**3,115.12**	**3,367.78**	**3,749.19**
IPPU		**Material substitution in cement production**	**1,554.27**	**1,585.17**	**1,548.09**
Agriculture		**MyOrganic Certification Program**	**7.68**	**7.76**	**7.80**
LULUCF		**Reducing Deforestation, Sustainable**	**46,292.97**	**44,187.32**	**17,637.78**

Sector	Sub-Sector	Mitigation Actions	Emission Reductions Achieved (Gg CO_2 eq.)		
			2017	2018	2019
		Management of Forest and Conservation of Carbon Stocks			
Total (without LULUCF)			**24,450.33**	**26,327.76**	**30,402.76**
Total (with LULUCF)			**70,743.30**	**70,515.08**	**48,040.54**

Note: As the general rule, the emissions reductions from mitigation actions such as renewable energy (renewable electricity) and energy efficiency are quantified based on the emissions avoidance from displacing and/or reducing the consumption of grid-electricity. In this regard, three regional grid-electricity emission factors were respectively used in 2017, 2018, and 2019 for:

- Peninsular Malaysia: 0.776 tonnes CO_2/MWh, 0.807 tonnes CO_2/MWh and 0.780 tonnes CO_2/MWh;
- Sabah: 0.513 tonnes CO_2/MWh, 0.520 tonnes CO_2/MWh, and 0.527 tonnes CO_2/MWh; and
- Sarawak: 0.213 tonnes CO_2/MWh, 0.193 tonnes CO_2/MWh and 0.222 tonnes CO_2/MWh.

3.2.2 Details of Mitigation Actions

This section provides the details of the mitigation actions across the areas of renewable energy, energy efficiency, transportation, waste, industrial processes and agricultural practices. The GHG emission reductions from mitigation actions in the oil and gas industry (energy sector), cement industry (IPPU sector) and organic farming programme (agriculture sector) are quantified for the first time in this report. The details of each mitigation action are listed in Table B – 2 in the Technical Annex.

3.2.2.1 Renewable energy

The generation of electricity from renewable energy sources quantified in this section are from five major RE programs, namely RE implementation through Feed-in Tariff (FiT) mechanism, RE generation from public and private licensees, hydropower generation, Net-Energy Metering (NEM) mechanism and Large-Scale Solar (LSS) program. From these programmes, the RE generation amounted to 27,294 GWh, 28,138 GWh, and 28,875 GWh, which resulted in the emission reduction of 10,056.81 Gg CO_2 eq., 9,507.89 Gg CO_2 eq., and 10,134.67 Gg CO_2 eq. in 2017, 2018 and 2019 respectively. The largest contribution to emission reduction from renewable electricity is through hydropower generation (excluding hydropower generation under the FiT mechanism), which contributed to 96%, 94% and 90% of the emission reduction achieved in 2017, 2018 and 2019 respectively. Within this period, the contribution of mitigation actions through the RE electricity from solar also increases, mainly through the generation of solar power under the FiT mechanism, as well as the concurrent commencement of two new solar programmes under the NEM scheme and LSS quota.

3.2.2.2 National Energy Efficiency Action Plan (NEEAP)

Recognising the crucial role of demand-side energy efficiency improvement, the National Energy Efficiency Action Plan (NEEAP) was introduced in 2016 by targeting

major end-use energy consumers, namely the residential, commercial and industrial sectors. Through five key initiatives of NEEAP, the total GHG emission reductions achieved were 1,284.18 Gg CO_2 eq., 2,144.26 Gg CO_2 eq. and 3,164.66 Gg CO_2 eq. in 2017, 2018 and 2019. The achievement of NEEAP is also expected to further increase with the latest targets included under the new National Energy Policy 2022-2040, where the percentage of industrial and commercial energy efficiency savings is set at 11% and the percentage of residential energy savings at 10%, both compared to its current level of less than 1%. The details of the achievement from different programs under NEEAP is described in Table B – 3 in the Technical Annex.

3.2.2.3 Rail-based Public Transport

In 2019, the Ministry of Transport launched the National Transport Policy 2019 – 2030 where its vision is anchored on the principles of sustainable transport. With the aim to increase the modal share for public transport made as one of the five policy objectives, this vision is further amplified in the NEP 2040 target of 50% of urban public transport modal share by 2040.

Among its effort to promote the use of urban rail-based public transportation, the coverage of the rail services has been expanded to include the commencement of the new Mass Rapid Transit (MRT) operations. In addition to the existing Light Rail Transit (LRT), KL Monorail and Express Rail Link (ERL) networks, MRT Line 1 which traverses 46 km through 29 stations, with the capacity to serve about 1.2 million people with a daily expected ridership of about 400,000 passengers started its operation in 2017. Concurrently, the construction of 57.7 km tracks for MRT Line 2 continued and the first phase was open to the public in June 2022. Beyond the Klang Valley area, the promotion of rail-based public transport among Malaysians is also done through the operation of the Electric Train Service (ETS) which provides connectivity along the West Coast through its 775-km existing double-tracked and electrified route.

In this section, the GHG emission reduction from the use of railed-based transportation is limited to selected train operations in the Klang Valley area, namely the LRT, Monorail, ERL and MRT lines due to insufficient activity data. In 2017, 2018 and 2019, the total GHG emission reductions achieved were 179.32 Gg CO_2 eq., 200.26 Gg CO_2 eq., and 269.61 Gg CO_2 eq. respectively.

3.2.2.4 Energy Efficient Vehicles (EEVs)

The National Automotive Policy 2014 (NAP2014) set the vision of Malaysia becoming a regional hub for Energy Efficient Vehicles (EEVs) by 2020 through strategic investments and the adoption of high technology. In its fourth version, NAP 2020 envisions the enhancement of Malaysia’s automotive industry through the era of digital industrial transformation with the central concept of Connected Mobility through the application of IR4.0 technologies. In this regard, the NEP 2040 also places a target of 38% of electric vehicle (EV) share in 2040, as compared to the current share of less than 1%.

In reporting mitigation action from EEVs use, the current estimation of GHG emission reductions only takes into consideration of electric cars (EVs) and hybrid cars, as provided by the total motor vehicle registry of the Road Transport Department

Database. In 2017, 2018, and 2019, the use of hybrid and electric vehicles has resulted in a total of 119.23 Gg CO_2 eq., 114.71 Gg CO_2 eq., and 140.15 Gg CO_2 eq. emissions avoidance respectively.

3.2.2.5 Palm oil-based fatty acid methyl ester (Biodiesel)

The National Biofuel Policy was introduced in 2006 under the Ministry of Plantation Industries and Commodities, followed by the introduction of the Malaysian Biofuel Industry Act in 2007 to regulate the biofuel industry and to facilitate the mandatory use of palm-based biodiesel with petroleum diesel. A biodiesel programme known as the B5 programme (a blend of 5% palm-based biodiesel and 95% petroleum diesel) was rolled out in 2011 and up to its end period in 2014, the B5 program had successfully established more than 1,500 retail stations to serve for the biodiesel consumption for the transport sector in Peninsular Malaysia. In 2015, the B7 programme continued as the successor to expand the coverage of this program nationwide, followed by the introduction of B10 programme in 2019 as well as the introduction of the B7 programme for the industry sector.

From 2017 to 2019, the use of palm-based biodiesel in the transport sector has contributed to a cumulative reduction of 4,026.17 Gg CO_2 eq. from a total use of 1,280,654 tonnes of biodiesel.

3.2.2.6 Natural Gas Vehicles (NGVs)

Starting in the late 1990s, the Natural Gas for Vehicles (NGVs) programme was kicked off to promote natural gas-vehicles in the public transport sector, particularly targeting taxis and buses. Through its implementation, there are 103 PETRONAS refueling stations equipped to provide retail services to approximately 77,000 NGVs on the road.

In 2017, 2018 and 2019, the emission reductions achieved from NGVs are 81.66 Gg CO_2 eq., 66.76 Gg CO_2 eq., and 54.07 Gg CO_2 eq. respectively. Overall, the trend emission reduction from this mitigation action shows a declining trend, similar to the declining trend of natural gas consumption in the transport sector, which are mainly due to the reduction of total distance travelled in taxis as well as the phasing out of NGV buses in favour of electric buses.

3.2.2.7 Emission Reductions in Venting and Flaring

The estimations of fugitive emissions of GHG in the oil and gas operations are mainly contributed from the activity of venting and flaring. PETRONAS, the national oil and gas company of Malaysia, is capping its overall GHG emissions at 49,500 Gg CO_2 eq. by 2024 for its Malaysian operations. Through various initiatives and commitments to drive towards the reduction of hydrocarbon venting and flaring under its Carbon Commitments, such as designing all new facilities to be zero continuous venting and flaring as well as reducing venting and flaring of hydrocarbons in all existing facilities. PETRONAS has recorded a reduction of GHG emissions amounting to 2,940.00 Gg CO_2 eq., 3,760.00 Gg CO_2 eq. and 4,910.00 Gg CO_2 eq. for 2017, 2018 and 2019 respectively.

3.2.2.8 Waste-Paper Recycling

The National Cleanliness Policy formulated in 2019 aims to achieve the vision of national socio-economic development with an emphasis on cleanliness and hygiene by 2030. This policy places a focus on environmental sustainability and circular economy as two of its five main clusters. In tandem with this vision, the existing National Solid Waste Management Policy which was revised in 2016 sets a target of redirection of 40% of the waste away from waste disposal sites, which will be achieved through 22% recycling rate and 18% waste treatment.

To ensure the success of the policy, Solid Waste and Public Cleansing Management Corporation (SWCorp) acts as the authority to administer and enforce laws related to solid waste management and public cleansing. Under its role, SWCorp also implements, and monitors programs related to recycling of waste, ranging from paper, plastic, aluminium, metals and other materials. Through various efforts, the recycling rate at the national level shows an improvement from 15% in 2015 to 28% in 2019. As a result, the achievement of recycling activities for paper resulted in emission reductions of 3,937.76 Gg CO_2 eq., 4,398.87 Gg CO_2 eq., and 4,746.94 Gg CO_2 eq. in 2017, 2018, and 2019 respectively. At the moment, only paper recycling is quantified in terms of GHG emission reduction due to insufficient activity data and quantification methods.

3.2.2.9 Biogas Recovery from Palm Oil Mill Effluent (POME)

The total methane recovery from POME through biogas capture facilities shows an increment on a year-to-year basis, as a result of the increment in the number of biogas capture plants installed in POME mills. In 2017, 2018 and 2019, the number of biogas capture plants installed were recorded at 104, 114, and 125, out of 454, 451 and 452 POME mills, respectively. Following these installations, a total of 3,115.12 Gg CO_2 eq., 3,367.78 Gg CO_2 eq., and 3,749.19 Gg CO_2 eq. were recovered from these facilities in 2017, 2018 and 2019 respectively.

3.2.2.10 Material Substitutions in Cement Production

For the cement industry, process emission from cement production is mainly from raw material calcination (98%) and raw meal organic carbon (2%). While the efforts in achieving emission reduction for this industry typically include mitigation initiatives on energy consumption, such as resourcing electricity from renewable energy generation and energy efficiency measures in plants, the quantification of mitigation action in this section focuses specifically on the reduction of emissions from industrial processes.

In the effort to reduce CO_2 emissions, the cement industry has shifted towards low carbon cement production process. This is carried out by replacing part of the clinker with other cementitious materials i.e. pulverised fly ash from coal fired power plants and granulated blast furnace slag. In 2017, 2018 and 2019, the total other cementitious materials used in cement production to replace clinker were 3,018 kt, 3,078 kt and 3,006 kt respectively. These resulted in emission reductions of 1,554.27 Gg CO_2 eq., 1,585.17 Gg CO_2 eq. and 1,548.09 Gg CO_2 eq. respectively.

3.2.2.11 MyOrganic Certification Program

GHG emissions in the agriculture sector are contributed among others, from the use of synthetic fertilisers, pesticides and other chemicals in post-treatment and soil structure improvements. The implementation of the Malaysia Organic (MyOrganic) certification program in 2002 was introduced to recognise good agricultural practices and organic farming nationwide. Through its core principle of no synthetic chemical use, the program is also identified to reduce GHG emissions. From 2002 to 2019, a total of 253 farms have been certified with a total area of 29,824 hectares. In the estimations of GHG emission reductions, the total emission reductions resulting from urea fertilization avoidance and the direct N_2O emissions from managed soils collectively contribute to 7.68 Gg CO_2 eq., 7.76 Gg CO_2 eq., and 7.80 Gg CO_2 eq. for 2017, 2018 and 2019 respectively.

3.2.2.12 Reducing Deforestation, Sustainable Management of Forest and Conservation of Carbon Stocks

Malaysia applied a net-net accounting approach with 2005 as the base year. The emission reductions came from the conservation, implementation of sustainable management of forest and reducing the rate of deforestation activities. An annual maximum cutting limit of 85 m^3 per hectare was implemented since 2006. Despite the annual cap, the harvesting volume continues to be below the approved cap (Table 3.3). In addition, Protected Area also increased by 48%, 58% and 60% respectively for the period of 2017 to 2019 when compared against 2005. Deforestation reduced when compared against the base year. Post-2010 deforestation occurred primarily in severely degraded forest. The GHG emission reduction achieved was 46,292.97 Gg CO_2 eq., 44,187.32 Gg CO_2 eq. and 17,637.78 Gg CO_2 eq. respectively in 2017, 2018 and 2019.

Table 3.3: Total commercial harvest: 2005 and 2017 – 2019

Year	Total Commercial harvest (m^3)
2005	24,922,000
2017	10,674,264
2018	10,272,705
2019	10,962,627

3.3 International Market Mechanisms

Under the UNFCCC, Malaysia had participated in the Clean Development Mechanism and Voluntary Carbon Market. However, the GHG emissions reduction from the market mechanism highlighted in this section is not accounted for as part of the national mitigation actions.

3.3.1 Clean Development Mechanism

Following Malaysia's ratification of the Kyoto Protocol in September 2002 and the Doha Amendment to the Protocol in April 2017, Malaysia developed a national

strategy on Clean Development Mechanism (CDM) that includes both short- and long-term perspectives of the country's position regarding climate change mitigation measures. Overall, Malaysia's participation in the CDM has resulted in diverse investments on GHG emission reduction projects which collectively have contributed to its sustainable development agenda.

As of 2021, Malaysia has a total of 149 CDM projects. In total, these projects involved an estimated investment of USD 453.26 million and resulted in a total of 13,777,247 CERs issued from 2006. Table B - 4 in the Technical Annex shows the distribution of CDM project activities, broken down by the project type, along with their potential annual emissions reductions, CERs issued and the reported investments. A large part of these project activities are related to the oil palm industries in terms of biomass energy generation, methane gas capture and avoidance. Collectively, oil palm-related project activities accounted for 77.9% of Malaysia's CDM pipeline of registered projects, contributing to more than 90% of the total potential emission reduction.

3.3.2 Voluntary Carbon Market

On top of CDM projects, Malaysia also participated in 12 voluntary carbon market projects which consist of eight projects under methane emission avoidance, two hydropower projects, and each one for biomass and reforestation project respectively as shown in Table B – 5 in the Technical Annex.

3.4 Improvement Plan

The GHG emission reductions are estimated from mitigation actions in the five following sectors; energy, IPPU, waste, agriculture and LULUCF sectors, compared to only three sectors reported in BUR3. Estimation of GHG emission reductions from mitigation actions particularly in the IPPU and agriculture sectors are still on-going particularly to obtain the relevant data collection and institutional arrangement for the information gathering. Efforts are also undertaken to institutionalise data collection processes from the relevant ministries/agencies and other stakeholders. As preparation for the transition to the Enhanced Transparency Framework, a new Technical Working Group on Transparency Related Activities have also been established to coordinate work for the future reporting of mitigation actions and in the preparation of information necessary to track progress made in implementing and achieving the NDC under Article 4 of the Paris Agreement.

4. LEVEL OF SUPPORT RECEIVED, CONSTRAINTS, GAPS AND NEEDS

4.1 Introduction

Climate actions in general require adequate finance, low carbon technologies as well as technical, planning and management skills for effective implementation. Mainstreaming climate change into national development plans is a priority and Malaysia continues to channel national resources in advancing its low carbon development agenda and enhance its adaptive capacity. The country has received some financial, technical and capacity building support from international sources.

This chapter provides updated information on the support received by federal and state agencies from multilateral and bilateral sources to address climate change. It also highlights the needs require to strengthen its capabilities for GHG emissions and removals estimation and implementing mitigation and adaptation actions. In addition, Malaysia will require capacity building and technical support to develop innovative sustainable financing mechanism for climate change including carbon pricing instrument.

These needs would help Malaysia implement the climate actions needed to achieve its NDC target as well as towards net zero GHG emissions as early as 2050.

4.2 Level of Support Received

As one of the two operating entities of the financial mechanism of the UNFCCC, the Global Environment Facility (GEF) has been the main source of funding. The funding provided by GEF, other multilateral agencies and bilateral sources were provided through specific projects. A summary of the financial supports received from 2017 onwards was also provided. Information on financial support received reported in previous BURs reports are not reported here unless there have been changes to the project duration or to the approved amount.

4.2.1 Global Environment Facility

Table 4.1 shows the funding allocated and received by Malaysia from GEF cycle 1 to 7 (June 1994 – June 2022) for climate change activities. From GEF cycle 4 to 7 (June 2006 – June 2022), Malaysia was allocated an indicative sum of USD43,770,035 and utilised USD38,030,884. The support received has been primarily used to develop the country's institutional and technical capacity on reporting obligations to the UNFCCC as well as the implementation of mitigation actions. The United Nations Development Programme (UNDP), the United Nations Industrial Development Organisation (UNIDO) and International Fund for Agricultural Development (IFAD) have facilitated these actions.

The funding received under GEF-6 and GEF-7 cycles were primarily used to build up technical and technological capacities. Sectors that have also received financial

support for mitigation projects were transport, energy, forestry (including peatland), low carbon cities and community empowerment projects.

Table 4.1: Summary of Global Environment Facility Funding on Climate Change Activities to Malaysia

GEF Cycle	Period	Indicative Allocation (USD)	Amount Utilised (USD)
1	July 1994 – June 1998	7,770,600	N/A
2	July 1998 – June 2002	4,000,000	N/A
3	July 2002 – June 2006	8,699,420	N/A
4	July 2006 – June 2010	11,800,000	10,768,500
5	July 2010 – June 2014	14,240,000	14,234,249
6	July 2014 – June 2018	11,964,400	7,262,500
7	July 2018 – June 2022	5,765,635	5,765,635

Note: N/A - data is not available

In the preparation of this report (BUR4), the allocation of USD352,000 from GEF for the preparation of BUR3 was used. This was made possible as the remaining of the previous allocation for BUR2 was used to prepare BUR3 and the report was submitted on 31 December 2020.

4.2.2 Green Climate Fund (GCF)

Malaysia has explored opportunities to access the Green Climate Fund and has received readiness support to enhance its implementation framework to access results-based payment. It is also in the process of applying for funding to support the development of a comprehensive National Adaptation Plan.

4.2.3 Multilateral and Bilateral Funding and Support

The updated information on financial support received from various sources since those reported in BUR3 is shown in Table 4.2.

Table 4.2: Financial Support Received from Various Sources

Source	Project Description	Focus of support	Project Duration	Implementing Agencies	Delivery Partners	Approved Amount
GEF	Sustainable Management of Peatland Ecosystems in Malaysia	Technical; Capacity-building; Mitigation	2020 – 2024	KETSA	IFAD	USD9,433,027
	Fourth National Communication and Third Biennial Update Report on Climate Change for Malaysia	Technical; Capacity-building; Reporting	2021 – 2024	KASA	UNDP	USD852,000
	Small Grant Programme Sixth Operational Phase	Technical; Capacity-building; Community level mitigation, education and awareness	2016 – 2020	NGOs and CBOs	UNDP	USD317,872
GCF	Energy Sector Programme Prioritisation, Direct Access Entity Support and Green Cities Fund Development	Technical; Capacity-building	2018 – 2019	MESTECC	Carbon Trust	USD300,000
	Strategic Frameworks support for Malaysia: Accessing REDD+ result-based payments in Malaysia	Technical; Capacity-building; Reporting	2019 – 2021	KETSA	UNEP	USD798,327
UK	Disaster Resilient City (Forecasting Local Level Climate Extremes and Physical Hazards for Kuala Lumpur)	Technical; Capacity-building; Community-level outreach	2017 – 2019	SEADPRI, UKM	MIGHT and Innovate-UK.	£875,000

4.2.4 Other Capacity Building Assistance

Malaysia has received capacity-building support on a wide range of training programmes conducted between 2017 and 2019.

Capacity building training received were in areas such as GHG inventory, mitigation (measurement, reporting and verifying emissions data), adaptation planning, implementing and enhancing NDC, climate negotiations, climate finance and Article 6 and 13 of the Paris Agreement. These trainings were provided by UNFCCC's Consultative Group of Experts (CGEs), the Intergovernmental Panel on Climate Change (IPCC), GCF, different multilateral organisations as well as Annex I Parties. In addition, several training programmes were provided by a few non-Annex I Parties. Malaysia also attended a training workshop to enhance climate negotiation skills organised by the European Capacity Building Initiative (ECBI) and the China-ASEAN workshop on climate change policies and actions organised by China.

Malaysia continues to participate in the annual Workshop on GHG Inventories in Asia (WGIA) conducted by the National Institute for Environmental Studies (NIES), Japan. Malaysian officials attended various regional training sessions on mitigation action conducted by the UNFCCC, ASEAN, Asian Development Bank, GCF and the Japan International Cooperation Agency (JICA) on the development of mitigation strategies and mechanisms. In the area of adaptation, the UNFCCC and IPCC provided training on identifying and reporting adaptation actions. Malaysia also received support from Germany via GIZ and Japan via JICA on climate change action development and implementation. Malaysia also received support from World Health Organisation (WHO) on vulnerability and adaptation assessment on climate-related health effects.

The Iskandar Regional Development Authority (IRDA) in Johor state and the Melaka Green Technology Corporation have received capacity-building support from the United Kingdom Prosperity Fund's Future Cities Programme in the area of green mobility. IRDA has also received capacity-building assistance from the Ministry of Environment Japan under its Joint Credit Mechanism's City to City Collaboration for Building Energy Monitoring and Reporting System.

4.3 Constraints, Gaps and Needs

Malaysia continues to face challenges in implementing its commitments to address climate change. This ranges from availability of finance in light of competing needs with other development programmes, recovery from the covid pandemic, technology as well as technical and human capacity. During the International Consultation and Analysis of Malaysia's third BUR, the Team of Technical Experts (TTE) identified the following capacity-building needs:

(a) Developing country specific EFs to enable application of the tier 2 methodology for the largest emissions sources in the energy sector;

(b) Developing methodologies and collecting data for estimating GHG emission reductions for non-quantified initiatives, especially for reducing

fugitive emissions by oil/gas operators, substituting material in the cement and iron and steel industries, and recycling non-paper materials;

(c) Developing country-specific EFs and improving AD to enable application of the first-order decay model in the waste sector;

(d) Long term modelling especially on the AFOLU sector, modelling mitigation assessment scenarios from the waste and IPPU sectors, as well as sector-wise factor/decomposition analyses;

(e) Enhancing the national capacity to conduct the technology needs assessment, when required, by improving access to adequate financial resources and technical support from international sources; and

(f) Enhancing the national capacity to estimate emissions from soils and use models, such as the Yasso model.

In addition, the TTE in consultation with Malaysia also identified a need for capacity-building that could facilitate the Party's transition to the enhanced transparency framework under the Paris Agreement, namely enhancing the national capacity for future scenario analysis, including factor analysis and decomposition analysis at the sectoral level.

Although Malaysia has reported its GHG inventory and mitigation actions and their effects, however gaps remain in the reporting. In the GHG inventory report, gaps still exist in the completeness, use of country specific emission factors and activity data. Malaysia is only beginning to report on its achievement of NDC. Hence additional technical capacity building and financial assistance would be required to develop systems to track the NDC implementation and cooperative approaches (Article 6 of Paris Agreement).

Malaysia's needs for external financial, technical/technology and capacity building support are summarised according to the thematic areas of Greenhouse Gas Inventories, Mitigation and Adaptation in Table 4.3, 4.4 and 4.5 respectively. These needs had been identified by the proponent agencies and nationally agreed upon through workshop consultations and reviewed by the TWG on Finance and Needs as well as been endorsed by the NSCCC

Table 4.3: Summary of Needs for GHG Inventory Improvement for Key Emitting Sectors

Sector	Activity	Lead Agencies	Status/ Duration	International support needed		
				Finance	Technical/ Technology	Capacity-building
All sector	Development of country-specific Emission Factors (CSEFs) for key categories	KASA	3 years	USD 2 mil	Not required	Development of CSEFs for key categories
Waste	Improvement on GHG calculation for domestic wastewater treatment and discharge	KASA, SSD	2 years	USD250,000	Not required	Training on GHG methodology and calculation (i.e. incorporate existing data available into the IPCC calculation template) to complete national reporting

Table 4.4: Summary of Needs for Mitigation Actions in Energy, IPPU, Waste, Forestry and Agriculture Sectors

Sector	Activity	Lead Agencies	Status/ Duration	International support needed		
				Finance	Technical/ Technology	Capacity-building
Industrial Processes	Reduction of emissions from the iron and steel industry	MISIF	New project	USD40 mil	Scrap pre-heating	Training on iron & steel Life-cycle Assessment and GHGs emission calculation
			New project	USD3.7 mil	EAF Meltshop Dedusting system	Carbon reduction strategy, Social Impact Assessment, Corporate Sustainability Foundation and Sustainability concept, myth & integration
			New project	USD2.2 mil	Carbon capture project	
			New project	USD220,000	Wet scrubber for Sinter Plant	
	Establishment of National Life Cycle Inventory Database	MITI, SIRIM	Extension to National programme	Not required	Expert technical review	National LCID governance. IT-based capacity development for

Sector	Activity	Lead Agencies	Status/ Duration	International support needed		
				Finance	Technical/ Technology	Capacity-building
	(LCID) for major industries specifically for iron and steel, cement and semiconductor industries		– new project			interoperable system to Global LCA Data Access (GLAD) network
	Reduction of emissions from the cement industry	C&CA	New Project	To be assessed	Carbon capture and processing for utilization in secondary cementitious material production	• R&D centre and researcher training • Presentation by technology provider to industry • Transfer of technology & knowledge to local universities and local technology partner • Collaboration/Partnerships with CIDB, SIRIM on cement standard
		C&CA	New Project	To be assessed	CO_2 storage and sequestration in a suitable geologic medium	• Training on selection of suitable geologic medium and site preparation • Collaboration with oil & gas companies and JMG to identify suitable storage / aquifer on land & sea for CO_2 storage
		Cement and construction sector/CIDB	New Project	To be assessed	Not required	Training to promote change in construction and precast sectors, to convert from using Portland cement to increasing use of low carbon cement and concrete
		MIDA, MITI, KASA	New Project	Not required	R&D on captured CO_2	Collaboration with MNC or other industries to identify off-take of

Sector	Activity	Lead Agencies	Status/ Duration	International support needed		
				Finance	Technical/ Technology	Capacity-building
						captured CO_2 to be utilised in food industry, gas industry etc
Transpor-tation	Develop techno-economic model and roadmap for e-Bus, e-2-wheelers, e-goods transfer and e-company fleet and propose incentive mechanism for commercial electric vehicle nationwide	MoT, APAD	2021 - 2030	Not required	Technical expertise for the development of the techno-economic incentive mechanism	Not required
	Second generation biodiesel	MPIC, MPOB	New project	USD50,000	• Joint R&D • Sharing of technology	Training on policy and technical knowledge
Waste	Improvement of performance efficiency and optimisation of resource recovery for anaerobic digestion of industrial wastewater for palm oil mills	MPIC, MPOB	On-going	Not required	Technology concerning biotechnology/biology synthesis and engineering	Training and collaboration needed with international technology to develop waste management locally
	Policy development on cleaner and climate-friendly sewerage treatment plants	KASA, SPAN MHLG, SSD & IWK	New project	Not required	Technical expertise and technological options for cleaner and climate-friendly	Training on developing policy options for cleaner and climate-friendly sewerage treatment plant

Sector	Activity	Lead Agencies	Status/ Duration	International support needed		
				Finance	Technical/ Technology	Capacity-building
					sewerage treatment plant	
Urban planning	Incorporating low carbon reduction strategies and climate change adaptation into town planning process	Town and Country Planning Department	New project	Not required	Tools for town planners to quantify the value of carbon emissions based on land use planning	Training to develop in-house expertise to understand the carbon emissions magnitude from urban development processes and land use change
Infrastruc-ture Buildings	Sustainable building project through MyCREST assessment	CIDB	3 years	USD450,000	Not required	Training to build up local capacity in designing, constructing, operating and maintaining sustainable building
	Sustainable infrastructure project through Sustainable INFRASTAR assessment	CIDB	3 years	USD450,000	Not required	Training to build up local capacity in designing and constructing sustainable infrastructure projects
Cross-cutting	Implementation of Article 6 of the Paris Agreement Rules, Modalities and Procedures	KASA	3 years	Not required	Technical capacity to develop tracking system for ITMOs	Capacity-building on applying corresponding adjustments
	Green Investment manual for Iskandar Malaysia	IRDA	1year	USD135,000	Dispatch technical assistance/ project funding	Provide capacity building programme for agency and local authorities
	• Capacity building on climate action for the financial sector.	Capital Markets Malaysia	2023-2025	Not required	Not required	Training and best practice sharing on:

Sector	Activity	Lead Agencies	Status/ Duration	International support needed		
				Finance	Technical/ Technology	Capacity-building
	• Capacity building on sustainable corporate practices for corporations • Capacity building and best practice sharing for the investment community					• innovative climate finance and social finance products and services; • ESG for corporations; and • sustainable investment best practices, stewardship, and engagement
Carbon Market	Capacity building programmes targeted at various stakeholders involved in the development of a voluntary carbon market, including potential buyers and suppliers of carbon credits.	Bursa Malaysia Berhad	2023-2025	Not required	Not required	Training on voluntary carbon market project development and corporate offsetting.

Table 4.5: Summary of Needs for Adaptation in Various Sectors

Sector	Activity	Lead Agencies	Status/ Duration	International support needed		
				Finance	Technical/ Technology	Capacity-building
Climate modelling and V&A assessment	Down-scaling climate change scenarios at local/city level for vulnerability and adaptation assessment	KASA; NAHRIM with TWG V&A; UKM; MET Malaysia	New project	USD5 mil	Technology to downscale and interpret climate outputs for adaptation policy options; sectoral tools and models for V&A assessment	Training to develop in-house expertise within NAHRIM to downscale climate change scenarios at national level. Training for sectoral expertise to carry out V&A assessment.
Policy Development	Development of National Adaptation Plan	KASA	New project	USD3 mil	Policy tools to make decision on adaptation measures to take	Identification of priority adaptation sectors and spatial areas.
Disaster Risks Management	Science, technology and innovation (STI) for integrating disaster risk reduction (DRR) and climate change action at local levels.	MOSTI/ASM/ NADMA	New project (2023-2027)	USD2 mil	Review of good practices to provide practical insights into the integration of disaster risk reduction and climate change adaptation agendas in cities.	Trainings and workshops for technical experts to enhance their knowledge in producing materials and technologies and foster innovative and forward-thinking solutions to help decision-makers and stakeholders on integrating disaster risk reduction and

Sector	Activity	Lead Agencies	Status/ Duration	International support needed		
				Finance	Technical/ Technology	Capacity-building
						climate change action at local levels.
	Incorporating climate change factor into flood mitigation and drainage project design taking into account rainfall patterns	DID	On-going	Not required	Technical expertise to review and improve current climate change factors for flood mitigation and drainage project design taking into account rainfall patterns	Workshops to train local officers in reviewing climate change factors.
		SEDIA, Sabah DID, Sabah Environment Protection Department, Sabah Ministry of Local Government and Housing, Sabah Forestry Department, Sabah Town and Regional Planning Department	In planning 2022 – 2030 (SDC Blueprint 2.0)	Yes	Expertise to evaluate and enhance the existing climate change aspects in storm drainage design	Workshops to train local officers in analysing climate change aspects

Sector	Activity	Lead Agencies	Status/ Duration	International support needed		
				Finance	Technical/ Technology	Capacity-building
	National Flood Forecasting and Warning Programme	DID	On-going	No	Technical expertise to: • review and improve the flood forecast techniques for adopting climate change factors • review and enhance flood-related variables resulting from present climate change especially for flash flood and monsoon flood	Training to improve local expertise on: • hydrometeorology in utilising Numerical Weather Prediction and radar data • Use of artificial intelligence and machine learning for flood forecasting
		SEDIA and Sabah DID	In planning 2022 – 2030 (SDC Blueprint 2.0)	Yes	Technical expertise to review and enhance flood-related variables resulting from present climate change	Workshop to train local officers in analysing climate change aspects

Sector	Activity	Lead Agencies	Status/ Duration	International support needed		
				Finance	Technical/ Technology	Capacity-building
	Action Plan for Living with Risks – Resilience City	IRDA	New project – one year	USD1.2 mil	Dispatch technical assistance/ Project funding	Provide capacity-building programme for agency and local authorities
	Review and update of Drainage and Stormwater Management Blueprint for Iskandar Malaysia with Integration of Flood Hazard and Risk Map to develop a Smart Disaster Risk Management System	IRDA		USD450,000	Dispatch technical assistance/ Project funding	Provide capacity-building programme for agency and local authorities
Agriculture	Soil Doctor Programme (under the FAO Global Soil Partnership)	DoA (PM)	2026-2030	USD50,000	Soil management techniques	To strengthen the capacity of farmers on sustainable soil management by providing soil doctors with training, educational material and soil testing kits to build capacity on the principles of soil science and promote the practice of sustainable soil management

Sector	Activity	Lead Agencies	Status/ Duration	International support needed		
				Finance	Technical/ Technology	Capacity-building
	Improvement of performance efficiency and optimisation on water recycle system for kenaf bio-retting and degumming processing	MPIC, NKTB	On-going	Not required	Technology concerning biotechnology/biology synthesis and engineering	Training to develop expertise within NKTB officers to innovate and optimize the bio-retting systems in concern with sustainable water recycling model
Water and Coastal Resources	Enhancing water resources security	KASA, DID	On-going	USD50 mil	Technology that can capture and integrate flood water as part of water resources in urban areas	Not required
	Adaptive Planning for Climate Change and Biodiversity Conservation in Coastal Ecosystems through improved Knowledge Management and Observatory Systems	IRDA	One-year	USD450,000	Dispatch technical assistance	Provide capacity-building programme for agency and local authorities
Public Health	Assessment of climate vulnerabilities of island communities	MoH (IMR)	New project (3 years)	USD560,000	Development of tools and methods of assessing public	Public health adaptation plan and management

Sector	Activity	Lead Agencies	Status/ Duration	International support needed		
				Finance	Technical/ Technology	Capacity-building
					health vulnerability among remote and small island communities	
Infrastructure and Buildings	Resilient construction courses on landslide	CIDB	3 years	USD450,000	Not required	Training to build up local understanding and knowledge in conducting risk and vulnerabilities assessment for landslide
	Resilient construction courses on flood	CIDB	3 years	USD450,000	Not required	Training to build up local understanding and knowledge in conducting risk and vulnerabilities assessment for floods

TECHNICAL ANNEX

Note: The following standard indicators are used for the Tables in this Technical Annex:

NO (Not occurring) for activities or processes that do not occur for a particular gas or source/sink category within a country;
NE (Not estimated) for existing emissions and removals which have not been estimated;
NA (Not applicable) for activities in a given source/sink category which do not result in emissions or removals of a specific gas;
IE (Included elsewhere) for emissions or removals estimated but included elsewhere in the inventory;
C denotes confidential data.

Table A - 1: Methodological Tiers and Type of Emission Factors

		CO_2		CH_4		N_2O	
		Method	EF	Method	EF	Method	EF
1 ENERGY							
1A Fuel Combustion Activities							
1A1 Energy Industries							
1A1a	Electricity and Heat Production						
1A1ai	Electricity Generation	T1	D	T1	D	T1	D
1A1 aii	Combined Heat and Power Generation (CHP)	T1	D	T1	D	T1	D
1A1 aiii	Heat Plants	-	-	-	-	-	-
1A1 b	Petroleum Refining	T1	D	T1	D	T1	D
1A1 c	Manufacture of Solid Fuels and Other Energy Industries						
1A1 ci	Manufacture of Solid Fuels	-	-	-	-	-	-
1A1 cii	Other Energy Industries	T1	D	T1	D	T1	D
1A2 Manufacturing Industries and Construction							
1A2 a	Iron and Steel	T1	D	T1	D	T1	D
1A2 b	Non-Ferrous Metals	T1	D	T1	D	T1	D
1A2 c	Chemicals	T1	D	T1	D	T1	D
1A2 d	Pulp, Paper and Print	T1	D	T1	D	T1	D
1A2 e	Food Processing, Beverages and Tobacco	T1	D	T1	D	T1	D
1A2 f	Non-Metallic Minerals	T1	D	T1	D	T1	D
1A2 g	Transport Equipment	T1	D	T1	D	T1	D
1A2 h	Machinery	T1	D	T1	D	T1	D
1A2 i	Mining (excluding fuels) and Quarrying	-	-	-	-	-	-
1A2 j	Wood and wood products	T1	D	T1	D	T1	D
1A2 k	Construction	-	-	-	-	-	-
1A2 l	Textile and Leather	T1	D	T1	D	T1	D

		CO_2		CH_4		N_2O	
		Method	EF	Method	EF	Method	EF
1A2 m	Non-specified Industry	T1	D	T1	D	T1	D
1A3 Transport							
1A3 a	Civil Aviation	T1	D	T1	D	T1	D
1A3 ai	International Aviation	T1	D	T1	D	T1	D
1A3 aii	Domestic Aviation	T1	D	T1	D	T1	D
1A3 b	Road Transportation	T1	D	T1	D	T1	D
1A3 c	Railways	T1	D	T1	D	T1	D
1A3 d	Water-borne Navigation	T1	D	T1	D	T1	D
1A3 di	International Water-borne Navigation	T1	D	T1	D	T1	D
1A3 dii	Domestic Water-borne Navigation	T1	D	T1	D	T1	D
1A4	**Other Sectors**						
1A4 a	Commercial/Institutional	T1	D	T1	D	T1	D
1A4 b	Residential	T1	D	T1	D	T1	D
1A4 c	Agriculture/Forestry/Fishing/Fish Farms	T1	D	T1	D	T1	D
1A4 ci	Stationary	T1	D	T1	D	T1	D
1A4 cii	Off-road Vehicles and Other Machinery	T1	D	T1	D	T1	D
1A4 ciii	Fishing (mobile combustion)	T1	D	T1	D	T1	D
1A5	**Non-Specified**						
1A5 a	Non specified stationary	-	-	-	-	-	-
1A5 b	Non specified mobile						
1A5 bi	Mobile (aviation component)	T1	D	T1	D	T1	D
1A5 bii	Mobile (water-borne component)	T1	D	T1	D	T1	D
1A5 biii	Mobile (other)	T1	D	T1	D	T1	D
1B Fugitive Emissions from Fuels							
1B1 Solid Fuels							
1B1a	Coal mining and handling			T1	D		
1B1 ai	Underground mines			T1	D		

		CO_2		CH_4		N_2O	
		Method	EF	Method	EF	Method	EF
1B1 aii	Surface mines			T1	D		
1B1b	Uncontrolled combustion and burning coal dumps	-	-	-	-	-	-
1B1c	Solid fuel transformation	-	-	-	-	-	-
1B2 Oil and Natural Gas							
1B2a	Oil						
1B2ai	Venting	T1	D	T1	D	-	-
1B2aii	Flaring	T1	D	T1	D	-	-
1B2aiii	All Other	T1	D	T1	D	-	-
1B2b	Natural Gas						
1B2bi	Venting	T1	D	T1	D	-	-
1B2bii	Flaring	T1	D	T1	D	-	-
1B2biii	All Other	T1	D	T1	D	-	-
2 Industrial Processes and Product Use							
2A Mineral Industry							
2A1	Cement Production	T2	CS				
2A2	Lime Production	T1	D				
2A3	Glass Production	T1	D				
2A4	Other Process Uses of Carbonates	T1	D				
2B Chemical Industry							
2B1	Ammonia Production	T2	D				
2B5	Carbide Production	T1	D				
2B8	Petrochemicals and Carbon Black Production	T1	D	T1	D		
2C Metal Industry							
2C1	Iron & Steel Production	T1	D	T1	D		
2C2	Ferroalloy Production	T1	D	T1	D		
2C3	Aluminium Production	T1	D				
2E Electronics Industry							

		CO_2		CH_4		N_2O	
		Method	EF	Method	EF	Method	EF
2E1	Semiconductor Production	T1	D	-	-	-	-
2E3	Photovoltaics Production	T1	D	-	-	-	-
2F Product Uses as Substitutes for Ozone Depleting Substances							
2F1	Mobile Air-Conditioning	T2	D	-	-	-	-
2G Other Product Manufacture and Use							
2G1	SF_6 Use in Electrical Equipment	T1	D	-	-	-	-
2G3a	N_2O in Medical Applications	-	-	-	-	T1	D
3 AFOLU							
3A Livestock							
3A1	Enteric Fermentation	-	-	T1	CS, D	-	-
3A2	Manure Management	-	-	T1	CS, D	T1	CS, D
3B Land							
3B1	Forest Land Remaining Forest Land	T2	CS, D	T1	D	T1	D
3B2	Cropland Remaining Cropland	T2	CS	T1	CS	T1	D
3B3	Grassland Remaining Grassland	T1	-	-	-	-	-
3B4	Wetland Remaining Wetlands	T1	-	-	-	-	-
3B5	Settlement Remaining Settlement	T1	CS, D	-	-	-	-
3B6	Other Land remaining Other Land	-	-	-	-	-	-
3C Aggregate Sources and Non-CO_2 Emissions Sources on Land							
3C1	Biomass burning in Cropland	-	-	T1	D	T1	D
3C2	Liming	T1	D	-	-	-	-
3C3	Urea Application	T1	D	-	-	-	-
3C4	Direct N_2O Emissions from Managed Soils	-	-	-	-	T1	CS, D
3C5	Indirect N_2O Emissions from Managed Soils	-	-	-	-	T1	D
3C6	Indirect N_2O Emissions from Manure Management	-	-	-	-	T1	D
3C7	Rice Cultivations	-	-	T1	D	-	-

		CO_2		CH_4		N_2O	
		Method	EF	Method	EF	Method	EF
4 Waste							
4A	**Solid Waste Disposal Sites**	-	-	T1	D	-	-
4B	**Biological Treatment of Solid Waste**	-	-	T1	D	T1	D
4C Incineration and Open Burning of Waste							
4C1	Incineration	T2a	D	T2a	D	T2a	D
4C2	Open Burning	T1	D	T1	D	T1	D
4D Wastewater Treatment and Discharge							
4D1	Domestic Wastewater	-	-	T1	D	-	-
4D2 Industrial Wastewater							
	POME Methane Emission	-	-	T2	CS	-	-
	Rubber	-	-	T1	D	-	-
	Petroleum Refineries	-	-	T1	D	-	-
	Pulp & Paper	-	-	T1	D	-	-
	Meat & Poultry	-	-	T1	D	-	-

Note:
D represents IPCC default
CS represents country-specific
T refers to IPCC Tiers

Table A - 2: Summary of Emission Factors Used
Energy Sector (1 of 4)

		Emission factors										
		CO_2 (kg /TJ)	CH_4 (kg /TJ)	N_2O (kg /TJ)	HFCs	PFCs	SF_6	NF_3	NO_X	CO	NMVOCs	SO_2
ENERGY												
1A Fuel Combustion Activities												
1A1 Energy Industries												
1A1a Electricity and Heat Production												
1A1ai	Electricity Generation											
	Diesel oil	74100	3	0.6								
	Residual Fuel Oil	77400	3	0.6								
	Bituminous	94,600	1	0.5								
	Sub-bituminous coal	96100	1	0.5								
	Lignite	101000	1	0.5								
	Natural Gas	56100	1	0.1								
	Biomass (Other Primary Solid Biomass)	100,000	30	4								
	Biogas (Other Biogas)	54,600	1	0.1								
1A1b	Petroleum Refining											
	Crude oil	73300	3	0.6								
1A1c	Manufacture of Solid Fuels and Other Energy Industries											
	Natural gas	56100	1	0.1								
1A2 Manufacturing Industries and Construction												
	Natural gas	56100	1	0.1								
	Motor Gasoline	69300	3	0.6								
	Gas/Diesel oil	74100	3	0.6								
	Residual Fuel Oil	77400	3	0.6								
	LPG	63100	1	0.1								
	Other kerosene	71900	3	0.6								
	Sub-bituminous coal	96100	10	1.5								
1A3 Transport												
1A3a	Civil Aviation											
1A3aii	Domestic Aviation											
	Jet kerosene	71500	0.5	2					7.19	13.03	0.75	0.79

Energy Sector (2 of 4)

		Emission factors										
		CO_2 (kg /TJ)	CH_4 (kg /TJ)	N_2O (kg /TJ)	HFCs	PFCs	SF_6	NF_3	NO_X	CO	NMVOCs	SO_2
1A3b	Road Transportation											
	Gasoline	69300	33	3.2								
	Diesel Oil	74100	3.9	3.9								
	Natural gas	56100	92	3								
	Biodiesel	70800	3	0.6								
1A3c	Railways											
	Diesel Oil	74100	4.15	28.6								
1A3d	Water-borne Navigation											
1A3dii	Domestic Water-borne Navigation											
	Diesel Oil	74100	7	2								
	Residual Fuel Oil	77400	7	2								
1A3eii	Off Road											
	Motor Gasoline	69300	33	3.2								
1A4 Other Sectors												
1A4a	Commercial/Institutional											
	Diesel Oil	74100	10	0.6								
	Residual Fuel Oil	77400	10	0.6								
	LPG	63100	5	0.1								
	Natural Gas	56100	5	0.1								
1A4b	Residential											
	Other kerosene	71900	10	0.6								
	LPG	63100	5	0.1								
	Natural Gas	56100	5	0.1								
1A4c	Agriculture/Forestry/Fishing/Fish Farms											
1A4ci	Stationary											
	Motor gasoline	69300	10	0.6								
	Diesel oil	74100	10	0.6								
	Residual Fuel oil	77400	10	0.6								
1A4cii	Off-road Vehicles and Other Machinery											
	Residual Fuel oil	77400	10	0.6								
1A4ciii	Fishing (mobile combustion)											
	Motor gasoline	69300	10	0.6								
	Diesel oil	74100	10	0.6								

Energy Sector (3 of 4)

		Emission factors										
		CO_2 (kg /TJ)	CH_4 (kg /TJ)	N_2O (kg /TJ)	HFCs	PFCs	SF_6	NF_3	NO_X	CO	**NMVOCs**	**SO_2**
1A5 Non-Specified												
1A5 b	Mobile											
1A5bi	Non specified mobile (aviation)											
	Jet Kerosene	71500	0.5	2								
1A5bii	Non specified mobile (waterborne)											
	Diesel Oil	74100	7	2								
1A5biii	Non specified mobile (other)											
	Diesel Oil Motor Gasoline	74100 69300	3.9 33	3.9 3.2								
1B Fugitive Emissions from Fuels												
1B1	Solid Fuels											
1B1a	Coal mining and handling											
1B1ai	Underground mines											
1B1Ai	Mining	-	10	-								
1B1Ai2	Post Mining seam gas emissions	-	2.45	-								
1B1ai3	Abandoned underground mines (m^3/year)	-	0.3430	-								
1B1aii	Surface mines (m^3 $tonne^{-1}$)											
	Mining		0.3									
	Post Mining		0.1									
1B2	Oil and Natural Gas											
1B2a	Oil											
1B2ai	Venting (Gg/10^6 m^3 gas)	0.0049	0.66	0								
1B2aii	Flaring (Gg/10^6 m^3 gas)	2.0	0.012	0.0000230								
1B 2aiii	All Other (Gg/10^3 m^3 oil)											
1B2Aiii2	Production and Upgrading	$4.3x10^{-8}$	$5.9x10^{-7}$	-				NA	NA	$7.4 x10^{-7}$	NA	
1B2aiii4	Refining	0	$6.4x10^{-6}$	-				NA	NA	$1.3 x10^{-3}$	NA	

Energy Sector (4 of 4)

		Emission factors										
		CO_2 (kg /TJ)	CH_4 (kg /TJ)	N_2O (kg /TJ)	HFCs	PFCs	SF_6	NF_3	NO_X	CO	NMVOCs	SO_2
1B2b	Natural Gas (Gg/10^6 m^3 gas)											
1B2bii	Flaring	2.0	0.012	$2.3x10^{-5}$					NA	NA	NA	NA
1B 2biii	All Other											
1B2biii2	Production	$3.6x10^{-5}$	$2.74x10^{-3}$						NA	NA	$2.02x10^{-4}$	NA
1B2biii3	Processing	$1.7x10^{-4}$	$5.42x10^{-4}$						NA	NA	$2.49x10^{-4}$	NA
1B2biii4	Transmission & Storage	$9.92x10^{-7}$	$2.59x10^{-4}$						NA	NA	$7.90x10^{-6}$	NA
1B2biii5	Distribution	$5.99x10^{-5}$	$1.24x10^{-3}$						NA	NA	$1.80x10^{-5}$	NA

IPPU Sector (1 of 2)

		Emission factors										
		CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	NF_3	NO_X	CO	$NMVOC_s$	SO_2
INDUSTRIAL PROCESSES AND PRODUCT USE												
2A Mineral Industry												
2A1	Cement Production	0.515										
2A2	Lime Production	0.75										
2A3	Glass Production	0.2										
2A4	Other Process Uses of Carbonates	0.43971 (Limestone) 0.47732 (Dolomite)										
2B Chemical Industry												
2B1	Ammonia Production	C							1 kg/ tonne ammonia	0.1 kg/tonne ammonia		
2B5	Carbide Production	1.1										
2B8	Petrochemicals & Carbon Black Production	Methanol - 0.67 Ethylene: - 0.76 (Ethane as feedstock) - 1.73 (Naphtha as feedstock) Ethylene Oxide – 0.663	Ethylene 6 (Ethane as Feedstock) 3 (Naphtha as Feedstock) Ethylene Oxide – 1.79 Methanol – 2.3 Carbon Black – 0.06									
2C	Metal Industry											
2C1	Iron & Steel Production											
	Electric Arc Furnace Basic Oxygen Furnace Sinter Coke Iron	0.08 1.46 0.2 0.56 1.35	0.07 0.0001								150 g /Mg steel	
2C2	Ferroalloy Production											
		1.4 (silicon manganese) 2.5 (ferrosilicon) 1.5(ferromanganese)	1 (FeSi) 1.2 (Si-metal)									
2C3	Aluminium Production	1.6				0.4 kg CF_4/t Al; 0.04 kg C_2F_6/t Al			1 kg/ Mg Al	120 kg/ Mg Al		4.5 kg/ Mg Al

IPPU Sector (2 of 2)

		Emission factors										
		CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	NF_3	NO_X	CO	$NMVOC_s$	SO_2
2E Electronic Industry												
2E1	Semiconductor production					CF_4: 0.9 kg/m^2 C_2F_6: 1 kg/m^2 CHF_3: 0.04 kg/m^2 C_3F_8: 0.05kg/m^2	0.2 kg/m^2	0.04 kg/m^2				
2E3	Photovoltaics Production					CF_4: 0.005 g/m^2 C_2F_6: 0.0002 g/m^2						
2F Product Uses as Substitutes for Ozone Depleting Substances												
2F1	Mobile Air-Conditioning				0.5% (assembly loss); 10% (annual leakage rate)							
2G Other Product Manufacture and Use												
2G1	Electrical Equipment						0.007					
2G3a	Medical Applications			1.0								

AFOLU Sector (1 of 4)

		Emission factors								
		CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	NF_3	NO_X	CO
AGRICULTURE, FORESTRY AND OTHER LAND USE										
3A Livestock										
3A1	Enteric Fermentation		Kg/head/yr							
	Dairy Cows		68							
	Other Cattle		58.65							
	Buffalo		55							
	Sheep		5							
	Goats		5							
	Camels		-							
	Horses		18							
	Mules and Asses		-							
	Swine		1							
	Poultry (Chicken)									
	Poultry (Ducks)									
	Other[1]									
3A2	Manure Management		(kg $head^{-1}$ yr^{-1})	[kg N_2O-N (kg N in MMS)$^{-1}$]						
	Dairy Cows		31	0.005						
	Other Cattle		1.24	0.005						
	Buffalo		2	0.005						
	Sheep		0.2	0.005						
	Goats		0.22	0.005						
	Camels									
	Horses		2.19							
	Mules and Asses									
	Swine		7	0.005						
	Poultry (Chicken)		0.02	0.001						
	Poultry (Ducks)		0.02							
	Other									

AFOLU Sector (2 of 4)

		Emission factors								
		CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	NF_3	NO_X	CO
3B Land		(t C/ha)	g/kg d.m.	g/kg d.m.					g/kg d.m.	g/kg d.m.
3B1a	Forest Land Remaining Forest Land	Inland forest: 4.37 Peat swamp: 4.32 Mangrove: 5.17 State land: 2.02 TPA: 2.02 Drained peat swamp 2.49 Plantation forest: 2.44 Fallow :1.70 Root shoot ratio: 0.18 Root shoot ratio (mangrove): 0.49								
3B2a	Cropland Remaining Cropland	Rubber :1.95 Oil palm:1.84 Cocoa :2.35								
3B5bi	Forest Land converted to Settlement	Inland State Land Forest: 140 PRF Inland: 194 Rubber: 67.68 Oil palm:63.92								
3C Aggregate Sources and Non-CO_2 Emissions Sources on Land										
3C1	Biomass burning									
3C1a	Biomass burning in Forest land	fraction of fuel mass 0.26	6.8g/kg d.m	0.2 g/kg d.m					1.6 g/kg d.m	104g/kg d.m
3C1b	Biomass burning in Cropland [g GHG (kg dm burnt)$^{-1}$]		2.7	0.07					2.5	9.2
3C2	Liming									
	Limestone [tonnes of C (tonne of limestone)$^{-1}$]	0.12*								
3C3	Urea application [tonnes of C (tonne of urea)$^{-1}$]	0.2*								

AFOLU Sector (3 of 4)

		Emission factors								
		CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	NF_3	NO_X	CO
3C4	Direct N_2O Emissions from Managed Soils [kg N2O-N (kg N input)$^{-1}$]									
	Anthropogenic N input types to estimate annual direct N2O-N emissions produced from managed soils: • synthetic fertilizers • animal manure, compost, sewage sludge • crop residues • changes in land use or management			0.01						
	Anthropogenic N input types to estimate annual direct N2O-N emissions produced from flooded rice: • synthetic fertilizers • animal manure, compost, sewage sludge • crop residues • changes to land use or management			0.003						
	Managed organic soils • Oil Palm (Organic Soils) [drained/managed organic soils]			1.2						
	Urine and dung inputs to grazed soils: • CPP • SO			0.02 0.01						
3C5	Indirect N_2O Emissions from Managed Soils (kg N_2O-N) (kg NH_3-N + NO_x-N volatilized)$^{-1}$									
	N_2O from Atmospheric Deposition of N Volatilised from Managed Soils			0.01						
	N_2O from N leaching/runoff from Managed Soils			0.0075						
3C6	Indirect N2O emissions from Manure Management [kg N_2O-N (kg NH_3-N+ NO_x-N volatilised)$^{-1}$]									
	Poultry Manure with /Without Litter			0.01						

AFOLU Sector (4 of 4)

		Emission factors								
		CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	NF_3	NO_X	CO
	Solid Storage (Buffalo, Dairy Cows, Goats, Other Cattle, Sheep, Swine)			0.01						
	Uncovered Anaerobic Lagoon Dairy (Cows, Other Cattle, Swine)			0.01						
3C7	Rice cultivations (kg CH_4 ha^{-1} day^{-1})									
	Irrigated (Granary)		1.6 With scaling factor of 1							
	Rainfed (Non-granary)		1.6 With scaling factor of 0.27							
	Upland		1.6 With scaling factor of 0							

Waste Sector (1 of 3)

		Emission factors								
		CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	NF_3	NO_X	CO
WASTE										
4A	**Solid Waste Disposal Sites**									
			Fraction of degradable organic carbon: • Bulk waste: 0.17 • Sewage Sludge: 0.05 Fraction of organic carbon which decomposes: 0.5 Methane correction factor (MCF): • Uncategorized SWDS: 0.6 • Unmanaged deep: 0.8 • Managed Anaerobic: 1							
4B	**Biological Treatment of Solid Waste**									
			4 g CH_4/ kg waste treated	0.24 g N_2O /kg waste treated						
4C	**Incineration and Open Burning of Waste**									
	Incineration	Hazardous waste: • Fraction dry matter content: 0.5 • Fraction of carbon in dry matter content: 0.275 • Fraction of fossil carbon in total carbon: 0.95 • Oxidation factor: 1		Hazardous waste: 100 kg N_2O/Gg wet waste						

Waste Sector (2 of 3)

		Emission factors								
		CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	NF_3	NO_X	CO
		Clinical Waste: • Fraction dry matter content: 0.65 • Fraction of carbon in dry matter content: 0.6 • Fraction of fossil carbon in total carbon: 0.4 • Oxidation factor: 1 Fossil Liquid Waste: • Fraction of fossil content of liquid waste: 0.8 • Oxidation factor:1		Clinical waste: 100 kg N_2O/ Gg wet waste						
	Open Burning	Municipal solid waste: • Fraction dry matter content: 0.43 • Fraction of carbon in dry matter content: 0.46 • Fraction of fossil carbon in total carbon: 0.14 • Oxidation factor: 0.58	Municipal solid waste: 6500 kg CH_4/ Gg wet waste	Municipal solid waste: 150 kg N_2O/Gg Dry matter						
4D Wastewater Treatment and Discharge										
4D1	Domestic Wastewater		Emission factor (Kg CH_4/kg BOD): $EF_j = B_o \times MCF_j$ B_o= 0.6 kg CH_4/kg BOD MCF_j= an indication of the degree to which the	Emission factor for indirect N_2O from waste water: 0.005 kg N_2O/kg N						

Waste Sector (3 of 3)

		Emission factors								
		CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	NF_3	NO_X	CO
			system is anaerobic as below: • Centralised Aerobic Treatment Plant: 0 • Septic Tank: 0.3 • Latrine 3 (Pour Flush): 0.42 • Sea, River and Lake Discharge: 0.06							
4D2	Industrial Wastewater									
			Emission factor (kg CH_4/kg COD): • POME: 0.225 • Natural Rubber (SMR): 0.2 • Natural Rubber (Latex): 0.2 • Paper & Pulp: 0.125 • Petroleum Refineries: 0.125 • Meat & Poultry: 0.125							

Table A - 3: Summary of Assumptions and Activity Data Sources

Sector & Sub Sector	Activity data	Assumptions	Data source
1. Energy Sector			
1 Fuel Combustion Activities			
1A1 Energy Industries			
1A1a - Electricity and Heat Production	Fuel Types in energy-producing industries	The type of fuels used for electricity generation combined heat and power generation.	**NEB**
1A1ai - Electricity Generation	Fuel types from thermal power plants.Biomas and Biogas are included.	All fuel consumption from thermal stations. Coal has been segregated into Bituminous, Sub- bituminous and Lignite.	**NEB** **Energy Commission**
1A1aii - Combined Heat and Power Generation (CHP)	Fuel types from the production of both heat and power plants. Biomas and biogas is included.	All fuel consumption from self-generation stations.	**NEB**
1A1aiii - Heat Plants	No activity data	No production of heat for sale by pipe network.	**NEB**
1A1b - Petroleum Refining	Refining of petroleum products including losses & own use for generation of electricity and heat.	Estimated from the refineries and petroleum losses and own use.	**NEB**
1A1c - Manufacture of Solid Fuels and Other Energy Industries			
1A1ci - Manufacture of Solid Fuels	No activity data	No combustion for production of coke, brown coal briquettes and patent fuel.	
1A1cii Other Energy Industries	Own use from the oil and gas extraction and processing of natural gas	Estimated from the gas plants' losses and own use.	**NEB**

Sector & Sub Sector	Activity data	Assumptions	Data source
1A2 Manufacturing Industries and Construction			
1A2a - Iron and Steel	Combustion of fuels by sub- sectors in manufacturing specific to iron and steel,	The percentage of fuel consumption by sub- categories of ISIC industry were based on survey data (520 manufacturing companies in Peninsular Malaysia) produced by NEB in 2016.This percentage for the sub-categories fuel consumption is multiplied to the NEB 2017- NEB 2019energy source.,	**Final energy consumption by sub- sectors in Manufacturing Sector of NEB 2016, NEB 2017 -2019**
1A2b - Non-Ferrous Metals	Combustion of fuels by sub- sectors in manufacturing specific to non- ferrous metals	The percentage of fuel consumption by sub- categories of ISIC industry were based on survey data (520 manufacturing companies in Peninsular Malaysia) produced by NEB in 2016. This percentage for the sub- categories fuel consumption is multiplied to the NEB 2017 - NEB 2019 energy source.	**Final energy consumption by sub-sectors in Manufacturing Sector of NEB 2016, NEB 2017 -2019**
1A2c - Chemicals	Combustion of fuels by sub- sectors in manufacturing specific to Chemicals	The percentage of fuel consumption by sub- categories of ISIC industry were based on survey data (520 manufacturing companies in Peninsular Malaysia) produced by NEB in 2016. This percentage for the sub- categories fuel consumption is multiplied to the NEB 2017- NEB 2019 energy source.	**Final energy consumption by sub-sectors in Manufacturing Sector of NEB 2016, NEB 2017 - 2019**
1A2d - Pulp, Paper and Print	Combustion of fuels by sub- sectors in manufacturing specific to pulp, paper and print	The percentage of fuel consumption by sub- categories of ISIC industry were based on survey data (520 manufacturing companies in Peninsular Malaysia) produced by NEB in 2016.	**Final energy consumption by sub-sectors in Manufacturing Sector of NEB 2016, NEB 2017 - 2019**

Sector & Sub Sector	Activity data	Assumptions	Data source
		This percentage for the sub- categories fuel consumption is multiplied to the NEB 2017 - NEB 2019 energy source.	
1A2e - Food Processing, Beverages and Tobacco	Combustion of fuels by sub- sectors in manufacturing specific to Food Processing, Beverages and Tobacco	The percentage of fuel consumption by sub- categories of ISIC industry were based on survey data (520 manufacturing companies in Peninsular Malaysia) produced by NEB in 2016. This percentage for the sub- categories fuel consumption is multiplied to the NEB 2017- - NEB 2019 energy source.	**Final energy consumption by sub-sectors in Manufacturing Sector of NEB 2016, NEB 2017 - 2019**
1A2f - Non-Metallic Minerals	Combustion of fuels by sub- sectors in manufacturing specific to Non- Metallic Minerals	The percentage of fuel consumption by sub- categories of ISIC industry were based on survey data (520 manufacturing companies in Peninsular Malaysia) produced by NEB in 2016. This percentage for the sub- categories fuel consumption is multiplied to the NEB 2017- NEB 2019 energy source. consumption is multiplied to the NEB 2017 - NEB 2019 energy source.	**Final energy consumption by sub-sectors in Manufacturing Sector of NEB 2016, NEB 2017 - 2019**
1A2h - Machinery	Combustion of fuels by sub- sectors in manufacturing specific to Machinery	The percentage of fuel consumption by sub- categories of ISIC industry were based on survey data (520 manufacturing companies in Peninsular Malaysia) produced by NEB in 2016. This percentage for the sub- categories fuel consumption is multiplied to the NEB 2017-- NEB 2019 energy source.	**Final energy consumption by sub-sectors in Manufacturing Sector of NEB 2016, NEB 2017 - 2019**
1A2l - Mining (excluding fuels) and Quarrying	No activity data Accounted as Non-specified Industry includes 1.A.2.i Mining	The percentage of fuel consumption by sub- categories of ISIC industry were based on survey data (520	**Final energy consumption by sub-sectors in Manufacturing Sector of NEB 2016, NEB 2017 - 2019**

Sector & Sub Sector	Activity data	Assumptions	Data source
	(excluding fuels) and quarrying and 1.A.2.k Construction	manufacturing companies in Peninsular Malaysia) produced by NEB in 2016. This percentage for the sub- categories fuel consumption is multiplied to the NEB 2017 - NEB 2019 energy source.	
1A2j - Wood and wood products	Combustion of fuels by sub- sectors in manufacturing specific to Wood and wood products	The percentage of fuel consumption by sub- categories of ISIC industry were based on survey data (520 manufacturing companies in Peninsular Malaysia) produced by NEB in 2016. This percentage for the sub- categories fuel consumption is multiplied to the NEB 2017 - NEB 2019 energy source.	**Final energy consumption by sub-sectors in Manufacturing Sector of NEB 2016, NEB 2017 - 2019**
1A2k - Construction	No activity data Accounted as Non-specified Industry includes 1.A.2.i Mining (excluding fuels) and quarrying and 1.A.2.k Construction	The percentage of fuel consumption by sub- categories of ISIC industry were based on survey data (520 manufacturing companies in Peninsular Malaysia) produced by NEB in 2016. This percentage for the sub- categories fuel consumption is multiplied to the NEB 2017 - NEB 2019 energy source.	**Final energy consumption by sub-sectors in Manufacturing Sector of NEB 2016, NEB 2017 - 2019**
1A2l - Textile and Leather	Combustion of fuels by sub- sectors in manufacturing specific to Textile and Leather	The percentage of fuel consumption by sub- categories of ISIC industry were based on survey data (520 manufacturing companies in Peninsular Malaysia) produced by NEB in 2016. This percentage for the sub- categories fuel consumption is multiplied to the NEB 2017- NEB 2019 energy source.	**Final energy consumption by sub-sectors in Manufacturing Sector of NEB 2016, NEB 2017 - 2019**
1A2m - Non-specified Industry	Combustion of fuels at not elsewhere specified	Any combustion that cannot be allocated to one of the other sub-categories.	**Final energy consumption by sub-sectors in Manufacturing Sector of NEB 2016, NEB 2017 - 2019**

Sector & Sub Sector	Activity data	Assumptions	Data source
		The percentage of fuel consumption by sub- categories of ISIC industry were based on survey data (520 manufacturing companies in Peninsular Malaysia) produced by NEB in 2016. This percentage for the sub- categories fuel consumption is multiplied to the NEB 2017- 2019 energy source.	
1A3 - Transport			
1A3 a – Civil Aviation	Fuel consumption ratio of ATF	The ratio of fuel consumption for domestic aviation to international aviation is 20:80 based on percentage ratio computed in 2016. The total amount is based on civil consumption. Not including the military.	**NEB 2017 - 2019** **Survey data from MAB comprising of MAS, Firefly and Mas Wings, Air Asia X, Air Asia (2015)**
1A3al – International Aviation (Bunker)	Fuel consumption ratio of ATF	The total amount of fuel consumption for domestic aviation is based on survey collected from the civil domestic operators. Not including the military.	**NEB 2017 - 2019** **Survey data from MAB comprising of MAS, Firefly and Mas Wings, Air Asia X, Air Asia (2015) and Military (TUDM/TDM/TLM) (2014)**
1A3aii – Domestic Aviation	Fuel consumption ratio of ATF	The total amount of fuel consumption for domestic aviation is based on survey collected from the civil aviation domestic operators. Not including the military aviation fuel consumption.	**NEB 2017 - 2019** **Survey data from MAB comprising of MAS, Firefly and Mas Wings, Air Asia X, Air Asia (2015)**
1A3b – Road Transportation	Fuel type used in Road transport	The percentage for fuel consumption specific to motor gasoline/ petrol disaggregated from the total EBT for transport sector and Other Non-specified (Mobile). For road transport, data from KPDNHEP is used. The percentage for petrol from road transport is about 74%.	**NEB 2017- 2019** **Motor gasoline and Diesel from KPDNHEP** **Survey data from Military (TUDM/TDM/TLM) (2014), and Railway (KTMB)**

Sector & Sub Sector	Activity data	Assumptions	Data source
		The percentage for fuel consumption for diesel in the road transport is about 94% of total diesel. The assumption derived from KPDNHEP data Remaining diesel is assumed for Off-road transportation (1A 3 e). The natural gas consumption by road transportation is 100%.	
1A3c - Railways	Diesel used in transport	The percentage of total diesel consumption based on survey data collected is about 0.2 to 0.3%.	**Survey data from KTMB**
1A3d – Water-borne Navigation	Diesel and Fuel Oil in Transport	25% of total diesel consumption in the transport sector. 100% of residual fuel oil consumption is by the water- bornenavigation. The percentage assumption for diesel is 25% based on expert judgement from the Maritime Department Malaysia (unpublished study by Maritime Institute of Malaysia taking into account of actively trading Malaysian registered vessels 400GTand above). There is no available method at maritime department prior to year 2020 to separate the fuel consumptions between domestic ships and international ships.	**NEB 2017 - 2019** **Survey data from Maritime Department, Malaysia**
1A3di – International water- borne (bunker)	Fuel Oil in Transport	100% of fuel oil consumption in the transport sector.	**NEB 2017- 2019**
1A3dii – Domestic water-borne navigation	Diesel and Fuel Oil in Transport	25% of total diesel consumption in the transport sector from expert judgement of Maritime Department, Malaysia.	**NEB 2017-2019** **Survey data from Maritime Department, Malaysia**

Sector & Sub Sector	Activity data	Assumptions	Data source
		100% of fuel oil consumption in the transport sector.	
1A3e – Other transportation Off Road Transportation	Diesel	The percentage for fuel consumption for diesel in the road transport is about 6% of total diesel.	**NEB 2017- 2019** **KPDNHEP**
1A4 – Other Sectors			
1A4a Commercial/Institutional	Fuel types in the commercial sector	Percentage of fuel consumption is based on EBT of reporting year.	**NEB 2017 - 2019**
1 A 4 b Residential	Fuel types in the residential sector	Percentage of fuel consumption is based on EBT of reporting year.	**NEB 2017 - 2019**
1A4c Agriculture/ Forestry/Fishing/Fish farms	Ratio of fuel consumption (i.e. Gasoline, diesel, fuel oil) between mobile and stationary	The ratio of fuel consumption of mobile and stationary is 95:5. 5% of the fuel consumption is for stationary and 95% of the consumption is for mobile.	**NEB 2017 – 2019** **Statistic Department, Malaysia**
1A4ci Stationary	Ratio of fuel consumption (i.e. Gasoline, diesel, fuel oil) between mobile and stationary	5% of the fuel consumption is for stationary.	**NEB 2017 – 2019** **Statistic Department, Malaysia**
1A4cii Off-road vehicles and Other Machinery	Ratio of fuel consumption (i.e. Gasoline, diesel, fuel oil) between mobile and stationary	5% of the fuel consumption is for stationary	**NEB 2017 – 2019** **Statistic Department, Malaysia**
1A4ciii Fishing (mobile combustion)	Ratio of fuel consumption (i.e. Gasoline, diesel, fuel oil) between mobile and stationary	95% of the fuel consumption is for mobile.	**NEB 2017 – 2019** **Statistic Department, Malaysia**

Sector & Sub Sector	Activity data	Assumptions	Data source
1A5b - Non specified mobile			
1A5bi Non specified mobile (aviation)	Ratio of fuel consumption from survey data and EBT reporting year for ATF and AV gas	3.5% of the total fuel consumption for ATF and AV gas	**Survey data from Military (TUDM/TDM/TLM) (2014)**
1A5bii Non specified mobile (waterborne)	Ratio of fuel consumption from survey data and EBT reporting year for diesel	0.41% of the total fuel consumption for diesel	**Survey data from Military (TUDM/TDM/TLM) (2014)**
1A5biii Non specified mobile (other)	Ratio of fuel consumption from survey data and EBT reporting year for diesel	0.25% of the total fuel consumption for diesel and 0.05% of the total fuel consumption for petrol	**Survey data from Military (TUDM/TDM/TLM) (2014)**
1B2 Fugitive Oil and Gas			
1B2 a - Oil			
1B2ai - Venting	Crude oil production	Actual venting production from PETRONAS	**NEB 2017-2019, Petronas, EPU**
1B2aii - Flaring	Crude oil production	Actual flaring production from PETRONAS	**NEB 2017-2019, Petronas, EPU**
1B2aiii - All Other			
1B2aiii1 - Exploration	Not accounted	Emission factor not applicable	
1B2aiii2 - Production & Upgrading	Crude oil production	Assume total amount of oil from oil Production occurs at the oil wellhead.	**NEB 2017-2019**
1B2aiii3 - Transport	Not accounted	Emission factor not applicable	
1B2aiii4 - Refining	Crude oil refineries	Assume the total amount of produces final refined products.	**NEB 2017-2019**
1B2aiii5 - Distribution of oil Products	Not accounted	Emission factor not applicable	
1B2aiii6 - Other	Not accounted	Emission factor not applicable	

Sector & Sub Sector	Activity data	Assumptions	Data source
1B2b – Natural gas			
1B2bi - Venting	Not applicable	Not applicable	
1B2bii - Flaring	Natural Gas production	Actual flaring production from PETRONAS	**NEB 2017-2019, Petronas, EPU**
1B2biii – All Other			
1B2biii1 – Exploration	Not accounted	Emission factor not applicable	
1B2biii2 – Production	Natural Gas production	Assume the total amount of gas production from gas fields.	**NEB 2017-2019**
1B2biii3 – Processing	Natural gas production	Estimated from natural gas processing facilities	**NEB 2017-2019**
1B2biii4 – Transmission and Storage	Natural Gas production	Estimated from natural gas processing including import of LNG.	**NEB 2017-2019**
1B2biii5 – Distribution	Natural gas production	Estimated from natural gas transmission and storage including export of LNG.	**NEB 2017-2019**
1B2biii6 – Other	Not accounted	Emission factor not applicable	
1B3 – Other emissions from energy production	No activity data		
2. Industrial Product & Product Use Sector			
2A Mineral Industry			
2A1 Cement Production	Clinker production	CNCA agreed to maintain the use of national lime fraction at 65.6%	**Malaysian Cement & Concrete Association (CNCA)**
2A2 Lime Production	Lime production	Type of lime: High-calcium lime	**Department of Mineral & Geoscience, Malaysia (JMG) Department of Statistics Malaysia (DOSM)**
2A3 Glass Production	Glass production	Annual cullet ratio at 25%	**Department of Mineral & Geoscience, Malaysia (JMG) Malaysia Sheet Glass (M) Sdn Bhd**
2A4 Other Process Uses of Carbonates	Limestone production Dolomite production	Total accounted limestone production exclude limestone for cement manufacturing, use for rock aggregates, use in lime production and use in agriculture.	**Department of Mineral & Geoscience, Malaysia (JMG)**

Sector & Sub Sector	Activity data	Assumptions	Data source
		Both limestone and dolomite activity data also consider the stock exchange, where imports are added and exports are removed from the activity data.	
2B Chemical Industry			
2B1 Ammonia Production	Ammonia production Urea production	CO_2 recovered for urea production is deducted from the activity data.	**Petroliam Nasional Berhad (Petronas)**
2B5 Carbide Production	Carbide production	Calcium carbide production does not emit CH_4	**MCB Industries Sdn Bhd**
2B8 Petrochemical & Carbon Black Production	Ethylene production Methanol production Ethylene Oxide production	Improvement was made in Ethylene production, whereby actual data was obtained for feedstock disaggregation.	**Petroliam Nasional Berhad (Petronas)** **Lotte Titan Chemicals Sdn Bhd**
2C Metal Industry			
2C1 Iron & Steel Production	Iron production - Pig Iron Steel production using process of Electric Arc Furnace and Basic Oxygen Furnace	99% of the steelmaking productions in Malaysia is using Electric Arc Furnace (EAF) in the year 2017 to 2018. For year 2019, Basic Oxygen Furnace (BOF) was used by Alliance Steel. The emission for iron making in blast furnaces will be quantified using pig iron production (EF=1.35 tonne CO_2 per tonne pig iron produced).	**Malaysian Iron & Steel Federation (MISIF)** **Malaysia Steel Association (MSA)** **Southern Steel** **Ann Joo Steel** **Malaysia Steel works** **AmSteel** **Eastern Steel** **Alliance Steel**
2C2 Ferroalloy Production	Ferroalloy production	Production capacity of Pertama Ferroalloy was used for calculation in absence of actual data from the company.	**Sakura Ferralloy** **Om Material Sdn Bhd** **Pertama Ferroalloy**

Sector & Sub Sector	Activity data	Assumptions	Data source
2C3 Aluminium Production	Aluminium production	The plant is running at 100% production capacity.	**Department of Mineral & Geoscience, Malaysia (JMG)**
2E Electronics Industry			
2E1 Semiconductor Production	Semiconductor production	Activity data derived from production capacity.	**Multiple references on industry plant capacity**
2E3 Photovoltaics Production	Photovoltaics production	Activity data derived from production capacity.	**Multiple references on industry plant capacity**
2F Product Uses as Substitutes for ODS			
2F1b Mobile Air-Conditioning	Amount of HFC charged into new systems Number of new non-commercial vehicles Number of registered non-commercial vehicles	Assembly losses 0.5% Does not account Disposal	**Ministry of Transport Malaysia (MOT),** **Malaysian Automotive Association (MAA)**
2G Other Product Manufacture & Use			
2G1b SF_6 Use in Electrical Equipment	Total nameplate capacity	Does not account 2G1a: Manufacture and 2G1c: Disposal.	**Tenaga Nasional Berhad (TNB), Sabah Electricity Sdn. Bhd. (SESB), Sarawak Energy (SEB)**
2G3a N_2O in Medical Applications	Amount of N_2O gas used	Data obtained from main stakeholder.	**Linde (M) Sdn Bhd. (Gas supplier)**
3. Agriculture, Forestry and Other Land Used			
3.A.1 Enteric Fermentation	Livestock population numbers	- No dairy cows in Sarawak till 2018	**Livestock Statistics (DVS), FAOSTAT**
3.A.2 Manure Management	Animal population	Proportions of animal waste management system	**Livestock Statistics**
	Fractions of Manure, Waste Management Systems		**Expert Judgment**
3.C.1.b Biomass Burning		Burning practices only on paddy field at proportion 10% of irrigated granary	

Sector & Sub Sector	Activity data	Assumptions	Data source
	Fraction of area burnt in paddy fields	area during dry season Agricultural residues were burnt completely (Combustion factor = 1)	**Agrofood Statistics 2020, MAFI; Document provided by DOA, 2022.**
3.C.2 Liming	Annual amount of subsidised lime for paddy	Subsidy scheme of liming only applied for paddy crop started in 2011 and no record purchased/used directly by farmers	**Document provided by MAFI, 2022.**
3.C.3 Urea Application in Cropland	Annual amount of import and export for urea	Consumptions of urea are based from the total of import and production minus the export amount	**Harmonized system data**
	Annual amount of urea production		**Document provided by PETRONAS, 2022**
4 WASTE			
4A Solid Waste Disposal Sites	Population Data		**Population and Housing Census in 2010. Data is acquired from Department of Statistics Malaysia (DOSM) based on 2010 population census**
	Waste per capita	Default IPCC Regional values for Southeast Asia were obtained from 2006 GL for the period from 1970 to 2000 Extrapolated values of MSW composition by percent for the period of 2001 to 2004 were obtained from the IPCC default for South-East Asia (2001) and the 2004 data from the study by JICA (2006) The period from 2005 to 2012 utilized the extrapolated values obtained from JICA (2006) After 2013, using the actual data from the Survey on Solid Waste Composition, Characteristics & Existing	**Waste composition varies widely between urban and rural populations within the countries. (Table 3.5, Chapter 3, Vol. 5, 2006GL) Survey on Solid Waste Composition, Characteristics & Existing Practice of Solid Waste Recycling in Malaysia (2012)**

Sector & Sub Sector	Activity data	Assumptions	Data source
		Practice of Solid Waste Recycling in Malaysia (2012)	
	Sludge Disposed at SWDS		**Data collected from Indah Water Konsortium and Sewerage Services Department Sarawak**
4B Biological Treatment of Solid Waste	Annual amount treated by treatment facility of EFB biological	The annual amount of EFB utilized in composting is calculated by fixing the operation days to 300 days in a year because generally for palm oil mills, the operating days per month is 25 days.	**Surveys conducted by MPOB and DOE.**
4C1 Incineration	Annual amount of Waste Incinerated		**Data is acquired from DOE database.**
4C2 Open Burning	Rural Population		**Population and Housing Census in 2010 Data is acquired from Department of Statistics Malaysia (DOSM) based on 2010 population census**
	Fraction of population Burning Waste	Only 1% of rural population practices open burning as a mean of waste disposal	**Data is acquired from reliable national source through discussion. (Expert judgement)**
	Per Capita Waste Generation (MSWp)		**Data was taken from JPSPN Study 2013. Waste Characterization (Expert judgement)**
	Fraction of the waste amount burned relative to the total amount of waste treated		**Default value based on 2006GL (Section 5.7.1, p 5.23, 2006 GL)**
4D1 Domestic Wastewater	Urban and rural population		**Population and Housing Census in 2010 Data is acquired from Department of Statistics Malaysia (DOSM) based on 2010 population census**
	Degradable organic component (BOD)	The BOD or degradable organic component in wastewater, 15.9 kg/person/year wastewater is derived from 56 g/PE/day (MSIG Vol IV) with PE	**Malaysian Sewerage Industry Guidelines (MSIG) Vol. IV, published by National Water Services Commission (SPAN)**

Sector & Sub Sector	Activity data	Assumptions	Data source
		per population ratio of 0.78 as shown in the equation below. The BOD value used for Malaysia (43.56 g/person/day) is within the IPCC BOD range value for Asia, Middle East, Latin America of 33-44 g/person/day Correction factor is 1.0 is used as industrial wastewater is not collected into the sewer system.	
		Inventory of sewage treatment system (i.e. numbers, capacity and type) was obtained from the following sources: Peninsular Malaysia • 1990-1997: Data extrapolation based on IWK Asset Database • 1998-2014: IWK Asset • 2015 -2016: SPAN (Malaysia Water Industry Guide (MWIG); published by Malaysian Water Associations (MWA)) • 2017-2019:SPAN (Water and Sewerage Fact Book) Sabah • 1990-2016: GHG Data Inventory Improvement Study conducted by Consultant (North Borneo Environmental Services Sdn. Bhd.) • 2017-2019: Data extrapolation based on GHG Data Inventory Improvement Study conducted by Consultant.	

Sector & Sub Sector	Activity data	Assumptions	Data source
		Sarawak • 1990-2007: Data extrapolation based on JPP Sarawak database • 2007-2019: JPP Sarawak database • Degree of utilization by treatment type for urban and rural areas were identified based on expert judgment as follows: Urban • Centralised Aerobic Treatment Plant • Septic System • Sea, River and Lake Discharge Rural • Septic System • Latrine 3 (Pour Flush) • Sea, River and Lake Discharge	
	Per capita protein consumption	1960 to 2009: Data used for domains [Food Balances (-2013, old methodology and population)] 2010 to 2019: Data used for domains [Food balances (2010-2019)]	**Based on yearly time range for Protein Supply Quantity (g/capita/day), Food and Agriculture Organization Statistic (FAOSTAT)**
	Sludge removed		**Dokuz Eylul University (DEU) Engineering Faculty. Biological Treatment Processes., 2006. (http://web.deu.edu.tr/atiksu/ana07/4thset.pdf)**
	Methane Recovered	Methane recovery from domestic wastewater treatment plants is very scarce. Thus, it is assumed that the methane recovery from domestic wastewater treatment plant is negligible.	

Sector & Sub Sector	Activity data	Assumptions	Data source
	Nitrogen removed with sludge (NSLUDGE)	No study has been conducted in the country to measure the amount of Nitrogen in sludge. Hence, 2006 GL default value of zero, 0 kg N/yr is being used in this estimation.	
4D2 Industrial Wastewater Treatment and Discharge	Total Industry Product:		
	Palm Oil		**MPOB Yearly Statistics**
	Natural Rubber		**Malaysian Rubber Statistics 2008, 2015 & 2021**
	Pulp & Paper Petroleum		**Annual production of pulp and paper**
	Refineries		**National Energy Balance 2019**
	Meat & Poultry		**FAOSTAT 2020**
	Wastewater generated per ton product (m3/ton product):		
	POME: 3.05		**Vijaya et al., 2008, JOPR 20: 484-494;** **Vijaya et al., 2010, Amer. J. Geosc. 1(1): 1-6.**
	Natural Rubber (SMR): 19.5		**Zaid I., 1993,** **Publication of Ministry of Science and the Environment, Malaysia, 137-151.**
	Natural Rubber (Latex): 10.5		
	Pulp & Paper: 85 Petroleum Refineries: 0.6 Meat & Poultry: 13		**IPCC default value (Table 6.10, Chapter 6, Vol. 5, 2006 IPCC Guidelines**
	Chemical oxygen demand (COD) kg COD/m3 waste water generated:		

Sector & Sub Sector	Activity data	Assumptions	Data source
	POME:53		**Survey on actual status of POME in palm oil mills, 2007 – 2008; Loh et al. 2009**
	Natural Rubber • Natural Rubber (SMR):1.5 • Natural Rubber (Latex): 6		**Zaid et al, 2006, Proc. IRRDB Conf.;** **Pretibaa et al, 2007, Proc. IRRDB Conf.; John, 1982, Proc. Workshop;** **Zaid, 1993;** **Publication of Ministry of Science and the Environment, Malaysia, 137-151**
	Pulp & Paper:2 Petroleum Refineries:1 Meat & Poultry: 4.		**IPCC default value (Table 6.10, Chapter 6, Vol. 5, 2006 IPCC Guidelines**
	Total Recovered Methane Annual total methane recovery POME:36.41 kg/t methane gas generated	The captured methane used for energy combustion is 100% recovered; and The flared methane is 50% recovered.	**Vijaya et al., 2010**

Table A - 4: Comparison of Emissions and Removals by Sector between BUR3 and BUR4

Summary of Emission Trend by Sector in BUR3 (Gg CO_2 eq.): 1990 – 2007

Greenhouse Gas Source and Sink by Sector (BUR3)	1990	1991	1992	1993	1994	1995	1996	1997	1998
Energy	67,293.03	77,931.98	84,252.57	85,310.29	92,049.66	95,889.68	111,291.05	129,598.70	118,850.16
IPPU	4,435.75	4,643.94	4,505.39	4,787.77	5,678.85	6,149.09	8,223.95	8,987.28	8,695.06
Agriculture	7,090.82	6,948.50	6,998.18	7,578.21	8,183.89	7,486.21	7,320.58	8,635.82	8,967.72
LULUCF	-95,727.80	-188,300.82	-174,418.24	-205,785.50	-74,320.11	-206,705.17	-220,268.69	-223,920.58	-224,111.57
Waste	11,124.91	11,284.57	11,586.10	12,644.83	12,605.09	13,273.39	13,934.13	14,671.01	14,087.28
Total Including LULUCF	-5,783.28	-87,491.84	-67,076.00	-95,464.41	44,197.39	-83,906.80	-79,498.98	-62,027.77	-73,511.34
Total Excluding LULUCF	89,944.51	100,808.99	107,342.23	110,321.10	118,517.49	122,798.37	140,769.71	161,892.81	150,600.23

Greenhouse Gas Source and Sink by Sector (BUR3)	1999	2000	2001	2002	2003	2004	2005	2006	2007
Energy	131,445.53	143,141.29	149,345.67	156,423.68	168,897.32	184,033.25	198,514.01	196,604.24	212,781.48
IPPU	9,111.46	11,531.89	11,754.71	13,538.47	14,985.33	15,317.10	15,101.60	15,999.80	16,153.40
Agriculture	8,637.64	8,752.54	7,867.92	8,772.08	8,745.48	9,558.21	10,253.15	9,747.13	10,785.13
LULUCF	-243,825.20	-180,945.46	-222,077.04	-233,038.97	-239,692.27	-228,595.50	-197,932.85	-230,265.67	-212,600.23
Waste	16,247.57	16,670.75	17,667.81	18,085.97	19,748.86	20,680.51	21,928.30	23,464.80	23,905.18
Total Including LULUCF	-78,383.00	-848.99	-35,440.93	-36,218.76	-27,315.28	993.57	47,864.20	15,550.31	51,024.97
Total Excluding LULUCF	165,442.20	180,096.47	186,636.11	196,820.20	212,376.99	229,589.07	245,797.05	245,815.98	263,625.20

Summary of Emission Trend by Sector in BUR3 (Gg CO_2 eq.): 2008 – 2016

Greenhouse Gas Source and Sink by Sector (BUR3)	2008	2009	2010	2011	2012	2013	2014	2015	2016
Energy	220,641.73	210,296.31	226,186.63	225,060.62	240,371.88	247,534.35	253,517.24	256,034.18	251,695.01
IPPU	16,893.78	17,061.40	16,471.77	17,058.02	19,743.89	19,549.98	20,257.83	22,362.22	27,348.83
Agriculture	11,192.45	9,742.52	10,141.99	9,906.24	11,025.47	10,551.01	11,081.37	10,670.85	10,627.72
LULUCF	-228,475.01	-238,387.18	-234,680.07	-239,025.77	-256,761.03	-259,119.32	-263,830.62	-248,186.40	-241,344.74
Waste	25,913.45	25,992.89	25,562.75	26,957.50	26,892.82	27,695.75	28,216.51	28,857.81	27,161.79
Total Including LULUCF	46,166.40	24,705.93	43,683.07	39,956.61	41,273.03	46,211.77	49,242.33	69,738.67	75,488.61
Total Excluding LULUCF	274,641.40	263,093.11	278,363.14	278,982.38	298,034.06	305,331.08	313,072.95	317,925.07	316,833.35

Note: As per Technical Annex in BUR3 with the totals corrected

Summary of Emission Trend by Sector in BUR4 (Gg CO_2 eq.): 1990 – 2007

Greenhouse Gas Source and Sink by Sector (BUR4)	1990	1991	1992	1993	1994	1995	1996	1997	1998
Energy	66,460.16	77,407.09	83,782.53	86,064.80	92,977.76	97,167.05	113,196.64	132,293.95	121,488.57
IPPU	4,435.75	4,643.94	4,505.39	4,787.77	5,678.85	6,149.09	8,223.95	8,987.28	8,695.06
Agriculture	7,094.44	6,949.26	7,000.41	7,579.01	8,184.72	7,486.34	7,320.68	8,635.95	8,976.49
LULUCF	-95,913.08	-188,378.16	-165,187.38	-204,288.09	-188,627.10	-200,932.81	-209,648.04	-224,679.16	-217,982.60
Waste	11,115.37	11,274.93	11,599.95	12,660.11	12,612.60	13,298.28	13,960.04	14,696.15	14,136.77
Total Including LULUCF	-6,807.36	-88,102.95	-58,299.11	-93,196.39	-69,173.17	-76,832.05	-66,946.74	-60,065.83	-64,685.71
Total Excluding LULUCF	89,105.72	100,275.22	106,888.27	111,091.69	119,453.92	124,100.75	142,701.30	164,613.33	153,296.90

Greenhouse Gas Source and Sink by Sector (BUR4)	1999	2000	2001	2002	2003	2004	2005	2006	2007
Energy	134,703.75	146,926.37	153,192.76	159,623.46	171,907.05	187,454.08	202,676.41	200,696.93	215,930.15
IPPU	9,111.46	11,531.89	11,754.71	13,538.47	14,985.33	15,317.10	15,101.60	15,999.80	16,153.40
Agriculture	8,637.78	8,752.57	7,869.50	8,779.28	8,752.51	9,565.14	10,265.04	9,754.19	10,792.33
LULUCF	-239,079.01	-169,397.24	-210,378.58	-238,613.80	-239,908.21	-224,169.43	-197,076.76	-233,977.99	-206,371.10
Waste	16,295.20	16,717.25	17,718.24	18,145.21	19,816.02	20,744.58	22,000.75	23,538.92	23,996.43
Total Including LULUCF	-70,330.82	14,530.85	-19,843.36	-38,527.38	-24,447.30	8,911.48	52,967.03	16,011.86	60,501.21
Total Excluding LULUCF	168,748.19	183,928.08	190,535.21	200,086.41	215,460.92	233,080.91	250,043.80	249,989.85	266,872.31

Summary of Emission Trend by Sector in BUR4 (Gg CO_2 eq.): 2008 – 2019

Greenhouse Gas Source and Sink by Sector (BUR4)	2008	2009	2010	2011	2012	2013	2014	2015	2016
Energy	225,511.09	214,900.73	232,182.53	230,603.00	246,235.17	251,780.66	255,079.75	256,850.16	253,156.64
IPPU	16,893.78	17,061.40	16,471.77	17,042.27	19,714.55	19,501.67	20,235.40	22,243.93	23,746.04
Agriculture	11,192.77	9,750.72	10,155.20	9,906.28	11,027.86	10,558.66	11,095.67	10,647.03	10,711.36
LULUCF	-228,672.30	-240,533.81	-237,394.69	-241,252.18	-246,470.68	-248,806.44	-249,952.54	-244,032.12	-215,375.05
Waste	26,011.19	26,095.32	25,688.39	27,081.76	27,031.93	27,839.01	28,377.66	28,783.91	26,565.41
Total Including LULUCF	50,936.53	27,274.36	47,103.20	43,381.13	57,538.83	60,873.56	64,835.93	74,492.91	98,804.40
Total Excluding LULUCF	279,608.83	267,808.17	284,497.89	284,633.31	304,009.51	309,680.00	314,788.47	318,525.03	314,179.45

Greenhouse Gas Source and Sink by Sector (BUR4)	2017	2018	2019
Energy	252,710.49	255,231.55	259,326.11
IPPU	24,203.62	26,697.07	32,853.80
Agriculture	11,063.54	10,690.29	9,921.71
LULUCF	-243,369.73	-241,264.08	-214,714.54
Waste	28,585.40	28,247.87	28,256.59
Total Including LULUCF	73,193.32	79,602.70	115,643.68
Total Excluding LULUCF	316,563.05	320,866.78	330,358.21

Table A - 5: Comparison of Emissions and Removals by Gas between BUR3 and BUR4

Summary of Emission Trend by Gas in BUR3 (Gg CO_2 eq.): 1990 – 1996

Greenhouse Gas Source and Sink by Gas (BUR3)	1990	1991	1992	1993	1994	1995	1996
CO_2 Emissions Including CO_2 From LULUCF	-30,365.70	-113,255.43	-93,676.70	-125,497.16	13,063.55	-116,943.68	-115,083.42
CO_2 Emissions Excluding CO_2 From LULUCF	65,366.54	75,046.14	80,744.23	80,288.70	87,384.66	89,761.65	105,185.39
CH_4 Emissions Including CH_4 From LULUCF	848.45	893.08	925.25	1,047.95	1,073.72	1,167.80	1,270.11
CH_4 Emissions Excluding CH_4 From LULUCF	848.31	893.05	925.17	1,047.94	1,073.69	1,167.80	1,270.10
N_2O Emissions Including N_2O From LULUCF	11.31	11.53	11.64	12.87	14.40	12.89	12.86
N_2O Emissions Excluding N_2O From LULUCF	11.31	11.53	11.64	12.86	14.40	12.89	12.86
HFC (CO_2 eq)	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
PFC (CO_2 eq)	NA,NE, NO	NA,NE, NO	NA,NE, NO	NA,NE, NO	NA,NE, NO	NA,NE, NO	NA,NE, NO
SF_6 (CO_2 eq)	0.23	0.23	0.23	0.23	0.23	0.23	0.50
Others (NF_3) (CO_2 eq)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Total Including LULUCF (CO_2 eq)	-5,783.28	-87,491.84	-67,076.00	-95,464.41	44,197.39	-83,906.80	-79,498.98
Total Excluding LULUCF (CO_2 eq)	89,944.51	100,808.99	107,342.23	110,321.10	118,517.49	122,798.37	140,769.71

Summary of Emission Trend by Gas in BUR3 (Gg CO_2 eq.): 1997 – 2003

Greenhouse Gas Source and Sink by Gas (BUR3)	1997	1998	1999	2000	2001	2002	2003
CO_2 Emissions Including CO_2 From LULUCF	-101,472.54	-112,916.26	-120,538.44	-45,830.17	-81,236.95	-83,570.50	-76,817.36
CO_2 Emissions Excluding CO_2 From LULUCF	122,448.21	111,205.89	123,286.93	135,115.33	140,842.00	149,477.14	162,883.40
CH_4 Emissions Including CH_4 From LULUCF	1,372.96	1,357.05	1,467.81	1,553.91	1,606.36	1,623.99	1,711.31
CH_4 Emissions Excluding CH_4 From LULUCF	1,372.96	1,356.74	1,467.80	1,553.90	1,606.30	1,623.73	1,711.06
N_2O Emissions Including N_2O From LULUCF	16.88	17.90	17.67	18.28	15.55	18.62	18.79
N_2O Emissions Excluding N_2O From LULUCF	16.88	17.90	17.67	18.28	15.55	18.61	18.78
HFC (CO_2 eq)	91.05	142.11	193.17	190.87	411.29	511.39	327.71
PFC (CO_2 eq)	NA,NE, NO	NA,NE, NO	NA,NE, NO	140.64	240.45	340.27	440.08
SF_6 (CO_2 eq)	0.78	1.05	1.32	310.12	306.02	306.48	306.48
Others (NF_3) (CO_2 eq)	NA,NO	NA,NO	NA,NO	45.90	45.90	45.90	45.90
Total Including LULUCF (CO_2 eq)	-62,027.77	-73,511.34	-78,383.00	-848.99	-35,440.93	-36,218.76	-27,315.28
Total Excluding LULUCF (CO_2 eq)	161,892.81	150,600.23	165,442.20	180,096.47	186,636.11	196,820.20	212,376.99

Summary of Emission Trend by Gas in BUR3 (Gg CO_2 eq.): 2004 – 2010

Greenhouse Gas Source and Sink by Gas (BUR3)	2004	2005	2006	2007	2008	2009	2010
CO_2 Emissions Including CO_2 From LULUCF	-52,279.74	-9,531.30	-42,434.83	-9,332.77	-17,495.45	-37,086.00	-20,162.52
CO_2 Emissions Excluding CO_2 From LULUCF	176,324.12	188,417.32	187,839.36	203,276.14	210,979.94	201,311.08	214,533.50
CH_4 Emissions Including CH_4 From LULUCF	1,821.57	1,955.93	1,995.92	2,051.51	2,163.54	2,135.38	2,193.24
CH_4 Emissions Excluding CH_4 From LULUCF	1,821.33	1,955.47	1,995.67	2,051.26	2,163.52	2,135.08	2,192.77
N_2O Emissions Including N_2O From LULUCF	21.45	23.40	21.76	24.53	25.62	21.24	22.79
N_2O Emissions Excluding N_2O From LULUCF	21.44	23.39	21.75	24.52	25.62	21.23	22.78
HFC (CO_2 eq)	449.76	518.83	504.49	563.03	642.19	678.73	723.02
PFC (CO_2 eq)	539.90	639.71	739.53	839.34	939.16	1,038.97	1,138.79
SF_6 (CO_2 eq)	306.93	319.02	313.27	311.48	311.47	313.85	315.42
Others (NF_3) (CO_2 eq)	45.90	45.90	45.90	45.90	45.90	45.90	45.90
Total Including LULUCF (CO_2 eq)	993.57	47,864.20	15,550.31	51,024.97	46,166.40	24,705.93	43,683.07
Total Excluding LULUCF (CO_2 eq)	229,589.07	245,797.05	245,815.98	263,625.20	274,641.40	263,093.11	278,363.14

Summary of Emission Trend by Gas in BUR3 (Gg CO_2 eq.): 2011 – 2016

Greenhouse Gas Source and Sink by Gas (BUR3)	2011	2012	2013	2014	2015	2016
CO_2 Emissions Including CO_2 From LULUCF	-25,146.39	-24,475.69	-20,832.61	-18,952.16	-48.77	4,430.47
CO_2 Emissions Excluding CO_2 From LULUCF	213,879.39	232,288.22	238,295.94	244,895.70	248,139.23	245,823.29
CH_4 Emissions Including CH_4 From LULUCF	2,233.24	2,170.82	2,228.02	2,240.95	2,254.08	2,288.44
CH_4 Emissions Excluding CH_4 From LULUCF	2,233.24	2,170.73	2,227.75	2,240.44	2,254.03	2,287.28
N_2O Emissions Including N_2O From LULUCF	22.73	26.24	25.37	26.92	25.59	25.89
N_2O Emissions Excluding N_2O From LULUCF	22.73	26.24	25.36	26.90	25.58	25.82
HFC (CO_2 eq)	688.57	726.51	743.32	764.47	760.40	757.00
PFC (CO_2 eq)	1,445.24	2,576.01	2,668.57	3,023.58	4,694.46	4,976.28
SF_6 (CO_2 eq)	317.42	309.54	324.41	316.45	311.02	348.17
Others (NF_3) (CO_2 eq)	45.90	45.29	47.03	45.36	45.36	50.85
Total Including LULUCF (CO_2 eq)	39,956.61	41,273.03	46,211.77	49,242.33	69,738.67	75,488.61
Total Excluding LULUCF (CO_2 eq)	278,982.38	298,034.06	305,331.08	313,072.95	317,925.07	316,833.35

Note: As per Technical Annex in BUR3 with the totals corrected.

Summary of Emission Trend by Gas in BUR4 (Gg CO_2 eq.): 1990 – 1997

Greenhouse Gas Source and Sink by Gas (BUR4)	1990	1991	1992	1993	1994	1995	1996	1997
CO_2 Emissions Including CO_2 From LULUCF	-30,958.43	-113,569.45	-84,599.72	-123,549.10	-100,704.50	-110,349.73	-103,197.75	-100,517.38
CO_2 Emissions Excluding CO_2 From LULUCF	64,954.65	74,808.71	80,587.66	80,738.99	87,922.59	90,583.07	106,450.29	124,161.78
CH_4 Emissions Including CH_4 From LULUCF	831.02	880.98	913.03	1,060.42	1,089.30	1,186.65	1,296.32	1,412.72
CH_4 Emissions Excluding CH_4 From LULUCF	831.02	880.98	913.03	1,060.42	1,089.30	1,186.65	1,296.32	1,412.72
N_2O Emissions Including N_2O From LULUCF	11.33	11.55	11.66	12.89	14.43	12.92	12.89	16.92
N_2O Emissions Excluding N_2O From LULUCF	11.33	11.55	11.66	12.89	14.43	12.92	12.89	16.92
HFC (CO_2 eq)	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	91.05
PFC (CO_2 eq)	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO
SF_6 (CO_2 eq)	0.23	0.23	0.23	0.23	0.23	0.23	0.50	0.78
Others (NF_3) (CO_2 eq)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Total Including LULUCF (CO_2 eq)	-6,807.36	-88,102.95	-58,299.11	-93,196.39	-69,173.17	-76,832.05	-66,946.74	-60,065.83
Total Excluding LULUCF (CO_2 eq)	89,105.72	100,275.22	106,888.27	111,091.69	119,453.92	124,100.75	142,701.30	164,613.33

Summary of Emission Trend by Gas in BUR4 (Gg CO_2 eq.): 1998 – 2004

Greenhouse Gas Source and Sink by Gas (BUR4)	1998	1999	2000	2001	2002	2003	2004
CO_2 Emissions Including CO_2 From LULUCF	-105,012.95	-113,639.94	-31,629.02	-66,894.19	-86,702.64	-74,666.82	-45,148.97
CO_2 Emissions Excluding CO_2 From LULUCF	112,969.65	125,439.07	137,768.22	143,484.39	151,911.16	165,241.40	179,020.46
CH_4 Emissions Including CH_4 From LULUCF	1,393.44	1,513.40	1,600.45	1,656.04	1,656.34	1,739.41	1,852.45
CH_4 Emissions Excluding CH_4 From LULUCF	1,393.44	1,513.40	1,600.45	1,656.04	1,656.34	1,739.41	1,852.45
N_2O Emissions Including N_2O From LULUCF	17.95	17.72	18.33	15.59	18.67	18.84	21.50
N_2O Emissions Excluding N_2O From LULUCF	17.95	17.72	18.33	15.59	18.67	18.84	21.50
HFC (CO_2 eq)	142.11	193.17	190.87	411.29	511.39	327.71	449.76
PFC (CO_2 eq)	NA,NE,NO	NA,NE,NO	140.64	240.45	340.27	440.08	539.90
SF_6 (CO_2 eq)	1.05	1.32	310.12	306.02	306.48	306.48	306.93
Others (NF_3) (CO_2 eq)	NA,NO	NA,NO	45.90	45.90	45.90	45.90	45.90
Total Including LULUCF (CO_2 eq)	-64,685.71	-70,330.82	14,530.85	-19,843.36	-38,527.38	-24,447.30	8,911.48
Total Excluding LULUCF (CO_2 eq)	153,296.90	168,748.19	183,928.08	190,535.21	200,086.41	215,460.92	233,080.91

Summary of Emission Trend by Gas in BUR4 (Gg CO_2 eq.): 2005 – 2011

Greenhouse Gas Source and Sink by Gas (BUR4)	2005	2006	2007	2008	2009	2010	2011
CO_2 Emissions Including CO_2 From LULUCF	-5,573.08	-42,871.53	-915.76	-13,995.70	-35,656.14	-18,572.92	-23,144.22
CO_2 Emissions Excluding CO_2 From LULUCF	191,503.69	191,106.45	205,455.34	214,676.60	204,877.67	218,821.77	218,107.95
CH_4 Emissions Including CH_4 From LULUCF	2,000.69	2,031.15	2,093.28	2,213.69	2,180.29	2,265.53	2,289.28
CH_4 Emissions Excluding CH_4 From LULUCF	2,000.69	2,031.15	2,093.28	2,213.69	2,180.29	2,265.53	2,289.28
N_2O Emissions Including N_2O From LULUCF	23.49	21.82	24.58	25.68	21.29	22.87	22.81
N_2O Emissions Excluding N_2O From LULUCF	23.49	21.82	24.58	25.68	21.29	22.87	22.81
HFC (CO_2 eq)	518.83	504.49	563.03	642.19	678.73	723.02	688.57
PFC (CO_2 eq)	639.71	739.53	839.34	939.16	1,038.97	1,138.79	1,445.24
SF_6 (CO_2 eq)	319.02	313.27	311.48	311.47	313.85	315.42	317.42
Others (NF_3) (CO_2 eq)	45.90	45.90	45.90	45.90	45.90	45.90	45.90
Total Including LULUCF (CO_2 eq)	52,967.03	16,011.86	60,501.21	50,936.53	27,274.36	47,103.20	43,381.13
Total Excluding LULUCF (CO_2 eq)	250,043.80	249,989.85	266,872.31	279,608.83	267,808.17	284,497.89	284,633.31

Summary of Emission Trend by Gas in BUR4 (Gg CO_2 eq.): 2012 – 2019

Greenhouse Gas Source and Sink by Gas (BUR4)	2012	2013	2014	2015	2016	2017	2018	2019
CO_2 Emissions Including CO_2 From LULUCF	-11,980.80	-7,039.31	169.19	9,045.55	30,227.49	5,115.51	14,433.42	51,155.40
CO_2 Emissions Excluding CO_2 From LULUCF	234,489.88	241,767.13	250,121.74	253,077.66	245,602.54	248,485.24	255,697.50	265,869.94
CH_4 Emissions Including CH_4 From LULUCF	2,321.32	2,261.95	2,098.92	2,080.00	2,189.37	2,145.27	2,039.23	2,029.20
CH_4 Emissions Excluding CH_4 From LULUCF	2,321.32	2,261.95	2,098.92	2,080.00	2,189.37	2,145.27	2,039.23	2,029.20
N_2O Emissions Including N_2O From LULUCF	26.30	25.44	26.99	25.62	25.87	27.00	26.00	24.41
N_2O Emissions Excluding N_2O From LULUCF	26.30	25.44	26.99	25.62	25.87	27.00	26.00	24.41
HFC (CO_2 eq)	717.37	743.32	764.47	760.40	757.00	904.82	936.96	973.53
PFC (CO_2 eq)	2,576.01	2,668.57	3,023.58	4,694.46	4,976.28	4,976.28	4,976.28	4,976.28
SF_6 (CO_2 eq)	309.54	324.41	316.50	311.02	348.17	468.83	476.30	483.76
Others (NF_3) (CO_2 eq)	45.29	47.03	45.36	45.36	50.85	50.85	50.85	50.85
Total Including LULUCF (CO_2 eq)	57,538.83	60,873.56	64,835.93	74,492.91	98,804.40	73,193.32	79,602.70	115,643.68
Total Excluding LULUCF (CO_2 eq)	304,009.51	309,680.00	314,788.47	318,525.03	314,179.45	316,563.05	320,866.78	330,358.21

Table A - 6: Comparison of Reference and Sectoral Approaches of CO_2 Estimates between BUR3 and BUR4

Years: 1990 – 2011

Greenhouse Gas Emissions (Gg CO_2 eq.)		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
BUR3	Reference Approach	54,610.31	66,970.96	74,815.73	79,176.52	79,233.05	80,972.83	96,572.57	113,238.63	105,704.92	104,720.36	120,961.88
	Sectoral Approach	59,070.83	68,598.85	74,400.85	73,475.64	79,634.64	81,582.04	94,978.33	111,500.06	100,535.19	112,385.04	122,474.78
	Percentage Difference	-8.17%	-2.43%	0.55%	7.20%	-0.51%	-0.75%	1.65%	1.54%	4.89%	-7.32%	-1.25%
BUR4	Reference Approach	54,610.31	66,970.96	74,815.73	79,176.52	79,233.05	80,972.83	96,572.57	113,238.63	105,704.92	104,720.36	120,961.88
	Sectoral Approach	59,070.82	68,598.85	74,400.85	73,475.64	79,634.64	81,582.04	94,978.33	111,500.06	100,534.84	112,385.04	122,474.78
	Percentage Difference	-8.17%	-2.43%	0.55%	7.20%	-0.51%	-0.75%	1.65%	1.54%	4.89%	-7.32%	-1.25%

Greenhouse Gas Emissions (Gg CO_2 eq.)		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
BUR3	Reference Approach	130,316.78	135,523.66	153,715.83	167,165.24	173,730.78	174,321.53	189,011.29	197,879.66	190,630.56	202,752.03	201,307.49
	Sectoral Approach	128,172.92	135,124.43	146,984.71	160,178.70	172,615.02	171,415.67	186,680.78	193,679.56	184,295.08	198,246.89	197,548.61
	Percentage Difference	1.65%	0.29%	4.38%	4.18%	0.64%	1.67%	1.23%	2.12%	3.32%	2.22%	1.87%
BUR4	Reference Approach	130,316.78	135,523.66	153,715.83	167,165.24	173,730.78	174,321.53	189,011.29	197,879.66	190,630.56	202,752.03	201,307.49
	Sectoral Approach	128,171.91	135,125.20	146,985.43	160,177.53	172,350.49	171,415.67	185,370.54	193,680.39	184,296.16	198,363.57	197,549.38
	Percentage Difference	1.65%	0.29%	4.38%	4.18%	0.79%	1.67%	1.93%	2.12%	3.32%	2.16%	1.87%

Years: 2012 – 2019

Greenhouse Gas Emissions (Gg CO_2 eq.)		2012	2013	2014	2015	2016	2017	2018	2019
BUR3	Reference Approach	218,937.80	228,435.83	233,503.39	232,894.57	235,881.97			
	Sectoral Approach	214,159.46	220,533.56	226,728.76	229,446.95	222,510.48			
	Percentage Difference	2.18%	3.46%	2.90%	1.48%	5.67%			
BUR4	Reference Approach	218,937.80	228,435.83	233,503.39	232,894.57	235,881.97	230,278.63	235,030.48	239,553.42
	Sectoral Approach	214,160.83	220,533.56	226,729.83	229,426.85	222,510.17	225,941.32	230,848.78	234,858.05
	Percentage Difference	2.18%	3.46%	2.90%	1.49%	5.67%	1.88%	1.78%	1.96%

Table A - 7: Short Summary Table for GHG Inventory Year 2019

Categories	Net CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Other halogenated gases with CO_2 equivalent conversion factors	Other halogenated gases without CO_2 equivalent conversion factors	NO_x	CO	NMVOCs	SO_2
	(Gg)			CO_2 equivalents (Gg)					(Gg)			
Total National Emissions and Removals	51,155.40	2,029.20	24.41	973.53	4,976.28	483.76	50.85	NA, NE, NO	3.66	100.20	65.92	3.49
1 ENERGY	239,458.25	739.75	4.61						0.61	1.11	65.55	0.07
1A Fuel Combustion Activities	234,858.00	25.13	4.56						0.61	1.11	0.06	0.07
1B Fugitive emissions from fuels	4,600.25	714.63	0.05						NA,NE,NO	NA,NE,NO	65.49	NA,NE,NO
1C Carbon dioxide Transport and Storage	NO								NO	NO	NO	NO
2 INDUSTRIAL PROCESSES AND PRODUCT USE	25,957.35	14.08	0.20	973.53	4,976.28	483.76	50.85	NA, NE, NO	2.67	91.39	0.37	3.42
2A Mineral Industry	10,085.04	NA, NE, NO	NO						NA, NO	NA, NO	NA, NO	NA, NO
2B Chemical Industry	5,432.65	13.11	NA, NO	NO	NO	NO	NO	NO	1.91	0.19	NA, NO	NA, NO
2C Metal Industry	10,439.66	0.97	NA, NE, NO	NO	2,617.44	NO	NO	NO	0.76	91.20	0.37	3.42
2D Non-Energy Products from Fuels and Solvent Use	NE, NO	NE, NO	NE, NO						NA, NO	NA, NO	NA, NO	NA, NO
2E Electronics Industry	NA, NO	NO	NA, NO	43.75	2,358.84	337.03	50.85	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
2F Product Uses as Substitutes for Ozone Depleting Substances	NA, NE, NO	NO	NO	929.77	NA, NE, NO		NA, NE, NO	NA, NE, NO	NA, NO	NA, NO	NA, NO	NA, NO
2G Other Product Manufacture and Use	NO	NO	0.20	NO	NE, NO	146.74	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
2H Other (please specify)	NE, NO	NE, NO	NO						NA, NO	NA, NO	NA, NO	NA, NO
3 AGRICULTURE, FORESTRY AND OTHER LAND USE	-214,302.97	162.06	18.32						0.39	7.70	IE, NA	IE, NA
3A Livestock		70.56	0.40						NA, NO	NA, NO	NA, NO	NA
3B Land	-214,714.54	IE, NA, NO	IE, NA, NO						IE, NA, NO	IE, NA, NO	IE, NA, NO	NA
3C Aggregate Sources and Non-CO_2 Emissions Sources on Land	411.57	91.50	17.91						0.39	7.70	NA, NO	NA, NO
3D Other	NE, NO	NO	NO						NE, NO	NE, NO	NE, NO	NE, NO
4 WASTE	42.77	1,113.31	1.28						NA,NE, NO	NA,NE, NO	NA,NE, NO	NA,NE, NO
4A Solid Waste Disposal		467.25	NA, NO						NA, NO	NA, NO	NA, NO	NA, NO
4B Biological Treatment of Solid Waste		0.01	0.00						NA	NA	NA	NA
4C Incineration and Open Burning of Waste	42.77	0.08	0.01						NE	NE	NE	NE
4D Wastewater Treatment and Discharge		645.98	1.27						NA	NA	NA	NA
4E Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5 OTHER	NO	NO	NE									
5A Indirect N_2O Emissions from the Atmospheric Deposition of Nitrogen in NO_x and NH_3			NE									
5B Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo items												
International Bunkers	9,431.48	0.18	0.26						NA	NA	NA	NA
International Aviation(International Bunkers)	8,141.80	0.06	0.23						NA	NA	NA	NA
International Water-borne Transport (International Bunkers)	1289.68	0.12	0.03						NA	NA	NA	NA
Multilateral Operations	NO	NO	NO						NO	NO	NO	NO

Table A - 8: Summary Table for GHG Inventory Year 2019
Year 2019 (1 of 3)

Categories	Net CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Other halogenated gases with CO_2 equivalent conversion factors	Other halogenated gases without CO_2 equivalent conversion factors	NO_x	CO	NMVOCs	SO_2
	(Gg)			CO_2 equivalents (Gg)				(Gg)	(Gg)			
Total National Emissions and Removals	51,155.40	2,029.20	24.41	973.53	4,976.28	483.76	50.85	NA, NE, NO	3.66	100.20	65.92	3.49
1 ENERGY	239,458.25	739.75	4.61						0.61	1.11	65.55	0.07
1A Fuel Combustion Activities	234,858.00	25.13	4.56						0.61	1.11	0.06	0.07
1A1 Energy Industries	131,274.34	2.29	1.36						NE, NO	NE, NO	NE, NO	NE, NO
1A2 Manufacturing Industries and \ Construction	33,482.54	1.37	0.21						IE, NE	IE, NE	IE, NE	IE, NE
1A3 Transport	63,576.39	20.75	2.95						0.61	1.11	0.06	0.07
1A4 Other Sectors	6,036.98	0.70	0.04						NE	NE	NE	NE
1A5 Non-Specified	487.76	0.01	0.02						NE	NE	NE	NE
1B Fugitive emissions from fuels	4,600.25	714.63	0.05						NA,NE,NO	NA,NE,NO	65.49	NA,NE,NO
1B1 Solid Fuels	NA, NO	0.95	NA,, NO						NA, NO	NA, NO	NA, NE, NO	NA, NO
1B2 Oil and Natural Gas	4,600.25	713.68	0.05						NA,NE,NO	NA,NE,NO	65.49	NA,NE,NO
1B3 Other emissions from Energy Production	NO	NO	NO						NO	NO	NO	NO
1C Carbon dioxide Transport and Storage	NO								NO	NO	NO	NO
1C1 Transport of CO_2	NO								NO	NO	NO	NO
1C2 Injection and Storage	NO								NO	NO	NO	NO
2 INDUSTRIAL PROCESSES AND PRODUCT USE	25,957.3498	14.08	0.20	973.53	4,976.28	483.76	50.85	NA, NE, NO	2.67	91.39	0.37	3.42
2A Mineral Industry	10,085.04	NA, NO	NO						NA, NO	NA, NO	NA, NO	NA, NO
2A1 Cement Production	9,120.65	NA							NA	NA	NA	NA
2A2 Lime Production	128.96	NA							NA	NA	NA	NA
2A3 Glass Production	340.52	NA							NA	NA	NA	NA
2A4 Other Process Uses of Carbonates	494.90	NA							NA	NA	NA	NA
2A5 Other (please specify)	NO	NO	NO						NO	NO	NO	NO
2B Chemical Industry	5,432.65	13.11	NA, NO	NO	NO	NO	NO	NO	1.91	0.19	NA, NO	NA, NO
2B1 Ammonia Production	1,224.16	NA	NA						1.91	0.19	NA	NA
2B2 Nitric Acid Production	NO	NO	NO						NO	NO	NO	NO
2B3 Adipic Acid Production	NO	NO	NO						NO	NO	NO	NO
2B4 Caprolactam, Glyoxal and Glyoxylic Acid	NO	NO	NO						NO	NO	NO	NO
2B5 Carbide Production	38.02	NA	NA						NA	NA	NA	NA
2B6 Titanium Dioxide Production	NO	NO	NO						NO	NO	NO	NO
2B7 Soda Ash Production	NO	NO	NO						NO	NO	NO	NO
2B8 Petrochemical and Carbon Black	4,170.48	13.11	NA						NA, NO	NA, NO	NA, NO	NA, NO
2B9 Fluorochemical Production				NO	NO	NO	NO	NO	NO	NO	NO	NO
2B10 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Year 2019 (2 of 3)

Categories	Net CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Other halogenated gases with CO_2 equivalent conversion factors	Other halogenated gases without CO_2 equivalent conversion factors	NO_x	CO	NMVOCs	SO_2
	(Gg)			CO_2 equivalents (Gg)				(Gg)	(Gg)			
2C Metal Industry	10,439.66	0.97	NA, NE, NO	NO	2,617.44	NO	NO	NO	0.76	91.20	0.37	3.42
2C1 Iron and Steel Production	7,543.24	0.41	NA						NE	NA	0.37	NE
2C2 Ferroalloys Production	1,680.43	0.56	NE						NE	NA	NA	NE
2C3 Aluminium Production	1,216.00	NA			2,617.44				0.76	91.20	NA	3.42
2C4 Magnesium Production	NO			NO	NO	NO	NO	NO	NO	NO	NO	NO
2C5 Lead Production	NE								NE	NE	NE	NE
2C6 Zinc Production	NO								NO	NO	NO	NO
2C7 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2D Non-Energy Products from Fuels and Solvent Use	NE, NO	NE, NO	NE, NO						NA, NO	NA, NO	NA, NO	NA, NO
2D1 Lubricant Use	NE								NA	NA	NA	NA
2D2 Paraffin Wax Use	NE	NE	NE						NA	NA	NA	NA
2D3 Solvent Use									NA	NA	NA	NA
2D4 Other (please specify)	NO	NO	NO						NO	NO	NO	NO
2E Electronics Industry	NA, NO	NO	NA, NO	43.75	2,358.84	337.03	50.85	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
2E1 Integrated Circuit or Semiconductor	NA		NA	43.75	1,425.89	337.03	50.85	NA	NA	NA	NA	NA
2E2 TFT Flat Panel Display				NO	NO	NO	NO	NO	NO	NO	NO	NO
2E3 Photovoltaics				NA	932.95	NA	NA	NA	NA	NA	NA	NA
2E4 Heat Transfer Fluid							NO	NO	NO	NO	NO	NO
2E5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F Product Uses as Substitutes for Ozone Depleting Substances	NA, NE, NO	NO	NO	929.77	NA, NE, NO		NA,NO	NA, NO	NA. NO	NA, NO	NA, NO	NA, NO
2F1 Refrigeration and Air Conditioning	NA, NE			929.77	NA, NE		NA	NA	NA	NA	NA	NA
2F2 Foam Blowing Agents	NE			NE	NE		NA	NA	NA	NA	NA	NA
2F3 Fire Protection	NE			NE	NE		NA	NA	NA	NA	NA	NA
2F4 Aerosols				NE	NE		NA	NA	NA	NA	NA	NA
2F5 Solvents				NE	NE		NA	NA	NA	NA	NA	NA
2F6 Other Applications	NO	NO	NO	NO	NO		NO	NO	NO	NO	NO	NO
2G Other Product Manufacture and Use	NO	NO	0.20	NO	NE, NO	146.74	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
2G1 Electrical Equipment					NE	146.74	NA	NA	NA	NA	NA	NA
2G2 SF6 and PFCs from Other Product Uses					NE, NO	NE, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
2G3 N_2O from Product Uses			0.20						NA	NA	NA	NA
2G4 Other (please specify)	NO	NO		NO			NO	NO	NO	NO	NO	NO
2H Other (please specify)	NE, NO	NE, NO	NO						NA, NO	NA, NO	NA, NO	NA, NO
2H1 Pulp and Paper Industry	NE	NE							NA	NA	NA	NA
2H2 Food and Beverages Industry	NE	NE							NA	NA	NA	NA
2H3 Other (please specify)	NO	NO	NO						NO	NO	NO	NO

Year 2019 (3 of 3)

Categories	Net CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Other halogenated gases with CO_2 equivalent conversion factors	Other halogenated gases without CO_2 equivalent conversion factors	NO_x	CO	NMVOCs	SO_2
	(Gg)			CO_2 equivalents (Gg)				(Gg)	(Gg)			
3 AGRICULTURE, FORESTRY AND OTHER LAND USE	-214,302.97	162.06	18.32						0.39	7.70	IE, NA, NO	NA, NO
3A Livestock		70.56	0.40						NA, NO	NA, NO	NA, NO	NA
3A1 Enteric Fermentation		48.98							NA, NO	NA, NO	NA, NO	NA
3A2 Manure Management		21.58	0.40						NA, NO	NA, NO	NA, NO	NA
3B Land	-214,714.54	IE, NA, NO	IE, NA, NO						IE, NA, NO	IE, NA, NO	IE, NA, NO	NA
3B1 Forest Land	-237,008.39	IE, NA, NO	IE, NA, NO						IE, NA, NO	IE, NA, NO	NA, NO	NA
3B2 Cropland	-18,561.09	IE, NA, NO	IE, NA, NO						IE, NA, NO	IE, NA, NO	NA, NO	NA
3B3 Grassland	0.00	NA, NO	NA, NO						NA, NO	NA, NO	NA, NO	NA
3B4 Wetlands	IE, NA, NO	IE, NA, NO	IE, NA, NO						IE, NA, NO	IE, NA, NO	NA, NO	NA
3B5 Settlements	40,854.94	NA, NO	NA, NO						NA, NO	NA, NO	NA, NO	NA
3B6 Other Land	NO	NO	NO						NO	NO	NO	NO
3C Aggregate Sources and Non-CO_2 Emissions Sources on Land	411.57	91.50	17.91						0.39	7.70	NA, NO	NA, NO
3C1 Biomass Burning	NO	0.74	0.02						0.39	7.70	NA	NA
3C2 Liming	21.67								NA	NA	NA	NA
3C3 Urea Application	389.89								NA	NA	NA	NA
3C4 Direct N_2O Emissions from Managed Soils			12.54						NA	NA	NA	NA
3C5 Indirect N_2O Emissions from Managed Soils			3.53						NA	NA	NA	NA
3C6 Indirect N_2O Emissions from Manure Management			1.82						NA	NA	NA	NA
3C7 Rice Cultivations		90.76	NA						NA	NA	NA	NA
3C8 Other (please specify)	NO	NO	NO						NO	NO	NO	NO
3D Other	NE, NO	NO	NO						NE, NO	NE, NO	NE, NO	NE, NO
3D1 Harvested Wood Products	NE								NE	NE	NE	NE
3D2 Other (please specify)	NO	NO	NO						NO	NO	NO	NO
4 WASTE	42.77	1,113.31	1.28						NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO
4A Solid Waste Disposal		467.25	NA, NO						NA, NO	NA, NO	NA, NO	NA, NO
4B Biological Treatment of Solid Waste		0.01	0.00						NA	NA	NA	NA
4C Incineration and Open Burning of Waste	42.77	0.08	0.01						NE	NE	NE	NE
4D Wastewater Treatment and Discharge		645.98	1.27						NA	NA	NA	NA
4E Other (please specify)	NO	NO	NO						NO	NO	NO	NO
5 OTHER	NO	NO	NE	NO	NO	NO	NO	NO	NO	NO	NO	NO
5A Indirect N_20 Emissions from the Atmospheric Deposition of Nitrogen in NO_x and NH_3			NE									
5B Other (please specify)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Memo items												
International Bunkers	9,431.48	0.18	0.26						NA	NA	NA	NA
International Aviation(International Bunkers)	8,141.80	0.06	0.23						NA	NA	NA	NA
International Water-borne Transport (International Bunkers)	1,289.68	0.12	0.03						NA	NA	NA	NA
Multilateral Operations	NO	NO	NO						NO	NO	NO	NO

Table A - 9: Energy Sectoral Table for GHG Inventory Year 2019

Year 2019 (1 of 4)

Categories		CO_2	CH_4	N_2O	NO_x	CO	NMVOCs	SO_2
		(Gg)						
1 Energy		239,458.25	739.75	4.61	0.61	1.11	65.55	0.07
1A	**Fuel Combustion Activities**	234,858.00	25.13	4.56	0.61	1.11	0.06	0.07
1A1	**Energy Industries**	131,274.34	2.29	1.36	NE, NO	NE, NO	NE, NO	NE, NO
1A1a	Main Activity Electricity and Heat Production	109,349.31	1.71	1.26	NE, NO	NE, NO	NE, NO	NE, NO
1A1ai	Electricity Generation	106,000.33	1.47	1.23	NE	NE	NE	NE
1A1aii	Combined Heat and Power Generation (CHP)	3,348.97	0.24	0.03	NE	NE	NE	NE
1A1aiii	Heat Plants	NO	NO	NO	NO	NO	NO	NO
1A1b	Petroleum Refining	8,200.82	0.34	0.07	NE	NE	NE	NE
1A1c	Manufacture of Solid Fuels and Other Energy Industries	13,724.22	0.24	0.02	NE, NO	NE, NO	NE, NO	NE, NO
1A1ci	Manufacture of Solid Fuels	NO	NO	NO	NO	NO	NO	NO
1A1cii	Other Energy Industries	13,724.22	0.24	0.02	NE	NE	NE	NE
1A2	**Manufacturing Industries and Construction**	33,482.54	1.37	0.21	IE, NE	IE, NE	IE, NE	IE, NE
1A2a	Iron and Steel	9,446.93	0.21	0.03	NE	NE	NE	NE
1A2b	Non-Ferrous Metals	311.66	0.01	0.00	NE	NE	NE	NE
1A2c	Chemicals	3,625.72	0.09	0.01	NE	NE	NE	NE
1A2d	Pulp, Paper and Print	982.93	0.03	0.00	NE	NE	NE	NE
1A2e	Food Processing, Beverages and Tobacco	6,323.68	0.12	0.01	NE	NE	NE	NE
1A2f	Non-Metallic Minerals	7,945.64	0.75	0.11	NE	NE	NE	NE
1A2g	Transport Equipment	2,729.51	0.11	0.02	NE	NE	NE	NE
1A2h	Machinery	256.47	0.01	0.00	NE	NE	NE	NE
1A2i	Mining (excluding fuels) and Quarrying	IE	IE	IE	IE	IE	IE	IE
1A2j	Wood and wood products	487.35	0.02	0.00	NE	NE	NE	NE
1A2k	Construction	IE	IE	IE	IE	IE	IE	IE
1A2l	Textile and Leather	852.28	0.02	0.00	NE	NE	NE	NE
1A2m	Non-specified Industry	520.36	0.01	0.00	NE	NE	NE	NE

Year 2019 (2 of 4)

Categories		CO_2	CH_4	N_2O	NO_x	CO	NMVOCs	SO_2
		(Gg)						
1A3	**Transport**	63,576.39	20.75	2.95	0.61	1.11	0.06	0.07
1A3a	Civil Aviation	1,276.23	0.01	0.04	0.61	1.11	0.06	0.07
1A3ai	International Aviation (International Bunkers)							
1A3aii	Domestic Aviation	1,276.23	0.01	0.04	0.61	1.11	0.06	0.07
1A3b	Road Transportation	54,225.95	19.07	2.63	IE, NE, NO	IE, NE, NO	IE, NE, NO	IE, NE, NO
1A3bi	Cars	IE	IE	IE	IE	IE	IE	IE
1A3bi1	Passenger cars with 3-way catalysts	IE	IE	IE	IE	IE	IE	IE
1A3bi2	Passenger cars without 3-way catalysts	IE	IE	IE	IE	IE	IE	IE
1A3bii	Light-duty trucks	IE	IE	IE	IE	IE	IE	IE
1A3bii1	Light-duty trucks with 3-way catalysts	IE	IE	IE	IE	IE	IE	IE
1A3bii2	Light-duty trucks without 3-way catalysts	IE	IE	IE	IE	IE	IE	IE
1A3biii	Heavy-duty trucks and buses	IE	IE	IE	IE	IE	IE	IE
1A3biv	Motorcycles	IE	IE	IE	IE	IE	IE	IE
1A3bv	Evaporative emissions from vehicles				NE	NE	NE	NE
1A3bvi	Urea-based catalysts	NO			NO	NO	NO	NO
1A3c	Railways	46.69	0.00	0.02	NE	NE	NE	NE
1A3d	Water-borne Navigation	5,650.38	0.53	0.15	NE	NE	NE	NE
1A3di	International water-borne navigation (International bunkers)							
1A3dii	Domestic Water-borne Navigation	5,650.38	0.53	0.15	NE	NE	NE	NE
1A3e	Other Transportation	2,377.14	1.13	0.11	NE,NO	NE,NO	NE,NO	NE,NO
1A3ei	Pipeline Transport	NE	NE	NE	NE	NE	NE	NE
1A3eii	Off-road	2,377.14	1.13	0.11	NO	NO	NO	NO
1A4	**Other Sectors**	6,036.98	0.70	0.04	NE	NE	NE	NE
1A4a	Commercial/Institutional	1,700.36	0.20	0.01	NE	NE	NE	NE
1A4b	Residential	1,650.08	0.13	0.00	NE	NE	NE	NE
1A4c	Agriculture/Forestry/Fishing/Fish Farms	2,686.54	0.36	0.02	NE	NE	NE	NE
1A4ci	Stationary	134.33	0.02	0.00	NE	NE	NE	NE
1A4cii	Off-road Vehicles and Other Machinery	15.38	0.00	0.00	NE	NE	NE	NE
1A4ciii	Fishing (mobile combustion)	2,536.83	0.34	0.02	NE	NE	NE	NE

Year 2019 (3 of 4)

Categories		CO_2	CH_4	N_2O	NO_x	CO	NMVOCs	SO_2
		(Gg)						
1A5	**Non-Specified**	487.76	0.01	0.02	NE	NE	NE	NE
1A5a	Stationary	NE	NE	NE	NE	NE	NE	NE
1A5b	Mobile	487.76	0.01	0.02	NE	NE	NE	NE
1A5bi	Mobile (aviation component)	337.45	0.00	0.01	NE	NE	NE	NE
1A5bii	Mobile (water-borne component)	90.30	0.01	0.00	NE	NE	NE	NE
1A5biii	Mobile (Other)	60.01	0.00	0.00	NE	NE	NE	NE
1A5c	Multilateral Operations							
1B	**Fugitive emissions from fuels**	4,600.25	714.63	0.05	NE,NA,NO	NE,NA,NO	65.49	NE,NA,NO
1B1	**Solid Fuels**	NA, NO	0.95	NA	NA, NO	NA, NO	NA, NE, NO	NA, NO
1B1a	Coal mining and handling	NA	0.95		NA	NA	NE	NA
1B1ai	Underground mines	NA, NO	0.02		NA, NO	NA, NO	NA, NE, NO	NA, NO
1B1ai1	Mining	NA	NA		NA	NA	NE	NA
1B1ai2	Post-mining seam gas emissions	NA	NA		NA	NA	NE	NA
1B1ai3	Abandoned underground mines	NA	0.02		NA	NA	NA	NA
1B1ai4	Flaring of drained methane or conversion of methane to CO_2	NO	NO	NO	NO	NO	NO	NO
1B1aii	Surface mines	NA	0.93	NA	NA	NA	NE	NA
1B1aii1	Mining	NA	0.70		NA	NA	NE	NA
1B1aii2	Post-mining seam gas emissions	NA	0.23		NA	NA	NE	NA
1B1b	Uncontrolled combustion and burning coal dumps	NO	NO		NO	NO	NO	NO
1B1c	Solid fuel transformation	NO	NO		NO	NO	NO	NO
1B2	**Oil and Natural Gas**	4,600.25	713.68	0.05	NE,NA,NO	NE,NA,NO	65.487647	NE,NA,NO
1B2a	Oil	4,335.70	430.04	0.05	NE,NA,NO	NE,NA,NO	37.45	NE,NA,NO
1B2ai	Venting	3.00	403.83	NA	NE	NE	0.00	NE
1B2aii	Flaring	4,332.70	26.00	0.05	NE	NE	0.00	NE
1B2aiii	All Other	0.00	0.21	NA	NA	NA	37.45	NA
1B2aiii1	Exploration	NE	NE	NE	NE	NE	NE	NE
1B2aiii2	Production and Upgrading	0.00	0.02	NA	NA	NA	0.00	NA
1B2aiii3	Transport	NE	NE	NE	NE	NE	NE	NE
1B2aiii4	Refining	NA	0.19	NA	NA	NA	37.45	NA
1B2aiii5	Distribution of oil products	NE	NE	NE	NE	NE	NE	NE
1B2aiii6	Other	NO	NO	NO	NO	NO	NO	NO
1B2b	Natural Gas	264.54	283.64	0.00	NA, NE, NO	NA, NE, NO	28.04	NA, NE, NO
1B2bi	Venting	NO	NO	NO	NO	NO	NO	NO
1B2bii	Flaring	254.46	1.53	0.00	NA	NA	NA	NA
1B2biii	All Other	10.08	282.11	NA	NA	NA	28.04	NA
1B2biii1	Exploration	NE	NE	NE	NE	NE	NE	NE
1B2biii2	Production	2.65	237.90	NA	NA	NA	17.52	NA
1B2biii3	Processing	6.84	21.81	NA	NA	NA	10.02	NA
1B2biii4	Transmission and Storage	0.04	11.26	NA	NA	NA	0.34	NA
1B2biii5	Distribution	0.54	11.15	NA	NA	NA	0.16	NA
1B2biii6	Other	NO	NO	NO	NO	NO	NO	NO
1B3	**Other emissions from Energy Production**	NO	NO	NO	NO	NO	NO	NO

Year 2019 (4 of 4)

Categories		CO_2	CH_4	N_2O	NO_x	CO	NMVOCs	SO_2
		(Gg)						
1C	**Carbon dioxide Transport and Storage**	NO	NO	NO	NO	NO	NO	NO
1C1	**Transport of CO_2**	NO			NO	NO	NO	NO
1C1a	Pipelines	NO			NO	NO	NO	NO
1C1b	Ships	NO			NO	NO	NO	NO
1C1c	Other (please specify)	NO			NO	NO	NO	NO
1C2	**Injection and Storage**	NO			NO	NO	NO	NO
1C2a	Injection	NO			NO	NO	NO	NO
1C2b	Storage	NO			NO	NO	NO	NO
1C3	**Other**	NO	NO	NO	NO	NO	NO	NO

Categories	Emissions (Gg)						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOCs	SO_2
Memo Items							
International Bunkers	9,431.48	0.18	0.26	NE	NE	NE	NE
International Aviation (International Bunkers)	8,141.80	0.06	0.23	NE	NE	NE	NE
International water-borne navigation (International bunkers)	1,289.68	0.12	0.03	NE	NE	NE	NE
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO
Information Items							
CO_2 from Biomass Combustion for Energy Production	3,042.66						

Table A - 10: IPPU Sectoral Table for GHG Inventory Year 2019
Year 2019 (1 of 3)

Category		CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Other halogenated gases with CO_2 equivalent conversion	Other halogenated gases without CO_2 equivalent conversion	NO_x	CO	NMVOCs	SOx
		(Gg)			CO_2 equivalents (Gg)					(Gg)			
2 INDUSTRIAL PROCESSES AND PRODUCT USE		25,957.35	14.08	0.20	973.53	4,976.28	483.76	50.85	NA, NE, NO	2.67	91.39	0.37	3.42
2A	**Mineral Industry**	10,085.04	NA, NO	NO						NA, NO	NA, NO	NA, NO	NA, NO
2A1	Cement Production	9,120.65	NA							NA	NA	NA	NA
2A2	Lime Production	128.96	NA							NA	NA	NA	NA
2A3	Glass Production	340.52	NA							NA	NA	NA	NA
2A4	Other Process Uses of Carbonates	494.90	NA							NA	NA	NA	NA
2A4a	Ceramics	IE	NA							NA	NA	NA	NA
2A4b	Other Uses of Soda Ash	NE	NA							NO	NO	NO	NO
2A4c	Non Metallurgical Magnesia Production	IE	NA							NO	NO	NO	NO
2A4d	Other (please specify)	IE	NA							NO	NO	NO	NO
2A5	Other (please specify)	NO	NO	NO						NO	NO	NO	NO
2B	**Chemical Industry**	5,432.65	13.11	NA, NO	NO	NO	NO	NO	NO	1.91	0.19	NA, NO	NA, NO
2B1	Ammonia Production	1,224.16	NA	NA						1.91	0.19	NA	NA
2B2	Nitric Acid Production	NO	NO	NO						NO	NO	NO	NO
2B3	Adipic Acid Production	NO	NO	NO						NO	NO	NO	NO
2B4	Caprolactam, Glyoxal and Glyoxylic Acid Production	NO	NO	NO						NO	NO	NO	NO
2B5	Carbide Production	38.02	NA	NA						NA	NA	NA	NA
2B6	Titanium Dioxide Production	NO	NO	NO						NO	NO	NO	NO
2B7	Soda Ash Production	NO	NO	NO						NO	NO	NO	NO
2B8	Petrochemical and Carbon Black Production	4,170.48	13.11	NA,NO						NA, NO	NA, NO	NA, NO	NA, NO
2B8a	Methanol	1,363.45	4.68	NA						NA	NA	NA	NA
2B8b	Ethylene	2,725.48	8.21	NA						NA	NA	NA	NA
2B8c	Ethylene Dichloride and Vinyl Chloride Monomer	NO	NO	NO						NO	NO	NO	NO
2B8d	Ethylene Oxide	81.55	0.22	NA						NA	NA	NA	NA
2B8e	Acrylonitrile	NO	NO	NO						NO	NO	NO	NO
2B8f	Carbon Black	NO	NO	NO						NO	NO	NO	NO
2B9	Fluorochemical Production				NO	NO	NO	NO	NO	NO	NO	NO	NO
2B9a	By-product Emissions				NO	NO	NO	NO	NO	NO	NO	NO	NO
2B9b	Fugitive Emissions				NO	NO	NO	NO	NO	NO	NO	NO	NO
2B10	Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Year 2019 (2 of 3)

Category		CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Other halogenated gases with CO_2 equivalent conversion	Other halogenated gases without CO_2 equivalent conversion	NO_x	CO	NMVOCs	SOx
		(Gg)			CO_2 equivalents (Gg)					(Gg)			
2C	**Metal Industry**	10,439.66	0.97	NA, NE, NO	NO	2,617.44	NO	NO	NO	0.76	91.20	0.37	3.42
2C1	Iron and Steel Production	7,543.24	0.41	NA						NE	NA	0.37	NE
2C2	Ferroalloys Production	1,680.43	0.56	NE						NE	NA	NA	NE
2C3	Aluminium Production	1,216.00	NA			2,617.44				0.76	91.20	NA	3.42
2C4	Magnesium Production	NO			NO	NO	NO	NO	NO	NO	NO	NO	NO
2C5	Lead Production	NE								NE	NE	NE	NE
2C6	Zinc Production	NO								NO	NO	NO	NO
2C7	Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2D	**Non-Energy Products from Fuels and Solvent Use**	NE, NO	NE, NO	NE, NO						NA, NO	NA, NO	NA, NO	NA, NO
2D1	Lubricant Use	NE								NA	NA	NA	NA
2D2	Paraffin Wax Use	NE	NE	NE						NA	NA	NA	NA
2D3	Solvent Use									NA	NA	NA	NA
2D4	Other (please specify)	NO	NO	NO						NO	NO	NO	NO
2E	**Electronics Industry**	NA, NO	NO	NA, NO	43.75	2,358.84	337.03	50.85	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
2E1	Integrated Circuit or Semiconductor	NA		NA	43.75	1,425.89	337.03	50.85	NA	NA	NA	NA	NA
2E2	TFT Flat Panel Display				NO	NO	NO	NO	NO	NO	NO	NO	NO
2E3	Photovoltaics				NA	932.95	NA	NA	NA	NA	NA	NA	NA
2E4	Heat Transfer Fluid							NO	NO	NO	NO	NO	NO
2E5	Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F	**Product Uses as Substitutes for Ozone Depleting Substances**	NA, NE, NO	NO	NO	929.77	NA, NE, NO		NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
2F1	Refrigeration and Air Conditioning	NA, NE			929.77	NA, NE		NA	NA	NA	NA	NA	NA
2F1a	Refrigeration and Stationary Air Conditioning	NE			NE	NE		NA	NA	NA	NA	NA	NA
2F1b	Mobile Air Conditioning	NA			929.77	NA		NA	NA	NA	NA	NA	NA
2F2	Foam Blowing Agents	NE			NE	NE		NA	NA	NA	NA	NA	NA
2F3	Fire Protection	NE			NE	NE		NA	NA	NA	NA	NA	NA
2F4	Aerosols				NE	NE		NA	NA	NA	NA	NA	NA
2F5	Solvents				NE	NE		NA	NA	NA	NA	NA	NA
2F6	Other Applications	NO	NO	NO	NO	NO		NO	NO	NO	NO	NO	NO

Year 2019 (3 of 3)

Category		CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Other halogenated gases with CO_2 equivalent conversion	Other halogenated gases without CO_2 equivalent conversion	NO_x	CO	NMVOCs	SOx
		(Gg)			CO_2 equivalents (Gg)					(Gg)			
2G Other Product Manufacture and Use		NO	NO	0.20	NO	NE, NO	146.74	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
2G1	Electrical Equipment					NE	146.74	NA	NA	NA	NA	NA	NA
2G1a	Manufacture of Electrical Equipment					NE	NE	NA	NA	NA	NA	NA	NA
2G1b	Use of Electrical Equipment					NE	146.74	NA	NA	NA	NA	NA	NA
2G1c	Disposal of Electrical Equipment					NE	NE	NA	NA	NA	NA	NA	NA
2G2	SF6 and PFCs from Other Product Uses					NE, NO	NE, NO	NA,NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
2G2a	Military Applications					NE	NE	NA	NA	NA	NA	NA	NA
2G2b	Accelerators					NE	NE	NA	NA	NA	NA	NA	NA
2G2c	Other (please specify)					NO	NO	NO	NO	NO	NO	NO	NO
2G3	N2O from Product Uses			0.20						NA	NA	NA	NA
2G3a	Medical Applications			0.20						NA	NA	NA	NA
2G3b	Propellant for Pressure and Aerosol Products			NE						NA	NA	NA	NA
2G3c	Other (please specify)			NO						NO	NO	NO	NO
2G4	Other (please specify)	NO	NO		NO			NO	NO	NO	NO	NO	NO
2H Other		NE, NO	NE, NO	NO						NA, NO	NA, NO	NA, NO	NA, NO
2H1	Pulp and Paper Industry	NE	NE							NA	NA	NA	NA
2H2	Food and Beverages Industry	NE	NE							NA	NA	NA	NA
2H3	Other (please specify)	NO	NO	NO						NO	NO	NO	NO

Table A - 11: AFOLU Sectoral Table for GHG Inventory Year 2019

Year 2019 (1 of 4)

Categories		(Gg)					
		Net CO2 emissions / removals	Emissions				
			CH_4	N_2O	NOx	CO	NMVOCs
3 Agriculture, Forestry, and Other Land Use (AFOLU)		-214,302.97	162.06	18.32	0.39	7.70	NA, NE, NO
3A	**Livestock**		70.56	0.40	NA, NO	NA, NO	NA, NO
3A1	Enteric Fermentation		48.98	NA, NO	NA, NO	NA, NO	NA, NO
3A1a	Cattle		38.98	NA	NA	NA	NA
3A1ai	Dairy Cows		3.07	NA	NA	NA	NA
3A1aii	Other Cattle		35.91	NA	NA	NA	NA
3A1b	Buffalo		5.88	NA	NA	NA	NA
3A1c	Sheep		0.61	NA	NA	NA	NA
3A1d	Goats		1.56	NA	NA	NA	NA
3A1e	Camels		NE	NA	NA	NA	NA
3A1f	Horses		0.06	NA	NA	NA	NA
3A1g	Mules and Asses		NE	NA	NA	NA	NA
3A1h	Swine		1.89	NA	NA	NA	NA
3A1j	Other (please specify)		NO	NO	NO	NO	NO
3A2	Manure Management		21.58	0.40	NA, NO	NA, NO	NA, NO
3A2a	Cattle		2.16	0.08	NA	NA	NA
3A2ai	Dairy cows		1.40	0.01	NA	NA	NA
3A2aii	Other cattle		0.76	0.08	NA	NA	NA
3A2b	Buffalo		0.21	0.00	NA	NA	NA
3A2c	Sheep		0.02	0.01	NA	NA	NA
3A2d	Goats		0.07	0.02	NA	NA	NA
3A2e	Camels		NE	NE	NA	NA	NA
3A2f	Horses		0.01	NA	NA	NA	NA
3A2g	Mules and Asses		NE	NE	NA	NA	NA
3A2h	Swine		13.22	0.01	NA	NA	NA
3A2i	Poultry		5.89	0.28	NA	NA	NA
3A2j	Other (please specify)		NO	NO	NO	NO	NO

Year 2019 (2 of 4)

Categories		(Gg)					
		Net CO2 emissions / removals	Emissions				
			CH_4	N_2O	NOx	CO	NMVOCs
3B	**Land**	-214,714.54	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	NA, NO
3B1	Forest land	-237,008.39	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	NA, NO
3B1a	Forest land Remaining Forest land	-237,008.39	0.00	0.00	0.00	0.00	NA
3B1b	Land Converted to Forest land	NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
3B1bi	Cropland converted to Forest Land	NO	NO	NO	NO	NO	NO
3B1bii	Grassland converted to Forest Land	NO	NO	NO	NO	NO	NO
3B1biii	Wetlands converted to Forest Land	NO	NO	NO	NO	NO	NO
3B1biv	Settlements converted to Forest Land	NO	NO	NO	NO	NO	NO
3B1bv	Other Land converted to Forest Land	NA	NA	NA	NA	NA	NA
3B2	Cropland	-18,561.09	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	NA, NO
3B2a	Cropland Remaining Cropland	-18,662.58	IE	IE	IE	IE	NA
3B2b	Land Converted to Cropland	101.49	NA	NA	NA	NA	NA
3B2bi	Forest Land converted to Cropland	101.49	NA	NA	NA	NA	NA
3B2bii	Grassland converted to Cropland	NO	NO	NO	NO	NO	NO
3B2biii	Wetlands converted to Cropland	NO	NO	NO	NO	NO	NO
3B2biv	Settlements converted to Cropland	NO	NO	NO	NO	NO	NO
3B2bv	Other Land converted to Cropland	NO	NO	NO	NO	NO	NO
3B3	Grassland	0.00	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
3B3a	Grassland Remaining Grassland	0.00	NA	NA	NA	NA	NA
3B3b	Land Converted to Grassland	NO	NO	NO	NO	NO	NO
3B3bi	Forest Land converted to Grassland	NO	NO	NO	NO	NO	NO
3B3bii	Cropland converted to Grassland	NO	NO	NO	NO	NO	NO
3B3biii	Wetlands converted to Grassland	NO	NO	NO	NO	NO	NO
3B3biv	Settlements converted to Grassland	NO	NO	NO	NO	NO	NO
3B3bv	Other Land converted to Grassland	NO	NO	NO	NO	NO	NO

Year 2019 (3 of 4)

Categories		(Gg)					
		Net CO2 emissions / removals	Emissions				
			CH_4	N_2O	NOx	CO	NMVOCs
3B4	Wetlands	IE, NO	IE,NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	NA, NO
3B4a	Wetlands Remaining Wetlands	IE	IE, NA	IE, NA	IE, NA	IE, NA	NA
3B4ai	Peatlands remaining peatlands	IE	IE	IE	IE	IE	NA
3B4aii	Flooded land remaining flooded land	IE	NA	NA	NA	NA	NA
3B4b	Land Converted to Wetlands	NO	NO	NO	NO	NO	NO
3B4bi	Land converted for peat extraction	NO	NO	NO	NO	NO	NO
3B4bii	Land converted to flooded land	NO	NO	NO	NO	NO	NO
3B4biii	Land converted to other wetlands	NO	NO	NO	NO	NO	NO
3B5	Settlements	40,854.94	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
3B5a	Settlements Remaining Settlements	0.00	NA	NA	NA	NA	NA
3B5b	Land Converted to Settlements	40,854.94	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
3B5bi	Forest Land converted to Settlements	35,564.03	NA	NA	NA	NA	NA
3B5bii	Cropland converted to Settlements	5,290.91	NA	NA	NA	NA	NA
3B5biii	Grassland converted to Settlements	NO	NO	NO	NO	NO	NO
3B5biv	Wetlands converted to Settlements	NO	NO	NO	NO	NO	NO
3B5bv	Other Land converted to Settlements	NO	NO	NO	NO	NO	NO
3B6	Other Land	NO	NO	NO	NO	NO	NO
3B6a	Other land Remaining Other land	NO	NO	NO	NO	NO	NO
3B6b	Land Converted to Other land	NO	NO	NO	NO	NO	NO
3B6bi	Forest Land converted to Other Land	NO	NO	NO	NO	NO	NO
3B6bii	Cropland converted to Other Land	NO	NO	NO	NO	NO	NO
3B6biii	Grassland converted to Other Land	NO	NO	NO	NO	NO	NO
3B6biv	Wetlands converted to Other Land	NO	NO	NO	NO	NO	NO
3B6bv	Settlements converted to Other Land	NO	NO	NO	NO	NO	NO

Year 2019 (4 of 4)

Categories		(Gg)					
		Net CO2 emissions / removals	Emissions				
			CH_4	N_2O	NOx	CO	NMVOCs
3C	**Aggregate sources and non-CO_2 emissions sources on land**	411.57	91.50	17.91	0.39	7.70	NA, NO
3C1	Emissions from biomass burning	IE, NO	0.74	0.02	0.39	7.70	NA, NO
3C1a	Biomass burning in forest lands	IE	0.44	0.01	0.10	6.66	NA
3C1b	Biomass burning in croplands	NO	0.31	0.01	0.28	1.04	NA
3C1c	Biomass burning in grasslands	NO	NO	NO	NO	NO	NO
3C1d	Biomass burning in all other land	NO	NO	NO	NO	NO	NO
3C2	Liming	21.67			NA	NA	NA
3C3	Urea application	389.89			NA	NA	NA
3C4	Direct N2O Emissions from managed soils			12.54	NA	NA	NA
3C5	Indirect N2O Emissions from managed soils			3.53	NA	NA	NA
3C6	Indirect N2O Emissions from manure management			1.82	NA	NA	NA
3C7	Rice cultivations		90.76		NA	NA	NA
3C8	Other (please specify)						
3D	**Other**	NE, NO	NO	NO	NE, NO	NE, NO	NE, NO
3D1	Harvested Wood Products	NE			NE	NE	NE
3D2	Other (please specify)	NO	NO	NO	NO	NO	NO

Table A - 12: Waste Sectoral Table for GHG Inventory Year 2019

Categories		CO_2	CH_4	N_2O	NOx	CO	NMVOCs	SO_2
		(Gg)						
4	**WASTE**	42.77	1113.31	1.28	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO
4A	**Solid Waste Disposal**		467.25	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
4A1	Managed Waste Disposal Sites		65.41	NA	NA	NA	NA	NA
4A2	Unmanaged Waste Disposal Sites		401.83	NA	NA	NA	NA	NA
4A3	Uncategorised Waste Disposal Sites		NO	NO	NO	NO	NO	NO
4B	**Biological Treatment of Solid Waste**		0.01	0.00	NA	NA	NA	NA
4C	**Incineration and Open Burning of Waste**	42.77	0.08	0.01	NE	NE	NE	NE
4C1	Waste Incineration	42.09	0.00	0.01	NE	NE	NE	NE
4C2	Open Burning of Waste	0.68	0.08	0.00	NE	NE	NE	NE
4D	**Wastewater Treatment and Discharge**		645.98	1.27	NA	NA	NA	NA
4D1	Domestic Wastewater Treatment and Discharge		67.48	1.27	NA	NA	NA	NA
4D2	Industrial Wastewater Treatment and Discharge		578.50	NA	NA	NA	NA	NA
4E	**Other (please specify)**	NO	NO	NO	NO	NO	NO	NO

Table A - 13a: Energy Background Table for GHG Inventory Year 2019 - 1A1-1A2

2006 IPCC Categories	Activity (TJ)						Emissions (Gg)																	Total emissions (Gg)			Information Items (Gg)	
							Solid			Liquid			Gas			Other Fossil			Peat			Biomass							
	Solid Fuel	Liquid Fuel	Gas	Other Fossil Fuel	Peat	Biomass	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2 Amount Captured	Biomass CO_2 emitted
1.A - Fuel Combustion Activities	840,919.64	1,237,686.23	1,174,867.20	NO	NO	40,584.80	80,512.54	1.48	1.26	88,435.42	21.75	3.12	65,910.05	1.55	0.13	NO	NO	NO	NO	NO	NO	0.34	0.05	234,858.00	25.13	4.56	0.00	3,042.66
1.A.1 - Energy Industries	769,540.60	137,277.04	847,343.68	NO	NO	13,472.48	73,653.01	0.77	1.15	10,085.35	0.41	0.08	47,535.98	0.85	0.08	NO	NO	NO	NO	NO	NO	0.26	0.03	131,274.34	2.29	1.36	0.00	1,123.10
1.A.1.a - Main Activity Electricity and Heat Production	769,540.60	25,396.88	602,705.20	NO	NO	13,472.48	73,653.01	0.77	1.15	1,884.53	0.08	0.02	33,811.76	0.60	0.06	NO	NO	NO	NO	NO	NO	0.26	0.03	109,349.31	1.71	1.26	0.00	1,123.10
1.A.1.a.i - Electricity Generation	769,540.60	22,426.24	546,932.48	NO	NO	6,819.92	73,653.01	0.77	1.15	1,664.41	0.07	0.01	30,682.91	0.55	0.05	NO	NO	NO	NO	NO	NO	0.09	0.01	106,000.33	1.47	1.23	0.00	501.54
1.A.1.a.ii - Combined Heat and Power Generation (CHP)	NO	2,970.64	55,772.72	NO	NO	6,652.56	NO	NO	NO	220.12	0.01	0.00	3,128.85	0.06	0.01	NO	NO	NO	NO	NO	NO	0.17	0.02	3,348.97	0.24	0.03	0.00	621.57
1.A.1.a.iii - Heat Plants	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00	NO	NO
1.A.1.b - Petroleum Refining	NO	111,880.16	NO	NO	NO	NO	NO	NO	NO	8,200.82	0.34	0.07	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	8,200.82	0.34	0.07	0.00	NO
1.A.1.c - Manufacture of Solid Fuels and Other Energy Industries	NO	NO	244,638.48	NO	NO	NO	NO	NO	NO	NO	NO	NO	13,724.22	0.24	0.02	NO	NO	NO	NO	NO	NO	NO	NO	13,724.22	0.24	0.02	0.00	NO
1.A.1.c.i - Manufacture of Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00	NO	NO
1.A.1.c.ii - Other Energy Industries	NO	NO	244,638.48	NO	NO	NO	NO	NO	NO	NO	NO	NO	13,724.22	0.24	0.02	NO	NO	NO	NO	NO	NO	NO	NO	13,724.22	0.24	0.02	0.00	NO
1.A.2 - Manufacturing Industries and Construction	71,379.04	115,520.24	322,419.04	NO	NO	NO	6,859.53	0.71	0.11	8,535.30	0.34	0.07	18,087.71	0.32	0.03	NO	NO	NO	NO	NO	NO	NO	NO	33,482.54	1.37	0.21	0.00	NO
1.A.2.a - Iron and Steel	0.00	31,266.71	127,773.21	NO	NO	NO	0.00	0.00	0.00	2,278.86	0.09	0.02	7,168.08	0.13	0.01	NO	NO	NO	NO	NO	NO	NO	NO	9,446.93	0.21	0.03	0.00	NO
1.A.2.b - Non-Ferrous Metals	0.00	0.00	5,555.36	NO	NO	NO	0.00	0.00	0.00	0.00	0.00	0.00	311.66	0.01	0.00	NO	NO	NO	NO	NO	NO	NO	NO	311.66	0.01	0.00	0.00	NO
1.A.2.c - Chemicals	0.00	16,509.42	42,637.37	NO	NO	NO	0.00	0.00	0.00	1,233.76	0.05	0.01	2,391.96	0.04	0.00	NO	NO	NO	NO	NO	NO	NO	NO	3,625.72	0.09	0.01	0.00	NO
1.A.2.d - Pulp, Paper and Print	0.00	6,031.55	9,582.99	NO	NO	NO	0.00	0.00	0.00	445.33	0.02	0.00	537.61	0.01	0.00	NO	NO	NO	NO	NO	NO	NO	NO	982.93	0.03	0.00	0.00	NO
1.A.2.e - Food Processing, Beverages and Tobacco	0.00	4,195.10	107,218.39	NO	NO	NO	0.00	0.00	0.00	308.73	0.01	0.00	6,014.95	0.11	0.01	NO	NO	NO	NO	NO	NO	NO	NO	6,323.68	0.12	0.01	0.00	NO
1.A.2.f - Non-Metallic Minerals	71,379.04	7,900.91	8,680.25	NO	NO	NO	6,859.53	0.71	0.11	599.15	0.02	0.00	486.96	0.01	0.00	NO	NO	NO	NO	NO	NO	NO	NO	7,945.64	0.75	0.11	0.00	NO
1.A.2.g - Transport Equipment	0.00	33,692.60	4,166.52	NO	NO	NO	0.00	0.00	0.00	2,495.77	0.10	0.02	233.74	0.00	0.00	NO	NO	NO	NO	NO	NO	NO	NO	2,729.51	0.11	0.02	0.00	NO
1.A.2.h - Machinery	0.00	3,373.51	208.33	NO	NO	NO	0.00	0.00	0.00	244.79	0.01	0.00	11.69	0.00	0.00	NO	NO	NO	NO	NO	NO	NO	NO	256.47	0.01	0.00	0.00	NO
1.A.2.i - Mining (excluding fuels) and Quarrying	0.00	0.00	0.00	NO	NO	NO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NO	NO	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00	0.00	NO
1.A.2.j - Wood and wood products	0.00	5,535.57	1,249.96	NO	NO	NO	0.00	0.00	0.00	417.23	0.02	0.00	70.12	0.00	0.00	NO	NO	NO	NO	NO	NO	NO	NO	487.35	0.02	0.00	0.00	NO
1.A.2.k - Construction	0.00	0.00	0.00	NO	NO	NO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NO	NO	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00	0.00	NO
1.A.2.l - Textile and Leather	0.00	3,350.03	10,763.50	NO	NO	NO	0.00	0.00	0.00	248.44	0.01	0.00	603.83	0.01	0.00	NO	NO	NO	NO	NO	NO	NO	NO	852.28	0.02	0.00	0.00	NO
1.A.2.m - Non-specified Industry	0.00	3,664.85	4,583.17	NO	NO	NO	0.00	0.00	0.00	263.24	0.01	0.00	257.12	0.00	0.00	NO	NO	NO	NO	NO	NO	NO	NO	520.36	0.01	0.00	0.00	NO

Table A - 13b: Energy Background Table for GHG Inventory Year 2019 - 1A3-1A5

Year 2019 (1 of 2)

2006 IPCC Categories	Activity (TJ)						Emissions (Gg)																Total emissions (Gg)		
							Solid			Liquid			Gas			Other Fossil Fuel			Peat			Biomass				
	Solid Fuel	Liquid Fuel	Gas	Other Fossil Fuel	Peat	Biomass	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CH_4	N_2O	CO_2	CH_4	N_2O
1.A.3 - Transport	NO	892,536.25	4,100.32	NO	NO	27,112.32	NO	NO	NO	63,346.36	20.29	2.92	230.03	0.38	0.01	NO	NO	NO	NO	NO	NO	0.08	0.02	63,576.39	20.75	2.95
1.A.3.a - Civil Aviation		17,849.39	NO	NO	NO	NO				1,276.23	0.01	0.04	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1,276.23	0.01	0.04
1.A.3.a.i - International Aviation (International Bunkers)																										
1.A.3.a.ii - Domestic Aviation		17,849.39	NO	NO	NO	NO				1,276.23	0.01	0.04	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1,276.23	0.01	0.04
1.A.3.b - Road Transportation *		763,501.22	4,100.32	NO	NO	27,112.32				53,995.92	18.62	2.60	230.03	0.38	0.01	NO	NO	NO	NO	NO	NO	0.08	0.02	54,225.95	19.07	2.63
1.A.3.b.i - Cars		IE	IE	NO	NO	IE				IE	IE	IE	IE	IE	IE	NO	NO	NO	NO	NO	NO	IE	IE	IE, NO	IE, NO	IE, NO
1.A.3.b.i.1 - Passenger cars with 3-way catalysts		IE	IE	NO	NO	IE				IE	IE	IE	IE	IE	IE	NO	NO	NO	NO	NO	NO	IE	IE	IE, NO	IE, NO	IE, NO
1.A.3.b.i.2 - Passenger cars without 3-way catalysts		IE	IE	NO	NO	IE				IE	IE	IE	IE	IE	IE	NO	NO	NO	NO	NO	NO	IE	IE	IE, NO	IE, NO	IE, NO
1.A.3.b.ii - Light-duty trucks		IE	IE	NO	NO	IE				IE	IE	IE	IE	IE	IE	NO	NO	NO	NO	NO	NO	IE	IE	IE, NO	IE, NO	IE, NO
1.A.3.b.ii.1 - Light-duty trucks with 3-way catalysts		IE	IE	NO	NO	IE				IE	IE	IE	IE	IE	IE	NO	NO	NO	NO	NO	NO	IE	IE	IE, NO	IE, NO	IE, NO
1.A.3.b.ii.2 - Light-duty trucks without 3-way catalysts		IE	IE	NO	NO	IE				IE	IE	IE	IE	IE	IE	NO	NO	NO	NO	NO	NO	IE	IE	IE, NO	IE, NO	IE, NO
1.A.3.b.iii - Heavy-duty trucks and buses		IE	IE	NO	NO	IE				IE	IE	IE	IE	IE	IE	NO	NO	NO	NO	NO	NO	IE	IE	IE, NO	IE, NO	IE, NO
1.A.3.b.iv - Motorcycles		IE	IE	NO	NO	IE				IE	IE	IE	IE	IE	IE	NO	NO	NO	NO	NO	NO	IE	IE	IE, NO	IE, NO	IE, NO
1.A.3.b.v - Evaporative emissions from vehicles		NE	NO																							
1.A.3.b.vi - Urea-based catalysts																								NO		
1.A.3.c - Railways	NO	630.13	NO	NO	NO	NO	NO	NO	NO	46.69	0.00	0.02	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	46.69	0.00	0.02
1.A.3.d - Water-borne Navigation	NO	76,253.40	NO	NO	NO	NO	NO	NO	NO	5,650.38	0.53	0.15	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	5,650.38	0.53	0.15
1.A.3.d.i - International water-borne navigation (International bunkers)																										
1.A.3.d.ii - Domestic Water-borne Navigation	NO	76,253.40	NO	NO	NO	NO	NO	NO	NO	5,650.38	0.53	0.15	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	5,650.38	0.53	0.15
1.A.3.e - Other Transportation	NO	34,302.11	NE, NO	NO	NO	NO	NO	NO	NO	2,377.14	1.13	0.11	NE, NO	NE, NO	NE, NO	NO	NO	NO	NO	NO	NO	NO	NO	2,377.14	1.13	0.11
1.A.3.e.i - Pipeline Transport	NO	NE	NE	NO	NO	NO	NO	NO	NO	NO	NO	NO	NE	NE	NE	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.A.3.e.ii - Off-road	NO	34,302.11	NO	NO	NO	NO	NO	NO	NO	2,377.14	1.13	0.11	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	2,377.14	1.13	0.11
1.A.4 - Other Sectors	NO	85,604.64	1,004.16	NO	NO	NO	NO	NO	NO	5,980.65	0.69	0.04	56.33	0.01	0.00	NO	NO	NO	NO	NO	NO	NO	NO	6,036.98	0.70	0.04
1.A.4.a - Commercial/Institutional	NO	23,137.52	962.32	NO	NO	NO	NO	NO	NO	1,646.37	0.20	0.01	53.99	0.00	0.00	NO	NO	NO	NO	NO	NO	NO	NO	1,700.36	0.20	0.01
1.A.4.b - Residential	NO	26,066.32	41.84	NO	NO	NO	NO	NO	NO	1,647.73	0.13	0.00	2.35	0.00	0.00	NO	NO	NO	NO	NO	NO	NO	NO	1,650.08	0.13	0.00
1.A.4.c - Agriculture/Forestry/Fishing/Fish Farms	NO	36,400.80	NO	NO	NO	NO	NO	NO	NO	2,686.54	0.36	0.02	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	2,686.54	0.36	0.02
1.A.4.c.i - Stationary	NO	1,820.04	NO	NO	NO	NO	NO	NO	NO	134.33	0.02	0.00	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	134.33	0.02	0.00
1.A.4.c.ii - Off-road Vehicles and Other Machinery	NO	198.74	NO	NO	NO	NO	NO	NO	NO	15.38	0.00	0.00	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	15.38	0.00	0.00
1.A.4.c.iii - Fishing (mobile combustion)	NO	34,382.02	NO	NO	NO	NO	NO	NO	NO	2,536.83	0.34	0.02	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	2,536.83	0.34	0.02
1.A.5 - Non-Specified	NO	6,748.07	IE, NO	NO	NO	NO	NO	NO	NO	487.76	0.01	0.02	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	487.76	0.01	0.02
1.A.5.a - Stationary	NO	IE	IE	NO	NO	NO	NO	NO	NO	IE	IE	IE	IE	IE	IE	NO	NO	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00
1.A.5.b - Mobile	NO	6,748.07	NO	NO	NO	NO	NO	NO	NO	487.76	0.01	0.02	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	487.76	0.01	0.02
1.A.5.b.i - Mobile (aviation component)	NO	4,719.56	NO	NO	NO	NO	NO	NO	NO	337.45	0.00	0.01	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	337.45	0.00	0.01
1.A.5.b.ii - Mobile (water-borne component)	NO	1,218.65	NO	NO	NO	NO	NO	NO	NO	90.30	0.01	0.00	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	90.30	0.01	0.00
1.A.5.b.iii - Mobile (Other)	NO	809.85	NO	NO	NO	NO	NO	NO	NO	60.01	0.00	0.00	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	60.01	0.00	0.00
1.A.5.c - Multilateral Operations																										

Year 2019 (2 of 2)

Memo Items																									
2006 IPCC Categories	Activity (TJ)						Emissions Solid Fuel (Gg)			Emissions Liquid Fuel (Gg)			Emissions Gas (Gg)			Emissions Other Fossil Fuels (Gg)			Emissions Peat (Gg)			Emissions Biomass (Gg)		Emissions Total (Gg)		
	Solid Fuel	Liquid Fuel	Gas	Other Fossil	Peat	Biomass	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CH_4	N_2O	CO_2	CH_4	N_2O
International Bunkers	NO	130,774.65	NO	NO	NO	NO	NO	NO	NO	9,431.48	0.18	0.26	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	9,431.48	0.18	0.26
International Aviation (International Bunkers)	NO	113,871.29	NO	NO	NO	NO	NO	NO	NO	8,141.80	0.06	0.23	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	8,141.80	0.06	0.23
International water-borne navigation (International bunker	NO	16,903.36	NO	NO	NO	NO	NO	NO	NO	1,289.68	0.12	0.03	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1,289.68	0.12	0.03
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
*1A3b road transport emission were calculated as a whole without breakdown into further sub categories. IE in the subcategories denotes the emissions were in the 1A3b total.																										

Table A - 13c: Energy Background Table for GHG Inventory Year 2019 - 1B

2006 IPCC Categories	Activity Data			Emissions(Gg)			Information Item: Amount Captured (Gg)
	Description	Unit	Value	CO_2	CH_4	N_2O	CO_2
1.B - Fugitive emissions from fuels				4,600.25	714.63	0.05	NO
1.B.1 - Solid Fuels				NA,NO	0.95	NA,NO	NO
1.B.1.a - Coal mining and handling				NA	0.95	NA	NO
1.B.1.a.i - Underground mines	coal produced	ktonnes	2.00	NA	0.02	NA	NO
1.B.1.a.i.1 - Mining	coal produced	ktonnes	0.00	NA	NA	NA	NO
1.B.1.a.i.2 - Post-mining seam gas emissions	coal produced	ktonnes	0.00	NA	NA	NA	NO
1.B.1.a.i.3 - Abandoned underground mines	number of mines	number	2.00	NA	0.02	NA	NO
1.B.1.a.i.4 - Flaring of drained methane or conversion of methane to CO_2	gas flared	10^6 Sm3	NO	NO	NO	NO	NO
1.B.1.a.ii - Surface mines				NA.NO	0.93	NA, NO	NO
1.B.1.a.ii.1 - Mining	coal produced	ktonnes	3,459.12	NA	0.70	NA	NO
1.B.1.a.ii.2 - Post-mining seam gas emissions	coal produced	ktonnes	3,459.12	NA	0.23	NA	NO
1.B.1.b - Uncontrolled combustion and burning coal dumps	solid fuel combusted	ktonnes	NO	NO	NO	NO	NO
1.B.1.c - Solid fuel transformation		ktonnes	NO	NO	NO	NO	NO
1.B.2 - Oil and Natural Gas				4,600.25	713.68	0.05	NO
1.B.2.a - Oil				4,335.70	430.04	0.05	NO
1.B.2.a.i - Venting	total gas vented from oil production	10^6 Sm3	611.87	3.00	403.83	NA	NO
1.B.2.a.ii - Flaring	gas flared from oil production	10^3 m3	2,166.35	4,332.70	26.00	0.05	NO
1.B.2.a.iii - All Other				0.00	0.21	NA	NO
1.B.2.a.iii.1 - Exploration	wells drilled	number	NE	NE	NE	NE	NO
1.B.2.a.iii.2 - Production and Upgrading	oil produced	10^3 m3	34,141.62	0.00	0.02	NA	NO
1.B.2.a.iii.3 - Transport	crude oil transported	10^3 m3	NE	NE	NE	NE	NO
1.B.2.a.iii.4 - Refining	refinery crude oil throughput	10^3 m3	28,804.07	0.00	0.19	NA	NO
1.B.2.a.iii.5 - Distribution of oil products	amount distributed	10^3 m3	NE	NE	NE	NE	NO
1.B.2.a.iii.6 - Other			0.00	0.00	0.00	NA	NO
1.B.2.b - Natural Gas				264.54	283.64	0.00	NO
1.B.2.b.i - Venting	total gas vented from natural gas production	10^6 Sm3	0.00	0.00	0.00	NA	NO
1.B.2.b.ii - Flaring	gas flared from natural gas production	10^6 Sm3	127.23	254.46	1.53	0.00	NO
1.B.2.b.iii - All Other				10.08	282.11	NA	NO
1.B.2.b.iii.1 - Exploration	wells drilled	number		NE	NE	NE	NO
1.B.2.b.iii.2 - Production	gas produced	10^6 Sm3	86,760.39	2.65	237.90	NA	NO
1.B.2.b.iii.3 - Processing	amount of gas processed at facilities	10^6 Sm3	40,244.12	6.84	21.81	NA	NO
1.B.2.b.iii.4 - Transmission and Storage	amount transported and stored	10^6 Sm3	43,399.15	0.04	11.26	NA	NO
1.B.2.b.iii.5 - Distribution	amount of gas distributed	10^6 m3	8,988.82	0.54	11.15	NA	NO
1.B.2.b.iii.6 - Other			0.00	0.00	0.00	NA	NO
1.B.3 - Other emissions from Energy Production				NO	NO	NO	NO

Table A - 13d(i): Energy Background Table for GHG Inventory Year 2019 - 1C CO_2 Transport, Injection and Storage

Category	Activity (Gg)		Annual mass of fugitive CO_2 emissions to the atmosphere or sea bed (Gg)
	Annual mass of CO_2 transported	Annual mass of CO_2 injected	
1C1 Transport of CO_2	NO		NO
1C1a Pipelines	NO		NO
1C1b Ships	NO		NO
1C1c Other (please specify)	NO		NO
1C2 Injection and Storage		NO	NO
1C2a Injection		NO	NO
1C2b Storage		NO	NO
1C3 Other	NO	NO	NO

Table A - 13d(ii): Energy Background Table for GHG Inventory Year 2019 - 1C CO_2 Transport, Injection and Storage – Overview

Category	CO_2 (Gg)
Total amount captured for storage (A)	0
Total amount of import for storage (B)	NO
Total amount of export for storage (C)	NO
Total amount of CO2 injected at storage sites (D)	NO
Total amount of leakage during transport (E1) category 1C1	NO
Total amount of leakage during injection (E2) category 1C2a	NO
Total amount of leakage from storage sites (E3) category 1C2b	NO
Total leakage (E4 = E1 + E2 + E3)	NO
Capture + imports (F = A + B)	NO
Injection + leakage + exports (G = D + E4 + C)	NO
Discrepancy (F – G)	NO

Table A - 13e: Energy Background Table for GHG Inventory Year 2019 - Reference Approach

Fuel Types			Production	Imports	Exports	International Bunkers	Stock change	Apparent Consumption	Conversion Factor	Apparent Consumption	Carbon emission factor	Carbon content	Carbon content	Excluded Carbon	Net Carbon Emissions	Fraction of Carbon Oxidised	Actual Carbon Emissions	CO_2 Emissions
			ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	(TJ/ktoe)	(TJ)	(tC/TJ)	(t C)	(Gg C)	(Gg C)	(Gg C)		(Gg C)	(Gg CO_2)
Liquid Fossil	Primary Fuels	Crude Oil	29,878.00	10,306.00	12,483.00		2,064.00	25,637.00	41.84	1,072,652.08	20.00	21,453,041.60	21,453.04	0.00	21,453.04	1.00	21,453.04	78,661.15
		Orimulsion	NO	NO	NO		NO	NO	NO	NO	NO	NO	NO	NO	NO	-	NO	NO
		Natural Gas Liquids	NO	NO	NO		NO	NO	NO	NO	NO	NO	NO	NO	NO	-	NO	NO
	Secondary Fuels	Gasoline		8,782.00	348.00	0.00	-203.00	8,637.00	41.84	361,372.08	18.90	6,829,932.31	6,829.93	0.00	6,829.93	1.00	6,829.93	25,043.09
		Jet Kerosene		577.00	665.00	2,721.59	139.00	-2,948.59	41.84	-123,369.01	19.50	-2,405,695.61	-2,405.70	0.00	-2,405.70	1.00	-2,405.70	-8,820.88
		Other Kerosene		0.00	48.00	0.00	-6.00	-42.00	41.84	-1,757.28	19.60	-34,442.69	-34.44	0.00	-34.44	1.00	-34.44	-126.29
		Shale Gas		NO	NO	NO	NO	NO	NO	NO	-	NO	NO	NO	NO	-	NO	NO
		Gas/Diesel Oil		6,216.00	5,167.00	135.00	-1,417.00	2,331.00	41.84	97,529.04	20.20	1,970,086.61	1,970.09	0.00	1,970.09	1.00	1,970.09	7,223.65
		Residual Fuel Oil		79.00	403.00	269.00	213.00	-806.00	41.84	-33,723.04	21.10	-711,556.14	-711.56	0.00	-711.56	1.00	-711.56	-2,609.04
		LPG		443.00	591.00		-545.00	397.00	41.84	16,610.48	17.20	285,700.26	285.70	1,516.30	-1,230.60	1.00	-1,230.60	-4,512.19
		Ethane		0.00	0.00		0.00	0.00	41.84	0.00	16.80	0.00	0.00	1,520.96	-1,520.96	1.00	-1,520.96	-5,576.86
		Naphtha		934.34	2,232.30		-62.09	-1,235.87	41.84	-51,708.80	20.00	-1,034,176.02	-1,034.18	0.00	-1,034.18	1.00	-1,034.18	-3,791.98
		Bitumen		244.09	1,062.67		0.00	-818.58	41.84	-34,249.51	22.00	-753,489.28	-753.49	510.88	-1,264.36	1.00	-1,264.36	-4,636.00
		Lubricants		70.75	341.47	NO	0.00	-270.71	41.84	-11,326.63	20.00	-226,532.64	-226.53	125.24	-351.77	1.00	-351.77	-1,289.82
		Petroleum Coke		35.39	175.94		0.00	-140.55	41.84	-5,880.57	26.60	-156,423.17	-156.42	0.00	-156.42	1.00	-156.42	-573.55
		Refinery Feedstocks		0.00	0.00		0.00	0.00	41.84	0.00	20.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
		Other Oils		279.16	744.32		0.00	-465.16	41.84	-19,462.25	20.00	-389,245.05	-389.25	0.00	-389.25	1.00	-389.25	-1,427.23
Liquid Fossil Totals																		
Solid Fossil	Primary Fuels	Anthracite	NO	NO	NO		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
		Coking Coal	NO	NO	NO		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
		Other Bit. Coal*	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
		Sub-bit. Coal	2,181.00	19,624.00	3.00	0.00	658.00	21,144.00	41.84	884,664.96	26.20	23,178,221.95	23,178.22		23,178.22	1.00	23,178.22	84,986.81
		Lignite*	IE	IE	IE		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
		Oil Shale and Tar Sands	NO	NO	NO		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	Secondary Fuels	BKB & Patent Fuel		NO	NO		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
		Coke Oven/Gas Coke		NO	NO		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
		Coal Tar	N0	NO	NO		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Solid Fossil Totals																		
Gaseous Fossil		Natural Gas (Dry)	63,631.00	7,988.00	30,158.00		NO	41,461.00	41.84	1,734,728.24	15.30	26,541,342.07	26,541.34	5,540.64	21,000.70	1.00	21,000.70	77,002.56
Other Fossil Fuels			NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peat			NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total			95,690.00	55,578.73	54,422.69	3,125.59	840.91	92,879.54		3,886,079.79		67,959,690.00	74,546.76	9,214.01	65,332.75		65,332.75	239,553.42

*** IE in Other Bit. Coal and Lignite are included in the Sub-bit Coal as the NEB primary fuel data did not provide a breakdown of coal into different coal types.**

Table A - 14a: IPPU Background Table for GHG Inventory Year 2019 - 2A Mineral Industry, 2B (2B1-2B8, 2B10) Chemical Industry - CO_2, CH_4 and N_2O

	Activity data			Emissions						
	Production/Consumption quantity			CO_2 (Gg)			CH_4 (Gg)		N_2O (Gg)	
	Description	Quantity	Unit	Emissions	Information item Captured	(memo) Other reduction	Emissions	Information item reduction	Emissions	Information item reduction
2A Mineral Industry				10,085.04	NO	NO	NA, NO	NA, NO	NO	NO
2A1 Cement production	Production of clinker	17,710,000.00	Tonnes	9,120.65	NO	NO	NA	NA		
2A2 Lime production	Production of Quicklime	171,946.75	Tonnes	128.96	NO	NO	NA	NA		
2A3 Glass Production	Production of Glass	2,270,150.00	Tonnes	340.52	NO	NO	NA	NA		
2A4 Other Process Uses of Carbonates				494.90	NO	NO	NA, NO	NO		
2A4a Ceramics *	Use of limestone and dolomite in ceramic production	IE	Tonnes	IE	NO	NO	NA	NO		
2A4b Other Uses of Soda Ash *	Use of limestone and dolomite in Soda Ash production	NE	Tonnes	NE	NO	NO	NA	NO		
2A4c Non Metallurgical Magnesia Production *	Use of limestone and dolomite in Non Metallurgical Magnesia Production production	IE	Tonnes	IE	NO	NO	NA	NO		
2A4d Other	Agregates of other proceses use of Limestone and Dolomite other than in 2A1, 2A2, 2A3	245,290 (limestone) 810,876 (dolomite)	Tonnes	494.90	NO	NO	NO	NO		
2A5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B Chemical Industry				5,432.65	NO	NO	13.11	NA, NO	NA, NO	NA, NO
2B1 Ammonia Production	Production of ammonia	C	Tonnes	1,224.16	NO	NO	NA	NA	NA	NA
2B2 Nitric Acid Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B3 Adipic Acid Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B4 Caprolactam, Glyoxal and Glyoxylic Acid Produc	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B5 Carbide Production	Production of carbide	34,560.00	Tonnes	38.02	NO	NO	NA	NA	NA	NA
2B6 Titanium Dioxide Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B7 Soda Ash Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B8 Petrochemical and Carbon Black Production				4,170.48	NO	NO	13.11	NO	NA, NO	NO
2B8a Methanol	Conventional Steam Reforming, without primary reformer	C	Tonnes	1,363.45	NO	NO	4.68	NO	NA	NA
2B8b Ethylene	Ethane and Naphtha	C	Tonnes	2,725.48	NO	NO	8.21	NO	NA	NA
2B8c Ethylene Dichloride and Vinyl Chloride Monome	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B8d Ethylene Oxide	Oxygen Process	C	Tonnes	81.55	NO	NO	0.22	NO	NA	NA
2B8e Acrylonitrile	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B8f Carbon Black	NO	NO	Tonnes	NO	NO	NO	NO	NO	NO	NO
2B10 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
* IE in 2A4a and 2A4c denotes emission in these subcategories were accounted in 2A4d										

Table A – 14b: IPPU Background Table for GHG Inventory Year 2019 - 2B (2B9 - 2B10) Chemical Industry, HFCs, PFCs, SF_6 and other halogenated gases

Categories		HFC-23	HFC-32	HFC-41	HFC-125	HFC-134	HFC-134a	HFC-143	HFC-143a	HFC-152	HFC-152a	HFC-161	HFC-227ea	HFC-236cb	HFC-236ea	HFC-236fa	HFC-245ca	HFC-245fa	HFC-365mfc	HFC-43-10mee	Other HFCs (please specify)	Total HFCs	CF_4	$C2F_6$	C_3F_8	C_4F_{10}	$c\text{-}C_4F_8$	C_5F_{12}	C_6F_{14}	Other HFCs (please specify)	Total PFCs	SF_6	Other halogenated gases
CO_2 equivalent conversion factors [Source of the factor: IPCC AR4, *AR5]		14,800	675	*116	3,500	*1,120	1,430	*328	4,470	*16	124	*4	3,220	*1,210	*1,330	9,810	*716	1,030	794	1,640			7,390	12,200	8,830	8,860	10,300	9,160	9,300			22,800	
Emissions in original mass unit (tonne)																																	
2B9	Fluorochemical Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		NO	NO	NO	NO	NO	NO	NO	NO		NO	NO
2B9a	By-product Emissions	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	(information) Reduced amount	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B9b	Fugitive Emissions	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		NO	NO	NO	NO	NO	NO	NO	NO		NO	NO
	(information) Reduced amount	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		NO	NO	NO	NO	NO	NO	NO	NO		NO	NO
2B10	Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		NO	NO	NO	NO	NO	NO	NO	NO		NO	NO
Emissions in CO2 equivalent unit (Gg-CO2)																																	
2B9	Fluorochemical Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B9a	By-product Emissions	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B9b	Fugitive Emissions	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B10	Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table A – 14c: IPPU Background Table for GHG Inventory Year 2019 - 2C Metal Industry CO_2, CH_4 and N_2O

Categories	Activity Data			Emissions						
	Production/Consumption quantity			CO_2 (Gg)			CH_4 (Gg)		N_2O (Gg)	
	Description	Quantity	Unit	Emissions	(information) Captured and Stored	(information) Other Reduction	Emissions	(information) Reduction	Emissions	(information) Reduction
2C Metal Industry				10,439.66	NA, NE, NO	NA, NE, NO	0.97	NA, NE, NO	NA, NE, NO	NA, NE, NO
2C1 Iron and Steel Production	Production of iron & steel	12,934,651.38	tonne	7,543.24	0.41	NO	0.41	NO	NA	NA
2C2 Ferroalloys Production	Production of Ferroalloys	829,486.68	tonne	1,680.43	NO	NO	0.56	NO	NE	NE
2C3 Aluminium Production	Production of aluminum	760,000.00	tonne	1,216.00	NA	NA	NA	NA		
2C4 Magnesium Production	NO	NO	tonne	NO	NO	NO				
2C5 Lead Production	NE	NE	tonne	NE	NE	NE				
2C6 Zinc Production	NO	NO	tonne	NO	NO	NO				
2C7 Other (please specify)	NO	NO	tonne	NO	NO	NO	NO	NO	NO	NO

Table A – 14d: IPPU Background Table for GHG Inventory Year 2019 - 2C (2C3, 2C4, 2C7) Metal Industry HFCs, PFCs, SF_6 and other halogenated gases

Categories	HFC-143a	Other HFCs (please specify)	Total HFCs	CF_4	C_2F_6	C_3F_8	C_4F_{10}	$c\text{-}C_4F_8$	C_5F_{12}	C_6F_{14}	Other PFCs (please specify)	Total PFCs	SF_6	Other halogenated gases (please specify)
CO_2 equivalent conversion factors [Source of the factor: IPCC AR4]	4,470			7,390	12,200	8,830	8,860	10,300	9,160	9,300			22,800	
Emissions in original mass unit (tonne)														
2C3 Aluminium Production				0.30	0.03	NA	NA	NA	NA	NA	NA			
(information) Reduced amount				NA	NA	NA	NA	NA	NA	NA	NA			
2C4 Magnesium Production	NO	NO		NO	NO	NO	NO	NO	NO	NO	NO		NO	NO
(information) Reduced amount	NO	NO		NO	NO	NO	NO	NO	NO	NO	NO		NO	NO
2C7 Other Metals (please specify)	NO	NO		NO	NO	NO	NO	NO	NO	NO	NO		NO	NO
(information) Reduced amount	NO	NO		NO	NO	NO	NO	NO	NO	NO	NO		NO	NO
Emissions in CO_2 equivalent unit (Gg $CO_{2\ eq.}$)														
2C3 Aluminium Production				2,246.56	370.88	NA	NA	NA	NA	NA	NA	2,617.44		
2C4 Magnesium Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C7 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table A – 14e: IPPU Background Table for GHG Inventory Year 2019 - 2D Non-Energy Products from Fuels and Solvent Use CO_2, CH_4 and N_2O

Categories	Activity Data			Emissions		
	Production/Consumption quantity			CO_2	CH_4	N_2O
	Description	Quantity	Unit	(Gg)	(Gg)	(Gg)
2D Non-Energy Products from Fuels and Solvent Use				NE, NO	NE, NO	NE, NO
2D1 Lubricant Use	Lubricant consumption	NE	tonne	NE		
2D2 Paraffin Wax Use	Wax consumption	NE	tonne	NE	NE	NE
2D3 Solvent Use						
2D4 Other				NO	NO	NO
Product (please specify)	NO	NO	NO	NO	NO	NO
Product (please specify)	NO	NO	NO	NO	NO	NO
Product (please specify)	NO	NO	NO	NO	NO	NO

Table A – 14f: IPPU Background Table for GHG Inventory Year 2019 - 2E Electronics Industry HFCs, PFCs, SF_6 NF_3 and other halogenated gases

Categories	CO_2	N_2O	HFC-23	HFC-32	Other HFCs (please specify)	Total HFCs	CF_4	C_2F_6	C_3F_8	c-C_4F_8	Other PFCs (please specify)	Total PFCs	SF_6	NF_3	Other halogenated gases (please specify)
CO_2 equivalent conversion factors [Source of the factor: IPCC AR4]	1	298	14,800	675			7,390	12,200	8,830	10,300			22,800	17,200	
Emissions in original mass unit (tonne)															
2E Electronics Industry	NA	NA	0.00	NA, NO	NA, NO		0.18	0.08	0.00	NA, NO	NA, NO		0.01	0.00	NA, NO
2E1 Integrated Circuit or Semiconductor	NA	NA	0.00	NA	NA		0.07	0.07	0.00	NA	NA		0.01	0.00	NA
2E2 TFT Flat Panel Display			NO	NO	NO		NO	NO	NO	NO	NO		NO	NO	NO
2E3 Photovoltaics			NA	NA	NA		0.12	0.00	NA	NA	NA		NA	NA	NA
2E4 Heat Transfer Fluid															NO
2E5 Other (please specify)		NO	NO	NO	NO		NO	NO	NO	NO	NO		NO	NO	NO
Emissions in CO2 equivalent unit (Gg CO_2 eq.)															
2E Electronics Industry			43.75	NA, NO	NA, NO	43.75	1,366.72	959.48	32.63	NA, NO	NA, NO	2,358.83	337.03	50.85	NA, NO
2E1 Integrated Circuit or Semiconductor			43.75	NA	NA	43.75	491.57	901.69	32.63	NA	NA	1,425.89	337.03	50.85	NA
2E2 TFT Flat Panel Display			NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E3 Photovoltaics			NA	NA	NA	NA	875.15	57.79	NA	NA	NA	932.95	NA	NA	NA
2E4 Heat Transfer Fluid															NO
2E5 Other (please specify)			NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table A – 14g: IPPU Background Table for GHG Inventory Year 2019 - 2F Product Uses as Substitutes for Ozone Depleting Substances HFCs, PFCs and other halogenated gases

Categories	CO_2	HFC-23	HFC-32	HFC-125	HFC-134a	HFC-143a	HFC-152a	HFC-227ea	HFC-236fa	HFC-245fa	HFC-365mfc	HFC-43-10mee	Other HFCs (please specify)	Total HFCs	CF_4	C_2F_6	C_3F_8	C_4F_{10}	Other PFCs (please specify)	Total PFCs	Other halogenated gases (please specify)
CO_2 equivalent conversion factors [Source of the factor: IPCC AR4]	**1**	**14,800**	**675**	**3,500**	**1,430**	**4,470**	**124**	**3,220**	**9,810**	**1,030**	**794**	**1,640**			**7,390**	**12,200**	**8,830**	**8,860**			
Emissions in original mass unit (tonne)																					
2F Product Uses as Substitutes for Ozone Depleting Substances	NA, NE	NA, NE, NO	NA, NE, NO	NA, NE, NO	0.65	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO		NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO		NA, NO
2F1 Refrigeration and Air Conditioning	NA, NE	NA, NE	NA, NE	NA, NE	0.65	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE		NA, NE	NA, NE	NA, NE	NA, NE	NA, NE		NA
2F1a Refrigeration and Stationary Air Conditioning	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE		NE	NE	NE	NE	NE		NA
2F1b Mobile Air Conditioning	NA	NA	NA	NA	0.65	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA		NA
2F2 Foam Blowing Agents	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE		NE	NE	NE	NE	NE		NA
2F3 Fire Protection	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE		NE	NE	NE	NE	NE		NA
2F4 Aerosols		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE		NE	NE	NE	NE	NE		NA
2F5 Solvents		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE		NE	NE	NE	NE	NE		NA
2F6 Other Applications		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO		NO	NO	NO	NO	NO		NO
Emissions in CO_2 equivalent unit (Gg CO_2 eq.)																					
2F Product Uses as Substitutes for Ozone Depleting Substances		NA, NE, NO	NA, NE, NO	NA, NE, NO	929.77	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	929.77	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO
2F1 Refrigeration and Air Conditioning		NA, NE	NA, NE	NA, NE	929.77	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	929.77	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE
2F1a Refrigeration and Stationary Air Conditioning		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F1b Mobile Air Conditioning		NA	NA	NA	929.77	NA	NA	NA	NA	NA	NA	NA	NA	929.77	NA	NA	NA	NA	NA	NA	NA
2F2 Foam Blowing Agents		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F3 Fire Protection		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F4 Aerosols		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F5 Solvents		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F6 Other Applications		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table A – 14h: IPPU Background Table or GHG Inventory Year 2019 - 2G (2G1, 2G2, 2G4) Other Product Manufacture and Use – PFCs, SF_6 and other halogenated gases F

Year 2019 (1 of 2)

Categories	CF_4	C_2F_6	C_3F_8	C_4F_{10}	$c\text{-}C_4F_8$	C_5F_{12}	C_6F_{14}	Other PFCs	Total PFCs	SF_6	Other halogenated gases
CO_2 equivalent conversion factors [Source of the factor: IPCC AR4]	7,390	12,200	8,830	8,860	10,300	9,160	9,300			22,800	
Emissions in original mass unit (Gg)											
2G Other Product Manufacture and Use	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO		0.01	NE, NO
2G1 Electrical Equipment	NE	NE	NE	NE	NE	NE	NE	NE		0.01	NE
2G1a Manufacture of Electrical Equipment	NE	NE	NE	NE	NE	NE	NE	NE		NE	NE
(information) Reduced amount	NE	NE	NE	NE	NE	NE	NE	NE		NE	NE
2G1b Use of Electrical Equipment	NE	NE	NE	NE	NE	NE	NE	NE		0.01	NE
(information) Reduced amount	NE	NE	NE	NE	NE	NE	NE	NE		NE	NE
2G1c. Disposal of Electrical Equipment	NE	NE	NE	NE	NE	NE	NE	NE		NE	NE
(information) Reduced amount	NE	NE	NE	NE	NE	NE	NE	NE		NE	NE
2G2 SF6 and PFCs from Other Product Uses	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO		NE, NO	NE, NO
2G2a Military Applications	NE	NE	NE	NE	NE	NE	NE	NE		NE	NE
(information) Reduced amount	NE	NE	NE	NE	NE	NE	NE	NE		NE	NE
2G2b Accelerators	NE	NE	NE	NE	NE	NE	NE	NE		NE	NE
University and Research Particle Accelerators	NE	NE	NE	NE	NE	NE	NE	NE		NE	NE
(information) Reduced amount	NE	NE	NE	NE	NE	NE	NE	NE		NE	NE
Industrial and Medical Particle Accelerators	NE	NE	NE	NE	NE	NE	NE	NE		NE	NE
(information) Reduced amount	NE	NE	NE	NE	NE	NE	NE	NE		NE	NE
2G2c Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO		NO	NO
(information) Reduced amount	NO	NO	NO	NO	NO	NO	NO	NO		NO	NO
2G4 Other (please specify)											NO
(information) Reduced amount											NO

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Categories	CF_4	C_2F_6	C_3F_8	C_4F_{10}	$c\text{-}C_4F_8$	C_5F_{12}	C_6F_{14}	Other PFCs	Total PFCs	SF_6	Other halogenated gases
CO_2 equivalent conversion factors [Source of the factor: IPCC AR4]	7,390	12,200	8,830	8,860	10,300	9,160	9,300			22,800	
Emissions in CO_2 equivalent unit (Gg CO_2 eq.)											
2G Other Product Manufacture and Use	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	146.74	NE, NO
2G1 Electrical Equipment	NE	NE	NE	NE	NE	NE	NE	NE	NE	146.74	NE
2G1a Manufacture of Electrical Equipment	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2G1b Use of Electrical Equipment	NE	NE	NE	NE	NE	NE	NE	NE	NE	146.74	NE
2G1c Disposal of Electrical Equipment	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2G2 SF6 and PFCs from Other Product Uses	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
2G2a Military Applications (AWACS)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2G2b Accelerators	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
University and Research Particle Accelerators	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Industrial and Medical Particle Accelerators	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2G2c Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2G4 Other (please specify)											NO

Table A – 14i: IPPU Background Table for GHG Inventory Year 2019 - 2G (2G3, 2G4) Other Product Manufacture and Use - N_2O, CO_2, CH_4

Categories	Activity Data			Emissions					
				N_2O (Gg)		CO_2 (Gg)		CH_4 (Gg)	
	Description	Quantity	Unit	Emissions	(information) Reduction	Emissions	(information) Reduction	Emissions	(information) Reduction
2G3 N_2O from Product Uses				0.20	NO,NE				
2G3a Medical Applications	N_2O supplied	196.94	tonne	0.20	NO				
2G3b Propellant for Pressure and Aerosol Products	N_2O supplied	NE	tonne	NE	NE				
2G3c Other (please specify)	N_2O supplied	NO	tonne	NO	NO				
2G4 Other (please specify)	NO	NO	tonne			NO	NO	NO	NO

Table A – 14j: IPPU Background Table for GHG Inventory Year 2019 - 2H Other

Categories		Activity Data		Emissions					
				CO_2 (Gg)		CH_4 (Gg)		N_2O (Gg)	
		Quantity	Unit	Emissions	(information) Reduction	Emissions	(information) Reduction	Emissions	(information) Reduction
2H	**Other**			NE, NO	NE, NO	NE, NO	NE, NO	NO	NO
2H1	Pulp and Paper Industry	NE	NE	NE	NE	NE	NE		
2H2	Food and Beverages Industry	NE	NE	NE	NE	NE	NE		
2H3	Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO

Table A – 14k: IPPU Background Table for GHG Inventory Year 2019 - Greenhouse gases without CO2 equivalent conversion factors

Year 2019 (1 of 2)

Categories		(Please specify)	(Please specify)	(Please specify)	(Please specify)	(Please specify)
Emissions in original mass unit (tonne)						
Total						
2B Chemical Industry		NO	NO	NO	NO	NO
2B9	Fluorochemical Production	NO	NO	NO	NO	NO
2B9a	By-product Emissions	NO	NO	NO	NO	NO
2B9b	Fugitive Emissions	NO	NO	NO	NO	NO
2B10	Other (please specify)	NO	NO	NO	NO	NO
2C Metal Industry		NO	NO	NO	NO	NO
2C4	Magnesium Production	NO	NO	NO	NO	NO
2C7	Other (please specify)	NO	NO	NO	NO	NO
2E Electronics Industry		NO	NO	NO	NO	NO
2E1	Integrated Circuit or Semiconductor	NO	NO	NO	NO	NO
2E2	TFT Flat Panel Display	NO	NO	NO	NO	NO
2E3	Photovoltaics	NO	NO	NO	NO	NO
2E4	Heat Transfer Fluid	NO	NO	NO	NO	NO
2E5	Other (please specify)	NO	NO	NO	NO	NO
2F Product Uses as Substitutes for Ozone Depleting Substances		NO	NO	NO	NO	NO
2F1	Refrigeration and Air Conditioning	NO	NO	NO	NO	NO
2F1a	Refrigeration and Stationary Air Conditioning	NO	NO	NO	NO	NO
2F1b	Mobile Air Conditioning	NO	NO	NO	NO	NO
2F2	Foam Blowing Agents	NO	NO	NO	NO	NO
2F3	Fire Protection	NO	NO	NO	NO	NO
2F4	Aerosols	NO	NO	NO	NO	NO
2F5	Solvents	NO	NO	NO	NO	NO
2F6	Other Applications (please specify)	NO	NO	NO	NO	NO

Year 2019 (2 of 2)

Categories	(Please specify)	(Please specify)	(Please specify)	(Please specify)	(Please specify)
Emissions in original mass unit (tonne)					
Total					
2G. Other Product Uses	NO	NO	NO	NO	NO
2G1 Electrical Equipment	NO	NO	NO	NO	NO
2G1a Manufacture of Electrical Equipment	NO	NO	NO	NO	NO
2G1b Use of Electrical Equipment	NO	NO	NO	NO	NO
2G1c Disposal of Electrical Equipment	NO	NO	NO	NO	NO
2G2 SF6 and PFCs from Other Product Uses	NO	NO	NO	NO	NO
2G2a Military Applications (AWACS)	NO	NO	NO	NO	NO
2G2b Accelerators	NO	NO	NO	NO	NO
2G2c Other (please specify)	NO	NO	NO	NO	NO
2G4 Other (please specify)	NO	NO	NO	NO	NO

Table A – 14l: IPPU Background Table for GHG Inventory Year 2019 - Allocation of CO_2 emissions from Non-Energy Use of fossil fuels: IPPU and other sectors

Year 2019 (1 of 2)

Category	Reported in year: 2019			
	Primary NEU fuel	Other NEU fuel(s)	Emissions Amount Reported in IPPU Sector CO_2(Gg)	In case reported elsewhere: Sub-category in 1A where these (partly) reported
2 Industrial Processes and Product Use				
2A Mineral Industry				
(Please specify the sub-category)			NO	
2B Chemical Industry				
2B1 Ammonia Production	natural gas	oil, coal	1,224.16	
2B5 Carbide Production	petroleum coke	oil	38.02	
2B6 Titanium Dioxide Production			NO	
2B8 Petrochemical and Carbon Black Production			4,170.48	
2B8a Methanol	natural gas	coal, oil	1,363.45	
2B8b Ethylene	naphtha	gas oil; butane, ethane, propane, LPG	2,725.48	
2B8f Carbon Black			NO	
2B10 Other (Ethylene Oxide)			81.55	
2C Metal Industry				
2C1 Iron and Steel Production	coke, graphite electrode	coke, coal, graphite electrode	7,543.24	
2C2 Ferroalloys Production			NO	
2C3 Aluminium Production	(carbon electrode)	coke, coal	1216.00	
2C5 Lead Production	coke	NA	NE	
2C6 Zinc Production			NO	
2C7 Other			NO	
2D Non-Energy Products from Fuels and Solvent Use				
2D1 Lubricant Use	lubricants	greases	NE	
2D2 Paraffin Wax Use	waxes	NA	NE	
2D3 Solvent Use	(mineral turpentine)	coal tars and oils	NE	
2D4 Other			NO	

Year 2019 (2 of 2)

Category	Reported in year: 2019			
	Primary NEU fuel	Other NEU fuel(s)	Emissions Amount Reported in IPPU Sector CO_2(Gg)	In case reported elsewhere: Sub-category in 1A where these (partly) reported
2H Other				
2H1 Pulp and Paper Industry	NA	NA	NE	
2H2 Food and Beverages Industry	coke	NA	NE	
2H3 Other			NO	
1 ENERGY				
1A Fuel Combustion Activities			**Reported in Sector 1A**	
1A1a Main Activity Electricity and Heat Production	(BF gas)	(chemical off-gases)	NE	
1A1b Petroleum Refining	NA	NA	NE	
1A1c Manufacture of Solid Fuels and Other Energy Industries	BF gas	NA	NE	
1A2 Manufacturing Industries and Construction	(BF gas)	(lubricants, chemical off-gases))	NE	

Table A - 15a: AFOLU Background Table for GHG Inventory Year 2019 - 3A1-3A2 Agriculture/Livestock

Categories	Activity Data	Emissions	
	Number of Animals	CH_4 (Gg)	N_2O (Gg)
3A Livestock		70.56	0.40
3A1 - Enteric Fermentation	3,090,198	48.98	
3.A.1.a - Cattle	657,407	38.98	
3.A.1.a.i - Dairy Cows	45,113	3.07	
3.A.1.a.ii - Other Cattle	612,294	35.91	
3.A.1.b - Buffalo	106,988	5.88	
3.A.1.c - Sheep	121,677	0.61	
3.A.1.d - Goats	312,571	1.56	
3.A.1.e - Camels	NE	NE	
3.A.1.f - Horses	3,095	0.06	
3.A.1.g - Mules and Asses	NE	NE	
3.A.1.h - Swine	1,888,460	1.89	
3.A.1.j - Other (please specify)	NO	NO	
3.A.2 - Manure Management (1)	297,530,290	21.58	0.40
3.A.2.a - Cattle	657,407	2.16	0.08
3.A.2.a.i - Dairy cows	45,113	1.40	0.01
3.A.2.a.ii - Other cattle	612,294	0.76	0.08
3.A.2.b - Buffalo	106,988	0.21	0.00
3.A.2.c - Sheep	121,677	0.02	0.01
3.A.2.d - Goats	312,571	0.07	0.02
3.A.2.e - Camels	NE	NE	NE
3.A.2.f - Horses	3,095	0.01	0.00
3.A.2.g - Mules and Asses	NE	NE	NE
3.A.2.h - Swine	1,888,460	13.22	0.01
3.A.2.i - Poultry	294,440,092	5.89	0.28
3.A.2.j - Other (please specify)	NO	NO	NO

Table A – 15b: AFOLU Background Table for GHG Inventory Year 2019 - 3B Carbon stock changes in FOLU

Year 2019 (1 of 2)

Categories	Activity Data		Net carbon stock change and CO_2 emissions									Net CO_2 emissions ($Gg\ CO_2$)
			Biomass				Dead organic matter			Soils		
	Total Area (ha)	Thereof: Area of organic soils (ha)	Increase (Gg C)	Decrease (Gg C)	Carbon emitted as CH_4 and CO from fires (Gg C)	Net carbon stock change (Gg C)	Carbon stock change (Gg C)	Carbon emitted as CH4 and CO from fires (Gg C)	Net carbon stock change (Gg C)	Net carbon stock change in mineral soils (Gg C)	Carbon loss from drained organic soils (Gg C)	
3.B - Land	27,573,215.61	1,588,432.00	108,363.08	31,749.07	0.00	63,215.18	0.00	0.00	0.00	0.00	8,055.50	-214,714.54
3.B.1 - Forest land	17,735,291.00	523,432.00	71,146.18	6,439.53	0.00	64,706.64	0.00	0.00	0.00	0.00	68.00	237,008.39
3.B.1.a - Forest land Remaining Forest land	17,735,291.00	523,432.00	71,146.18	6,439.53	0.00	64,706.64	0.00	0.00	0.00	0.00	68.00	237,008.39
3.B.1.b - Land Converted to Forest land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.1.b.i - Cropland converted to Forest Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.1.b.ii - Grassland converted to Forest Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3.B.1.b.iii - Wetlands converted to Forest Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3.B.1.b.iv - Settlements converted to Forest Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3.B.1.b.v - Other Land converted to Forest Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3.B.2 - Cropland	7,038,775.91	1,065,000.00	38,359.15	25,309.54	0.00	13,049.61	0.00	0.00	0.00	0.00	7,987.50	-18,561.09
3.B.2.a - Cropland Remaining Cropland	7,037,930.00	1,065,000.00	38,359.15	25,281.86	0.00	13,077.29	0.00	IE	0.00	0.00	7,987.50	-18,662.58
3.B.2.b - Land Converted to Cropland	845.91	0.00	0.00	27.68	0.00	-27.68	0.00	0.00	0.00	0.00	0.00	0.00
3.B.2.b.i - Forest Land converted to Cropland	845.91	NO	NO	27.68	NO	NO	NO	NO	NO	NO	NO	101.49
3.B.2.b.ii - Grassland converted to Cropland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3.B.2.b.iii - Wetlands converted to Cropland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3.B.2.b.iv - Settlements converted to Cropland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3.B.2.b.v - Other Land converted to Cropland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3.B.3 - Grassland	313,000.00	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.a - Grassland Remaining Grassland	313,000.00	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 - Land Converted to Grassland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.B.3.b.i - Forest Land converted to Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3.B.3.b.ii - Cropland converted to Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3.B.3.b.iii - Wetlands converted to Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3.B.3.b.iv - Settlements converted to Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3.B.3.b.v - Other Land converted to Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3.B.4 - Wetlands												

Year 2019 (2 of 2)

Categories	Activity Data		Net carbon stock change and CO_2 emissions									
			Biomass				Dead organic matter			Soils		
	Total Area (ha)	Thereof: Area of organic soils (ha)	Increase (Gg C)	Decrease (Gg C)	Carbon emitted as CH_4 and CO from fires (Gg C)	Net carbon stock change (Gg C)	Carbon stock change (Gg C)	Carbon emitted as CH4 and CO from fires (Gg C)	Net carbon stock change (Gg C)	Net carbon stock change in mineral soils (Gg C)	Carbon loss from drained organic soils (Gg C)	Net CO_2 emissions (Gg CO_2)
3.B.5 - Settlements	2,486,148.70	0.00	-1,142.26	0.00	0.00	-14,541.07	0.00	0.00	0.00	0.00	0.00	40,854.94
3.B.5.a - Settlements Remaining Settlements	2,327,114.00	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 - Land Converted to Settlements	159,034.70	0.00	-11,142.26	4,841.79	0.00	-14,541.07	0.00	0.00	0.00	0.00	0.00	40,854.94
3.B.5.b.i - Forest Land converted to Settlements	137,105.00	0.00	-9,699.28	4,841.79	0.00	-14,541.07	0.00	0.00	0.00	0.00	0.00	35,564.03
3.B.5.b.ii - Cropland converted to Settlements	21,929.70	0.00	-1,442.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5,290.91
3.B.5.b.iii - Grassland converted to Settlements	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3.B.5.b.iv - Wetlands converted to Settlements	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3.B.5.b.v - Other Land converted to Settlements	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3.B.6 - Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3.B.6.a - Other land Remaining Other land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3.B.6.b - Land Converted to Other land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3.B.6.b.i - Forest Land converted to Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3.B.6.b.ii - Cropland converted to Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3.B.6.b.iii - Grassland converted to Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3.B.6.b.iv - Wetlands converted to Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3.B.6.b.v - Settlements converted to Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table A – 15c: AFOLU Background Table for GHG Inventory Year 2019 - Emissions in Wetlands (3B4)

Categories	Activity Data	Emissions		
	Area (ha)	CO_2 (Gg)	CH_4 (Gg)	N_2O (Gg)
3.B.4 - Wetlands	622,000.00	NO	NO	NO
3.B.4.a - Wetlands Remaining Wetlands	622,000.00	NO	NO	NO
3.B.4.a.i - Peatlands remaining peatlands	0.00	NO	NO	NO
3.B.4.a.ii - Flooded land remaining flooded land	622,000.00	NO	NO	NO
3.B.4.b - Land Converted to Wetlands	0.00	NO	NO	NO
3.B.4.b.i - Land converted for peat extraction	0.00	NO	NO	NO
3.B.4.b.ii - Land converted to flooded land	0.00	NO	NO	NO
3.B.4.b.iii - Land converted to other wetlands	0.00	NO	NO	NO

Table A – 15d: AFOLU Background Table for GHG Inventory Year 2019 - Biomass Burning (3C1)
Year 2019 (1 of 2)

Categories	Activity Data			Emissions							Information item: Carbon emitted as CH_4 and CO	
	Description	Unit	Values	CO_2	CH_4		N_2O	CO		NO_x		
					Biomass	DOM		Biomass	DOM		Biomass	DOM
		(ha or kg dm)		(Gg)							(C Gg)	
3C1 Biomass Burning	Area burned	ha	23,340.50	0.00	0.44	0.31	0.02	6.66	1.04	0.38	16.13	0.68
3C1a Biomass Burning in Forest Land	Area burned	ha	2,757.40	0.00	0.44	0.00	0.01	6.66	0.00	0.10	16.13	0.00
Controlled Burning				NO	NO	NO	NO	NO	NO	NO	NO	NO
Wildfires	Area burned	ha	2,757.40	0.00	0.44	0.00	0.01	6.66	0.00	0.10	16.13	0.00
3C1b Biomass Burning in Cropland	Area burned	ha	20,583.10	0.00	0.00	0.31	0.01	0.00	1.04	0.28	0.00	0.68
Biomass Burning in Cropland Remaining Cropland				0.00	0.00	0.31	0.01	0.00	1.04	0.28	0.00	0.68
Controlled Burning	Area burned	ha	20,583.10	NA	NA	0.31	0.01	0.00	1.04	0.28	0.00	0.68
Wildfires				NO	NO	NO	NO	NO	NO	NO	NO	NO
Biomass burning in Forest Land Converted to Cropland				NO	NO	NO	NO	NO	NO	NO	NO	NO
Controlled Burning				NO	NO	NO	NO	NO	NO	NO	NO	NO
Wildfires				NO	NO	NO	NO	NO	NO	NO	NO	NO
Biomass Burning in Non Forest Land Converted to Cropland				NO	NO	NO	NO	NO	NO	NO	NO	NO
Controlled Burning				NO	NO	NO	NO	NO	NO	NO	NO	NO
Wildfires				NO	NO	NO	NO	NO	NO	NO	NO	NO

Year 2019 (2 of 2)

Categories	Activity Data			Emissions							Information item: Carbon emitted as CH_4 and CO	
	Description	Unit	Values	CO_2	CH_4		N_2O	CO		NO_x	Biomass	DOM
		(ha or kg dm)			Biomass	DOM		Biomass	DOM		(C Gg)	
					(Gg)							
3C1c Biomass Burning in Grassland				NO	NO	NO	NO	NO	NO	NO	NO	NO
Burning in Grassland Remaining Grassland				NO	NO	NO	NO	NO	NO	NO	NO	NO
Controlled Burning				NO	NO	NO	NO	NO	NO	NO	NO	NO
Wildfires				NO	NO	NO	NO	NO	NO	NO	NO	NO
Burning in Forest Land Converted to Grassland				NO	NO	NO	NO	NO	NO	NO	NO	NO
Controlled Burning				NO	NO	NO	NO	NO	NO	NO	NO	NO
Wildfires				NO	NO	NO	NO	NO	NO	NO	NO	NO
Burning in Non Forest Land Converted to Grassland				NO	NO	NO	NO	NO	NO	NO	NO	NO
Controlled Burning				NO	NO	NO	NO	NO	NO	NO	NO	NO
Wildfires				NO	NO	NO	NO	NO	NO	NO	NO	NO
3C1d Biomass Burning in All Other Land				NO	NO	NO	NO	NO	NO	NO	NO	NO
Biomass Burning in Other Land Remaining All Other Land				NO	NO	NO	NO	NO	NO	NO	NO	NO
Controlled Burning				NO	NO	NO	NO	NO	NO	NO	NO	NO
Wildfires				NO	NO	NO	NO	NO	NO	NO	NO	NO

Table A – 15e: AFOLU Background Table for GHG Inventory Year 2019 - CO_2 Emission form Liming (3C2)

Categories	Activity Data			Emissions
	Limestone CaCO3 (Mg / yr)	Dolomite $CaMg(CO_3)_2$ (Mg / yr)	Total amount of lime categories applied (Mg / yr)	CO_2 (Gg)
3.C.2 - Liming	49,253.99	IE	49,253.99	21.67
Forest Land	NO	NO	NO	NO
Cropland	49,253.99	IE	49,253.99	21.67
Grassland	NO	NO	NO	NO
Wetland	NO	NO	NO	NO
Settlements	NO	NO	NO	NO
Other Land	NO	NO	NO	NO

Table A – 15f: AFOLU Background Table for GHG Inventory Year 2019 - CO_2 Emission from Urea Fertilisation (3C3)

Categories	Activity Data	Emissions
	Annual Average Population (Mg / yr)	CO2 (Gg)
3.C.3 - Urea application	531,674.90	389.89
Forest Land	NO	NO
Cropland	531,674.90	389.89
Grassland	NO	NO
Wetland	NO	NO
Settlements	NO	NO
Other Land	NO	NO

Table A – 15g: AFOLU Background Table for GHG Inventory Year 2019 - Direct N_2O Emission from Managed Soils (3C4)

Categories	Activity Data	Emissions
	Total amount of nitrogen applied (Gg N / yr)	N2O (Gg)
3.C.4 - Direct N2O Emissions from Managed Soils	613,266,883.28	12.54
Inorganic N fertilizer application	**412,659,784.40**	**6.78**
Forest Land	NO	NO
Cropland	412,659,784.40	6.48
Other Cropland - flooded rice	**63,399,856.00**	**0.30**
Grassland	NO	NO
Wetland	NO	NO
Settlements	NO	NO
Other Land	NO	NO
Organic N applied as fertilizer (manure and sewage sludge)	**63,112,066.21**	**0.99**
Forest Land	NO	NO
Cropland	63,112,066.21	0.99
Grassland	NO	NO
Wetland	NO	NO
Settlements	NO	NO
Other Land	NO	NO
Urine and dung N deposited on pasture, range and paddock by grazing animals	**39,106,481.71**	**1.11**
N in crop residues	**98,388,550.96**	**1.55**
Inorganic N fertilizer application- flooded rice	**20,549,613.81**	**0.10**
	Area (ha)	
N mineralization/immobilization associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soils	NO	0.00
Drainage/management of organic soils (i.e., Histosols)	1,065,584.00	2.01

Table A – 15h: AFOLU Background Table for GHG Inventory Year 2019 - Indirect N_2O Emission from Managed Soils and Manure Management (3C4 and 3C6)

Categories	Activity Data	Emissions
	Total amount of nitrogen applied / excreted (Gg N / yr)	N_2O (Gg)
3.C.5 - Indirect N2O Emissions from managed soils	1,275.49	3.53
From atmospheric deposition of N volatilized from managed soils from agricultural inputs of N (synthetic N fertilizers; organic N applied as fertilizer; urine and dung N deposited on pasture, range and paddock by grazing animals (2)	578.28	1.07
Forest Land	NO	NO
Cropland	578.28	1.07
Grassland	NO	NO
Wetland	NO	NO
Settlements	NO	NO
Other Land	NO	NO
From N leaching/runoff from managed soils (i.e. from synthetic N fertilizers; organic N applied as fertilizer; urine and dung N deposited on pasture, range and paddock by grazing animals (2); N in crop residues (3); and N mineralization/immobilization associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soils)	697.22	2.47
Forest Land	NO	NO
Cropland	697.22	2.47
Grassland	NO	NO
Wetland	NO	NO
Settlements	NO	NO
Other Land	NO	NO
3.C.6 - Indirect N2O Emissions from manure management	233.68	1.82

Table A – 15i: AFOLU Background Table for GHG Inventory Year 2019 - Non-CO_2 GHG Emission Not Included Elsewhere (3C7)

Categories	Activity Data	Emissions	
	Area (ha)	CH4 (Gg)	N2O (Gg)
3.C.7 - Rice cultivation	672,084.00	90.76	IE*
3.C.8 - Other (please specify)	0.00	0.00	0.00
**Direct N_2O emission from flooded rice is reported in Table A - 15g*			

Table A – 15j: AFOLU Background Table for GHG Inventory Year 2019 - Harvested Wood Products (3D1) - Annual Carbon HWP Contribution to Total AFOLU CO2 Removal and Emission and Background Information (Years: 1990 – 2008)

	Variable Number										
	Gg C/yr									Gg CO2/yr	
Inventory Year	1A Annual Change in stock of HWP in use from consumption	1B Annual Change in stock of HWP in SWDS from consumption	2A Annual Change in stock of HWP in use produced from domestic harvest	2B Annual Change in stock of HWP in SWDS produced from domestic harvest	3 Annual Imports of wood, and paper products + wood fuel, pulp, recovered paper, roundwood/ chips	4 Annual Exports of wood, and paper products + wood fuel, pulp, recovered paper, roundwood/ chips	5 Annual Domestic Harvest	6 Annual release of carbon to the atmosphere from HWP consumption (from fuelwood & products in use and products in SWDS)	7 Annual release of carbon to the atmosphere from HWP (including fuelwoood) where wood came from domestic harvest (from products in use and products in SWDS)	8 HWP Contribution to AFOLU CO2 emissions/removals	9 Approach used to estimate HWP Contribution
	ΔC HWP IU DC	ΔC HWP SWDS DC	ΔC HWP IU DH	ΔC HWP SWDS DH	Pim	Pex	H	↑C HWP DC	↑C HWP DH		
1990	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	SC
1991	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	SC
1992	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	SC
1993	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	SC
1994	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	SC
1995	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	SC
1996	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	SC
1997	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	SC
1998	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	SC
1999	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	SC
2000	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	SC
2001	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	SC
2002	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	SC
2003	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	SC
2004	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	SC
2005	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	SC
2006	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	SC
2007	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	SC
2008	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	SC

(Years: 2009 – 2019)

	Variable Number										
	Gg C/yr									Gg CO2/yr	
Inventory Year	1A Annual Change in stock of HWP in use from consumption	1B Annual Change in stock of HWP in SWDS from consumption	2A Annual Change in stock of HWP in use produced from domestic harvest	2B Annual Change in stock of HWP in SWDS produced from domestic harvest	3 Annual Imports of wood, and paper products + wood fuel, pulp, recovered paper, roundwood/ chips	4 Annual Exports of wood, and paper products + wood fuel, pulp, recovered paper, roundwood/ chips	5 Annual Domestic Harvest	6 Annual release of carbon to the atmosphere from HWP consumption (from fuelwood & products in use and products in SWDS)	7 Annual release of carbon to the atmosphere from HWP (including fuelwoood) where wood came from domestic harvest (from products in use and products in SWDS)	8 HWP Contribution to AFOLU CO2 emissions/removals	9 Approach used to estimate HWP Contribution
	ΔC HWP IU DC	ΔC HWP SWDS DC	ΔC HWP IU DH	ΔC HWP SWDS DH	Pim	Pex	H	↑C HWP DC	↑C HWP DH		
2009	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	SC
2010	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	SC
2011	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	SC
2012	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	SC
2013	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	SC
2014	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	SC
2015	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	SC
2016	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	SC
2017	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	SC
2018	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	SC
2019	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	SC

Table A - 16a: Waste Background Table for GHG Inventory Year 2019 - CO_2, CH_4, N_2O Emissions

Categories	Type of Activity Data	Activity Data	Unit	Emissions Factor			Emissions		
				CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
				(Gg/unit activity data)			(Gg)		
4A Solid Waste Disposal								467.25	NA, NO
4A1 Managed Waste Disposal Sites	Total MSW	1,912.73	Gg		1.00	NA		65.41	NA
4A2 Unmanaged Waste Disposal Sites		11,977.84	Gg		0.80	NA		401.83	NA
4A3 Uncategorised Waste Disposal Sites		NO	Gg		0.60	NO		NO	NO
4B Biological Treatment of Solid Waste	Total annual amount treated by biological treatment facilities	2.43	Gg		4.00	0.24		0.01	0.00
4C Incineration and Open Burning of Waste							42.77	0.08	0.01
4C1 Waste Incineration	Annual amount of waste incinerated	81.32	Gg				42.09	0.00	0.01
Hazardous Waste		47.56	Gg	0.48	0.00	100.00	22.78	0.00	0.00
Clinical Waste		33.76	Gg	0.57	0.00	100.00	19.31	0.00	0.00
Fossil Liquid Waste		0.00	Gg	2.93	NA	NA	0.00	NA	NA
4C2 Open Burning of Waste	Total amount of waste open-burned	11.55	Gg	0.06	0.01	0.00	0.68	0.08	0.00
4D Wastewater Treatment and Discharge								645.98	1.27
4D1 Domestic Wastewater Treatment and Discharge								67.48	1.27
CH_4 Emissions	Total amount of organically degradable material in wastewater (TOW)	517.12	kg BOD					67.48	
Centralized Aerobic Treatment Plant		318.86	kg BOD		0.00			0.00	
Septic Tank		104.04	kg BOD		0.30			29.96	
Latrin 3 (Pour Flush)		92.86	kg BOD		0.42			37.44	
Sea, River and Lake Discharge		1.36	kg BOD		0.06			0.08	
N_2O Emissions	Total amount of nitrogen in effluent ($N_{EFFLUENT}$)	161.50	Gg N			0.01			1.27
4D2 Industrial Wastewater Treatment and Discharge								578.50	NA
CH_4 Emissions	Total Organic degradable material in wastewater (TOW_i)	3,638.05	Gg COD					578.50	
Palm Oil Mill Effluent		3,210.11	Gg COD		0.23			572.31	
Natural Rubber (SMR & Latex)		19.94	Gg COD		0.20			3.99	
Pulp and Paper		319.77	Gg COD		0.01			1.10	
Petroleum Refineries		0.01	Gg COD		0.01			0.00	
Meat & Poultry		88.23	Gg COD		0.01			1.10	
N_2O Emissions	Total amount of nitrogen in effluent ($N_{EFFLUENT}$)	NA	Gg N			NA			NA
4E Other (please specify)		NO	NO	NO	NO	NO	NO	NO	NO

Table A – 16b: Waste Background Table for GHG Inventory Year 2019 – CH_4 Recovery

Categories	Unit	CH_4	
	Gg CH_4	Flared	Energy Recovery
4A Solid Waste Disposal	11.51	0.00	11.51
4B Biological Treatment of Solid Waste	NO	NO	NO
4D Wastewater Treatment and Discharge	149.97	49.99	99.98
4D1 Domestic Wastewater Treatment and Discharge	NO	NO	NO
4D2 Industrial Wastewater Treatment and Discharge	149.97	49.99	99.98
4E Other (please specify)	NO	NO	NO

Table A – 16c: Waste Background Table: Long-term storage of carbon Information Items

Categories	C
	Gg
Information Items	
Long-term storage of carbon in waste disposal sites	-29.54
Annual change in total long-term storage of carbon stored	-22.58
Annual change in long-term storage of carbon in HWP waste	-6.96

Table A - 17: Cross Sectoral Table for GHG Inventory Year 2019 - Indirect Emission of N_2O

	Categories	Activity Data/ Source Emission		Emissions
		Emission NH_3 (Gg NH_3)	Emissions NO_x (Gg NO_2-equivalents)	N_2O (Gg N_2O)
1	Energy	NO	0.62	NE
2	Industrial Processes and Product Use	0.02	2.81	NE
3	Agriculture, Forestry and Other Land Use	NE	NA	NE
	3C5 Indirect N_2O Emission from managed soils	NE	NA	NE
	3C6 Indirect N_2O Emissions from manure management	NE	NA	NE
	Other (Biomass Burning)	NO	0.39	NE
4	Waste	NE	NA,NE,NO	NE
5	Other (Please specify)	NO	NO	NO

Table A - 18: Trends of CO_2 (Gigagrams)
Years: 1990 – 1998 (1 of 4)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998
Total National Emissions and Removals	**-30,958.43**	**-113,569.45**	**-84,599.72**	**-123,549.10**	**-100,704.50**	**-110,349.73**	**-103,197.75**	**-100,517.38**	**-105,012.95**
1 ENERGY	60,381.74	70,155.66	76,063.63	75,751.81	82,032.68	84,397.53	98,281.57	115,251.16	104,347.66
1A Fuel Combustion Activities	59,070.82	68,598.85	74,400.85	73,475.64	79,634.64	81,582.04	94,978.33	111,500.06	100,534.84
1A1 Energy Industries	28,454.60	35,129.83	37,595.88	35,525.66	38,489.67	37,294.10	43,174.90	56,148.68	47,596.74
1A2 Manufacturing Industries and Construction	13,981.49	15,360.48	16,661.06	17,801.90	17,975.88	19,614.39	22,898.86	23,850.07	23,651.75
1A3 Transport	14,535.17	15,640.94	16,722.43	17,403.17	19,223.19	20,448.70	23,353.19	26,885.95	25,115.23
1A4 Other Sectors	2,049.41	2,413.08	3,361.67	2,679.26	3,872.85	4,140.66	5,455.01	4,508.06	4,058.50
1A5 Non-Specified	50.16	54.52	59.82	65.65	73.06	84.19	96.37	107.30	112.62
1B Fugitive emissions from fuels	1,310.91	1,556.81	1,662.78	2,276.17	2,398.04	2,815.48	3,303.23	3,751.10	3,812.82
1B1 Solid Fuels	NA	NA	NA	NA	NA	NA	NA	NA	NA
1B2 Oil and Natural Gas	1,310.91	1,556.81	1,662.78	2,276.17	2,398.04	2,815.48	3,303.23	3,751.10	3,812.82
1B3 Other emissions from Energy Production	NA	NA	NA	NA	NA	NA	NA	NA	NA
1C Carbon dioxide Transport and Storage									
2 INDUSTRIAL PROCESSES AND PRODUCT USE	4,275.28	4,476.29	4,336.98	4,615.13	5,495.45	5,957.99	7,952.46	8,602.35	8,270.05
2A Mineral Industry	3,441.77	3,607.94	3,461.09	3,670.17	4,264.18	4,549.56	5,087.48	5,502.23	5,603.53
2A1 Cement production	3,244.50	3,383.55	3,275.40	3,424.75	4,006.70	4,284.80	4,789.50	5,206.65	5,325.10
2A2 Lime production	77.50	85.00	92.50	100.00	107.50	115.00	122.50	130.00	137.50
2A3 Glass Production	17.10	17.88	18.65	19.43	20.21	20.98	21.76	22.53	23.31
2A4 Other Process Uses of Carbonates	102.67	121.51	74.54	125.99	129.77	128.78	153.72	143.04	117.62
2A5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B Chemical Industry	275.02	346.05	364.06	360.66	392.84	387.82	1,787.78	1,822.96	1,899.71
2B1 Ammonia Production	132.00	199.49	213.95	207.01	235.64	227.09	225.81	179.01	241.74
2B2 Nitric Acid Production	NA	NA	NA	NA	NA	NA	NA	NA	NA
2B3 Adipic Acid Production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B4 Caprolactam, Glyoxal and Glyoxylic Acid Production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B5 Carbide Production	27.74	27.35	26.97	26.58	26.19	25.81	25.42	25.03	24.65
2B6 Titanium Dioxide Production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B7 Soda Ash Production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B8 Petrochemical and Carbon Black Production	115.28	119.21	123.14	127.07	131.00	134.93	1,536.55	1,618.92	1,633.33
2B9 Fluorochemical Production									
2B10 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years: 1990 – 1998 (2 of 4)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998
2C Metal Industry	558.49	522.30	511.83	584.30	838.44	1,020.60	1,077.20	1,277.16	766.82
2C1 Iron and Steel Production	558.49	522.30	511.83	584.30	838.44	1,020.60	1,077.20	1,277.16	766.82
2C2 Ferroalloys Production	NE	NE	NE	NE	NE	NE	NE	NE	NE
2C3 Aluminium production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C4 Magnesium production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C5 Lead Production	NE	NE	NE	NE	NE	NE	NE	NE	NE
2C6 Zinc Production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C7 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
2D Non-Energy Products from Fuels and Solvent Use	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
2D1 Lubricant Use	NE	NE	NE	NE	NE	NE	NE	NE	NE
2D2 Paraffin Wax Use	NE	NE	NE	NE	NE	NE	NE	NE	NE
2D3 Solvent Use									
2D4 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E Electronics Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E1 Integrated Circuit or Semiconductor	NA	NA	NA	NA	NA	NA	NA	NA	NA
2E2 TFT Flat Panel Display									
2E3 Photovoltaics									
2E4 Heat Transfer Fluid									
2E5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F Product Uses as Substitutes for Ozone Depleting Substances	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO
2F1 Refrigeration and Air Conditioning	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE
2F2 Foam Blowing Agents	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F3 Fire Protection	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F4 Aerosols									
2F5 Solvents									
2F6 Other Applications	NO	NO	NO	NO	NO	NO	NO	NO	NO
2G Other Product Manufacture and Use	NO	NO	NO	NO	NO	NO	NO	NO	NO
2G1 Electrical Equipment									
2G2 SF6 and PFCs from Other Product Uses									
2G3 N2O from Product Uses									
2G4 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
2H Other	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
2H1 Pulp and Paper Industry	NE	NE	NE	NE	NE	NE	NE	NE	NE
2H2 Food and Beverages Industry	NE	NE	NE	NE	NE	NE	NE	NE	NE
2H3 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years: 1990 – 1998 (3 of 4)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998
3 AGRICULTURE, FORESTRY AND OTHER LAND USE	-95,616.21	-188,202.19	-165,001.12	-203,916.84	-188,233.43	-200,706.04	-209,432.57	-224,371.69	-217,638.84
3A Livestock									
3A1 Enteric Fermentation									
3A2 Manure Management									
3B Land	-95,913.08	-188,378.16	-165,187.38	-204,288.09	-188,627.10	-200,932.81	-209,648.04	-224,679.16	-217,982.60
3B1 Forest land	-183,005.87	-182,335.99	-172,972.40	-187,514.25	-183,085.73	-183,814.67	-193,992.22	-199,933.52	-217,347.35
3B2 Cropland	-23,889.88	-24,244.29	-24,578.92	-24,449.98	-24,712.42	-24,525.30	-25,045.47	-25,965.76	-26,492.91
3B3 Grassland	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
3B4 Wetlands	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO
3B5 Settlements	110,982.67	18,202.12	32,363.95	7,676.14	19,171.05	7,407.17	9,389.65	1,220.12	25,857.66
3B6 Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO
3C Aggregate sources and non-CO2 emissions sources on land	296.87	175.97	186.26	371.25	393.66	226.76	215.47	307.47	343.76
3C1 Emissions from biomass burning	NA	NA	NA	NA	NA	NA	NA	NA	NA
3C2 Liming	NE	NE	NE	NE	NE	NE	NE	NE	NE
3C3 Urea application	296.87	175.97	186.26	371.25	393.66	226.76	215.47	307.47	343.76
3C4 Direct N2O Emissions from managed soils									
3C5 Indirect N2O Emissions from managed soils									
3C6 Indirect N2O Emissions from manure management									
3C7 Rice cultivations									
3C8 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
3D Other	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
3D1 Harvested Wood Products	NE	NE	NE	NE	NE	NE	NE	NE	NE
3D2 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
4 WASTE	0.77	0.79	0.79	0.80	0.80	0.80	0.80	0.80	8.18
4A Solid Waste Disposal									
4A1 Managed Waste Disposal Sites									
4A2 Unmanaged Waste Disposal Sites									
4A3 Uncategorised Waste Disposal Sites									
4B Biological Treatment of Solid Waste									
4C Incineration and Open Burning of Waste	0.77	0.79	0.79	0.80	0.80	0.80	0.80	0.80	8.18
4C1 Waste Incineration	NO	NO	NO	NO	NO	NO	NO	NO	7.39
4C2 Open Burning of Waste	0.77	0.79	0.79	0.80	0.80	0.80	0.80	0.80	0.79
4D Wastewater Treatment and Discharge									
4D1 Domestic Wastewater Treatment and Discharge									
4D2 Industrial Wastewater Treatment and Discharge									
4E Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
5 OTHER	NO	NO	NO	NO	NO	NO	NO	NO	NO
5A Indirect N_2O emissions from the atmospheric deposition of nitrogen in NOx and NH3									
5B Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years: 1990 – 1998 (4 of 4)

Memo items	1990	1991	1992	1993	1994	1995	1996	1997	1998
International Bunkers	1,756.68	1,958.83	2,015.96	2,233.28	3,069.22	3,228.49	3,707.11	3,899.22	5,213.51
International Aviation (International Bunkers)	1,470.05	1,610.06	1,782.73	2,041.74	2,282.08	2,706.76	3,115.11	3,357.79	3,777.80
International Water-borne Transport (International Bunkers)	286.62	348.77	233.23	191.54	787.14	521.72	592.00	541.43	1,435.71
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO
Information items	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**
CO_2 from Biomass Burning for Energy Production	NE	NE	NE	NE	NE	NE	NE	NE	NE
CO_2 captured	NO	NO	NO	NO	NO	NO	NO	NO	NO
For domestic storage	NO	NO	NO	NO	NO	NO	NO	NO	NO
For storage in other countries	NO	NO	NO	NO	NO	NO	NO	NO	NO
Long-term storage of carbon in waste disposal sites	9.42	9.52	11.15	11.43	11.55	11.55	11.58	11.68	12.09
Annual change in total long-term storage of carbon stored	6.06	6.13	7.17	7.35	7.44	7.44	7.45	7.52	7.78
Annual change in long-term storage of carbon in HWP waste	3.36	3.39	3.97	4.07	4.12	4.12	4.13	4.16	4.31
Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years: 1999-2007 (1 of 4)

Categories	1999	2000	2001	2002	2003	2004	2005	2006	2007
Total National Emissions and Removals	**-113,639.94**	**-31,629.02**	**-66,894.19**	**-86,702.64**	**-74,666.82**	**-45,148.97**	**-5,573.08**	**-42,871.53**	**-915.76**
1 ENERGY	116,425.69	126,911.91	132,712.68	139,564.93	151,471.73	165,067.16	177,796.12	176,678.11	190,835.38
1A Fuel Combustion Activities	112,385.04	122,474.78	128,171.91	135,125.20	146,985.43	160,177.53	172,350.49	171,415.67	185,370.54
1A1 Energy Industries	54,615.10	60,006.07	62,588.92	66,192.37	75,164.74	81,484.98	91,750.26	92,979.81	101,019.60
1A2 Manufacturing Industries and Construction	23,071.71	25,891.29	26,343.90	28,470.96	29,618.13	33,358.89	35,197.35	33,870.18	37,254.40
1A3 Transport	30,365.83	32,157.46	34,908.60	35,736.62	38,044.67	40,872.90	40,540.80	39,037.00	41,409.59
1A4 Other Sectors	4,225.56	4,298.32	4,199.18	4,575.42	4,008.18	4,281.44	4,621.39	5,258.46	5,478.06
1A5 Non-Specified	106.84	121.64	131.31	149.83	149.71	179.31	240.69	270.22	208.89
1B Fugitive emissions from fuels	4,040.65	4,437.13	4,540.76	4,439.73	4,486.30	4,889.63	5,445.63	5,262.44	5,464.84
1B1 Solid Fuels	NA	NA	NA	NA	NA	NA	NA	NA	NA
1B2 Oil and Natural Gas	4,040.65	4,437.13	4,540.76	4,439.73	4,486.30	4,889.63	5,445.63	5,262.44	5,464.84
1B3 Other emissions from Energy Production	NA	NA	NA	NA	NA	NA	NA	NA	NA
1C Carbon dioxide Transport and Storage									
2 INDUSTRIAL PROCESSES AND PRODUCT USE	8,630.27	10,473.51	10,472.19	11,973.41	13,394.73	13,501.58	13,102.13	13,936.21	13,932.78
2A Mineral Industry	5,786.90	6,911.77	6,685.39	7,480.14	8,209.94	8,196.90	8,062.24	8,603.50	8,345.58
2A1 Cement production	5,479.60	6,587.95	6,327.25	7,145.68	7,731.19	7,774.56	7,615.98	8,135.97	7,872.29
2A2 Lime production	145.00	153.00	159.00	168.00	286.50	239.25	239.24	239.23	239.21
2A3 Glass Production	24.09	24.86	25.64	26.42	25.98	29.99	28.34	29.11	32.54
2A4 Other Process Uses of Carbonates	138.21	145.96	173.51	140.05	166.26	153.11	178.68	199.19	201.54
2A5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B Chemical Industry	1,956.77	2,401.73	2,742.00	3,373.53	3,747.99	3,651.84	3,671.91	3,972.10	3,725.90
2B1 Ammonia Production	285.30	400.70	635.88	891.16	998.37	1,013.56	988.52	1,097.49	985.38
2B2 Nitric Acid Production	NA	NA	NA	NA	NA	NA	NA	NA	NA
2B3 Adipic Acid Production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B4 Caprolactam, Glyoxal and Glyoxylic Acid Production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B5 Carbide Production	24.26	23.15	24.93	22.38	68.20	51.70	49.49	47.28	45.06
2B6 Titanium Dioxide Production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B7 Soda Ash Production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B8 Petrochemical and Carbon Black Production	1,647.22	1,977.89	2,081.18	2,459.98	2,681.42	2,586.58	2,633.90	2,827.34	2,695.46
2B9 Fluorochemical Production									
2B10 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C Metal Industry	886.60	1,160.00	1,044.80	1,119.74	1,436.80	1,652.84	1,367.98	1,360.62	1,861.30
2C1 Iron and Steel Production	886.60	1,160.00	1,044.80	1,119.74	1,436.80	1,652.84	1,367.98	1,360.62	1,861.30
2C2 Ferroalloys Production	NE	NE	NE	NE	NE	NE	NE	NE	NE
2C3 Aluminium production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C4 Magnesium production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C5 Lead Production	NE	NE	NE	NE	NE	NE	NE	NE	NE
2C6 Zinc Production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C7 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years: 1999-2007 (2 of 4)

Categories	1999	2000	2001	2002	2003	2004	2005	2006	2007
2D Non-Energy Products from Fuels and Solvent Use	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
2D1 Lubricant Use	NE	NE	NE	NE	NE	NE	NE	NE	NE
2D2 Paraffin Wax Use	NE	NE	NE	NE	NE	NE	NE	NE	NE
2D3 Solvent Use									
2D4 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E Electronics Industry	NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
2E1 Integrated Circuit or Semiconductor	NA	NA	NA	NA	NA	NA	NA	NA	NA
2E2 TFT Flat Panel Display									
2E3 Photovoltaics									
2E4 Heat Transfer Fluid									
2E5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F Product Uses as Substitutes for Ozone Depleting Substances	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO
2F1 Refrigeration and Air Conditioning	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE
2F2 Foam Blowing Agents	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F3 Fire Protection	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F4 Aerosols									
2F5 Solvents									
2F6 Other Applications	NO	NO	NO	NO	NO	NO	NO	NO	NO
2G Other Product Manufacture and Use	NO	NO	NO	NO	NO	NO	NO	NO	NO
2G1 Electrical Equipment									
2G2 SF6 and PFCs from Other Product Uses									
2G3 N2O from Product Uses									
2G4 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
2H Other	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
2H1 Pulp and Paper Industry	NE	NE	NE	NE	NE	NE	NE	NE	NE
2H2 Food and Beverages Industry	NE	NE	NE	NE	NE	NE	NE	NE	NE
2H3 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
3 AGRICULTURE, FORESTRY AND OTHER LAND USE	-238,710.76	-169,029.18	-210,093.68	-238,261.33	-239,551.80	-223,741.10	-196,501.69	-233,513.66	-205,718.86
3A Livestock									
3A1 Enteric Fermentation									
3A2 Manure Management									
3B Land	-239,079.01	-169,397.24	-210,378.58	-238,613.80	-239,908.21	-224,169.43	-197,076.76	-233,977.99	-206,371.10
3B1 Forest land	-219,683.69	-212,894.31	-220,641.02	-229,882.86	-221,637.45	-216,371.29	-215,490.65	-219,669.75	-213,895.81
3B2 Cropland	-27,370.91	-23,213.43	-23,589.75	-24,374.94	-25,071.13	-21,902.86	-20,215.98	-20,359.48	-21,041.33
3B3 Grassland	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
3B4 Wetlands	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO
3B5 Settlements	7,975.59	66,710.51	33,852.20	15,644.01	6,800.37	14,104.73	38,629.86	6,051.24	28,566.04
3B6 Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years: 1999-2007 (3 of 4)

Categories	1999	2000	2001	2002	2003	2004	2005	2006	2007
3C Aggregate sources and non-CO2 emissions sources on land	368.26	368.06	284.90	352.47	356.41	428.33	575.07	464.32	652.23
3C1 Emissions from biomass burning	NA	NA	NA	NA	NA	NA	NA	NA	NA
3C2 Liming	NE	NE	NE	NE	NE	NE	NE	NE	NE
3C3 Urea application	368.26	368.06	284.90	352.47	356.41	428.33	575.07	464.32	652.23
3C4 Direct N2O Emissions from managed soils									
3C5 Indirect N2O Emissions from managed soils									
3C6 Indirect N2O Emissions from manure management									
3C7 Rice cultivations									
3C8 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
3D Other	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
3D1 Harvested Wood Products	NE	NE	NE	NE	NE	NE	NE	NE	NE
3D2 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
4 WASTE	14.85	14.74	14.63	20.35	18.53	23.39	30.37	27.80	34.94
4A Solid Waste Disposal									
4A1 Managed Waste Disposal Sites									
4A2 Unmanaged Waste Disposal Sites									
4A3 Uncategorised Waste Disposal Sites									
4B Biological Treatment of Solid Waste									
4C Incineration and Open Burning of Waste	14.85	14.74	14.63	20.35	18.53	23.39	30.37	27.80	34.94
4C1 Waste Incineration	14.06	13.95	13.85	19.57	17.76	22.62	29.61	27.04	34.19
4C2 Open Burning of Waste	0.79	0.78	0.78	0.78	0.77	0.77	0.77	0.76	0.75
4D Wastewater Treatment and Discharge									
4D1 Domestic Wastewater Treatment and Discharge									
4D2 Industrial Wastewater Treatment and Discharge									
4E Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
5 OTHER	NO	NO	NO	NO	NO	NO	NO	NO	NO
5A Indirect N_2O emissions from the atmospheric deposition of nitrogen in NOx and NH3									
5B Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years: 1999-2007 (4 of 4)

Memo items	1999	2000	2001	2002	2003	2004	2005	2006	2007
International Bunkers	4,576.79	4,356.09	4,602.82	4,447.49	4,552.89	5,066.31	4,884.86	6,162.77	5,244.95
International Aviation (International Bunkers)	3,322.79	3,672.80	4,111.48	4,165.15	4,328.16	4,800.02	4,698.90	5,889.72	5,036.80
International Water-borne Transport (International Bunkers)	1,254.01	683.29	491.34	282.34	224.73	266.29	185.96	273.04	208.15
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO
Information items	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
CO_2 from Biomass Burning for Energy Production	NE	203.90	203.90	210.60	313.70	1,792.72	2,324.30	351.00	380.41
CO_2 captured	NO	NO	NO	NO	NO	NO	NO	NO	NO
For domestic storage	NO	NO	NO	NO	NO	NO	NO	NO	NO
For storage in other countries	NO	NO	NO	NO	NO	NO	NO	NO	NO
Long-term storage of carbon in waste disposal sites	12.33	12.52	145.12	18.09	18.65	18.64	204.04	3.08	2.67
Annual change in total long-term storage of carbon stored	7.93	8.06	92.90	18.86	18.97	19.53	146.99	12.01	12.11
Annual change in long-term storage of carbon in HWP waste	4.39	4.46	52.22	-0.76	-0.31	-0.89	57.05	-8.93	-9.43
Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years: 2008-2013 (1 of 4)

Categories	2008	2009	2010	2011	2012	2013
Total National Emissions and Removals	**-13,995.70**	**-35,656.14**	**-18,572.92**	**-23,144.22**	**-11,980.80**	**-7,039.31**
1 ENERGY	199,367.73	189,769.29	204,419.10	203,461.78	218,085.26	225,729.71
1A Fuel Combustion Activities	193,680.39	184,296.16	198,363.57	197,549.38	214,160.83	220,533.56
1A1 Energy Industries	107,367.35	104,918.68	119,138.35	121,730.90	126,714.18	129,331.89
1A2 Manufacturing Industries and Construction	36,394.15	31,022.13	26,066.98	23,261.78	27,334.61	24,865.05
1A3 Transport	43,457.98	42,571.65	43,945.06	44,496.45	52,033.86	58,222.51
1A4 Other Sectors	6,216.41	5,534.53	8,926.20	7,835.90	7,526.67	7,657.03
1A5 Non-Specified	244.49	249.18	286.99	224.35	551.51	457.09
1B Fugitive emissions from fuels	5,687.34	5,473.12	6,055.53	5,912.39	3,924.43	5,196.15
1B1 Solid Fuels	NA	NA	NA	NA	NA	NA
1B2 Oil and Natural Gas	5,687.34	5,473.12	6,055.53	5,912.39	3,924.43	5,196.15
1B3 Other emissions from Energy Production	NA	NA	NA	NA	NA	NA
1C Carbon dioxide Transport and Storage						
2 INDUSTRIAL PROCESSES AND PRODUCT USE	14,533.04	14,650.48	13,885.36	14,223.98	15,714.20	15,435.13
2A Mineral Industry	8,863.22	8,385.92	7,413.25	8,089.61	8,484.62	9,320.66
2A1 Cement production	8,416.13	7,929.97	7,059.11	7,766.20	8,111.04	8,793.36
2A2 Lime production	239.20	239.19	160.55	139.19	133.86	134.12
2A3 Glass Production	31.07	29.65	29.25	29.06	29.56	30.73
2A4 Other Process Uses of Carbonates	176.82	187.12	164.36	155.17	210.16	362.44
2A5 Other (please specify)	NO	NO	NO	NO	NO	NO
2B Chemical Industry	3,786.09	4,164.63	4,343.66	3,611.53	4,342.08	3,925.53
2B1 Ammonia Production	1,007.48	1,068.01	970.99	789.60	971.47	994.78
2B2 Nitric Acid Production	NA	NO	NO	NO	NO	NO
2B3 Adipic Acid Production	NO	NO	NO	NO	NO	NO
2B4 Caprolactam, Glyoxal and Glyoxylic Acid Production	NO	NO	NO	NO	NO	NO
2B5 Carbide Production	42.85	40.64	38.43	36.22	38.02	38.02
2B6 Titanium Dioxide Production	NO	NO	NO	NO	NO	NO
2B7 Soda Ash Production	NO	NO	NO	NO	NO	NO
2B8 Petrochemical and Carbon Black Production	2,735.76	3,055.98	3,334.25	2,785.72	3,332.60	2,892.73
2B9 Fluorochemical Production						
2B10 Other (Please specify)	NO	NO	NO	NO	NO	NO

Years: 2008-2013 (2 of 4)

Categories	2008	2009	2010	2011	2012	2013
2C Metal Industry	1,883.74	2,099.92	2,128.44	2,522.83	2,887.50	2,188.95
2C1 Iron and Steel Production	1,883.74	2,099.92	2,128.44	2,522.73	2,311.50	1,612.95
2C2 Ferroalloys Production	NE	NE	NE	NE	NE	NE
2C3 Aluminium production	NO	NO	NO	0.10	576.00	576.00
2C4 Magnesium production	NO	NO	NO	NO	NO	NO
2C5 Lead Production	NE	NE	NE	NE	NE	NE
2C6 Zinc Production	NO	NO	NO	NO	NO	NO
2C7 Other (please specify)	NO	NO	NO	NO	NO	NO
2D Non-Energy Products from Fuels and Solvent Use	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
2D1 Lubricant Use	NE	NE	NE	NE	NE	NE
2D2 Paraffin Wax Use	NE	NE	NE	NE	NE	NE
2D3 Solvent Use						
2D4 Other (please specify)	NO	NO	NO	NO	NO	NO
2E Electronics Industry	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
2E1 Integrated Circuit or Semiconductor	NA	NA	NA	NA	NA	NA
2E2 TFT Flat Panel Display						
2E3 Photovoltaics						
2E4 Heat Transfer Fluid						
2E5 Other (please specify)	NO	NO	NO	NO	NO	NO
2F Product Uses as Substitutes for Ozone Depleting Substances	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO
2F1 Refrigeration and Air Conditioning	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE
2F2 Foam Blowing Agents	NE	NE	NE	NE	NE	NE
2F3 Fire Protection	NE	NE	NE	NE	NE	NE
2F4 Aerosols						
2F5 Solvents						
2F6 Other Applications	NO	NO	NO	NO	NO	NO
2G Other Product Manufacture and Use	NO	NO	NO	NO	NO	NO
2G1 Electrical Equipment						
2G2 SF6 and PFCs from Other Product Uses						
2G3 N2O from Product Uses						
2G4 Other (Please specify)	NO	NO	NO	NO	NO	NO

Years: 2008-2013 (3 of 4)

Categories	2008	2009	2010	2011	2012	2013
2H Other	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
2H1 Pulp and Paper Industry	NE	NE	NE	NE	NE	NE
2H2 Food and Beverages Industry	NE	NE	NE	NE	NE	NE
2H3 Other (please specify)	NO	NO	NO	NO	NO	NO
3 AGRICULTURE, FORESTRY AND OTHER LAND USE	-227,931.50	-240,107.67	-236,909.16	-240,862.86	-245,813.30	-248,239.02
3A Livestock						
3A1 Enteric Fermentation						
3A2 Manure Management						
3B Land	-228,672.30	-240,533.81	-237,394.69	-241,252.18	-246,470.68	-248,806.44
3B1 Forest land	-218,219.52	-220,912.86	-224,941.54	-227,854.52	-232,337.47	-235,441.23
3B2 Cropland	-21,063.46	-20,841.07	-17,016.53	-16,958.06	-16,399.11	-16,473.89
3B3 Grassland	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
3B4 Wetlands	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO
3B5 Settlements	10,610.68	1,220.12	4,563.39	3,560.41	2,265.89	3,108.68
3B6 Other Land	NO	NO	NO	NO	NO	NO
3C Aggregate sources and non-CO2 emissions sources on land	740.80	426.14	485.53	389.31	657.39	567.42
3C1 Emissions from biomass burning	NA	NA	NA	NA	NA	NA
3C2 Liming	NE	NE	NE	9.07	9.07	9.07
3C3 Urea application	740.80	426.14	485.53	380.24	648.31	558.35
3C4 Direct N2O Emissions from managed soils						
3C5 Indirect N2O Emissions from managed soils						
3C6 Indirect N2O Emissions from manure management						
3C7 Rice cultivations						
3C8 Other (please specify)	NO	NO	NO	NO	NO	NO
3D Other	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
3D1 Harvested Wood Products	NE	NE	NE	NE	NE	NE
3D2 Other (please specify)	NO	NO	NO	NO	NO	NO

Years: 2008-2013 (4 of 4)

Categories	2008	2009	2010	2011	2012	2013
4 WASTE	35.04	31.76	31.78	32.88	33.04	34.87
4A Solid Waste Disposal						
4A1 Managed Waste Disposal Sites						
4A2 Unmanaged Waste Disposal Sites						
4A3 Uncategorised Waste Disposal Sites						
4B Biological Treatment of Solid Waste						
4C Incineration and Open Burning of Waste	35.04	31.76	31.78	32.88	33.04	34.87
4C1 Waste Incineration	34.29	31.02	31.05	32.16	32.32	34.15
4C2 Open Burning of Waste	0.75	0.74	0.73	0.72	0.72	0.72
4D Wastewater Treatment and Discharge						
4D1 Domestic Wastewater Treatment and Discharge						
4D2 Industrial Wastewater Treatment and Discharge						
4E Other (please specify)	NO	NO	NO	NO	NO	NO
5 OTHER	NO	NO	NO	NO	NO	NO
5A Indirect N_2O emissions from the atmospheric deposition of nitrogen in NOx and NH3						
5B Other (please specify)	NO	NO	NO	NO	NO	NO
Memo items						
International Bunkers	5,134.03	5,107.65	5,712.17	6,638.75	5,818.77	8,110.19
International Aviation (International Bunkers)	4,941.94	4,971.43	5,535.37	5,989.76	5,637.42	6,983.50
International Water-borne Transport (International Bunkers)	192.10	136.21	176.79	648.99	181.35	1,126.69
Multilateral Operations	NO	NO	NO	NO	NO	NO
Information items						
CO_2 from Biomass Burning for Energy Production	545.09	585.59	744.21	724.21	769.86	1,242.65
CO_2 captured	NO	NO	NO	NO	NO	NO
For domestic storage	NO	NO	NO	NO	NO	NO
For storage in other countries	NO	NO	NO	NO	NO	NO
Long-term storage of carbon in waste disposal sites	9.03	3.36	1.43	-0.95	159.91	-42.53
Annual change in total long-term storage of carbon stored	17.06	13.92	12.61	11.05	135.08	-33.01
Annual change in long-term storage of carbon in HWP waste	-8.03	-10.56	-11.18	-12.00	24.83	-9.51
Other (please specify)	NO	NO	NO	NO	NO	NO

Years: 2014-2019 (1 of 4)

Categories	2014	2015	2016	2017	2018	2019
Total National Emissions and Removals	**169.19**	**9,045.55**	**30,227.49**	**5,115.51**	**14,433.42**	**51,155.40**
1 ENERGY	233,706.20	236,412.69	227,834.67	230,418.26	235,189.28	239,458.25
1A Fuel Combustion Activities	226,729.83	229,426.85	222,510.17	225,941.32	230,848.78	234,858.00
1A1 Energy Industries	133,097.15	137,226.92	130,923.78	126,615.35	129,669.97	131,274.34
1A2 Manufacturing Industries and Construction	22,907.60	25,186.18	23,855.62	31,568.84	34,149.96	33,482.54
1A3 Transport	63,039.62	59,964.23	61,924.38	61,572.82	60,185.84	63,576.39
1A4 Other Sectors	7,195.28	6,561.75	5,318.63	5,696.55	6,355.25	6,036.98
1A5 Non-Specified	490.18	487.76	487.76	487.76	487.76	487.76
1B Fugitive emissions from fuels	6,976.38	6,985.84	5,324.50	4,476.94	4,340.50	4,600.25
1B1 Solid Fuels	NA	NA	NA	NA	NA	NA
1B2 Oil and Natural Gas	6,976.38	6,985.84	5,324.50	4,476.94	4,340.50	4,600.25
1B3 Other emissions from Energy Production	NA	NA	NA	NA	NA	NA
1C Carbon dioxide Transport and Storage						
2 INDUSTRIAL PROCESSES AND PRODUCT USE	15,792.21	16,070.64	17,204.98	17,410.87	19,855.22	25,957.35
2A Mineral Industry	9,834.25	9,056.02	9,812.78	9,132.89	10,176.56	10,085.04
2A1 Cement production	9,467.91	8,672.60	9,125.80	8,775.60	9,064.00	9,120.65
2A2 Lime production	130.65	131.33	77.00	147.36	138.16	128.96
2A3 Glass Production	28.44	29.73	28.71	33.41	337.04	340.52
2A4 Other Process Uses of Carbonates	207.25	222.37	581.26	176.52	637.35	494.90
2A5 Other (please specify)	NO	NO	NO	NO	NO	NO
2B Chemical Industry	4,063.32	4,182.58	4,791.70	4,814.83	5,739.51	5,432.65
2B1 Ammonia Production	1,046.35	1,022.54	1,170.28	1,114.65	1,585.27	1,224.16
2B2 Nitric Acid Production	NO	NO	NO	NO	NO	NO
2B3 Adipic Acid Production	NO	NO	NO	NO	NO	NO
2B4 Caprolactam, Glyoxal and Glyoxylic Acid Production	NO	NO	NO	NO	NO	NO
2B5 Carbide Production	38.02	38.02	38.02	38.02	38.02	38.02
2B6 Titanium Dioxide Production	NO	NO	NO	NO	NO	NO
2B7 Soda Ash Production	NO	NO	NO	NO	NO	NO
2B8 Petrochemical and Carbon Black Production	2,978.96	3,122.02	3,583.40	3,662.16	4,116.23	4,170.48
2B9 Fluorochemical Production						
2B10 Other (Please specify)	NO	NO	NO	NO	NO	NO

Years: 2014-2019 (2 of 4)

Categories	2014	2015	2016	2017	2018	2019
2C Metal Industry	1,894.64	2,832.04	2,600.51	3,463.15	3,939.15	10,439.66
2C1 Iron and Steel Production	1,318.64	1,616.04	1,384.51	859.64	1,107.28	7,543.24
2C2 Ferroalloys Production	NE	NE	NE	1,387.51	1,615.87	1,680.43
2C3 Aluminium production	576.00	1,216.00	1,216.00	1,216.00	1,216.00	1,216.00
2C4 Magnesium production	NO	NO	NO	NO	NO	NO
2C5 Lead Production	NE	NE	NE	NE	NE	NE
2C6 Zinc Production	NO	NO	NO	NO	NO	NO
2C7 Other (please specify)	NO	NO	NO	NO	NO	NO
2D Non-Energy Products from Fuels and Solvent Use	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
2D1 Lubricant Use	NE	NE	NE	NE	NE	NE
2D2 Paraffin Wax Use	NE	NE	NE	NE	NE	NE
2D3 Solvent Use						
2D4 Other (please specify)	NO	NO	NO	NO	NO	NO
2E Electronics Industry	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
2E1 Integrated Circuit or Semiconductor	NA	NA	NA	NA	NA	NA
2E2 TFT Flat Panel Display						
2E3 Photovoltaics						
2E4 Heat Transfer Fluid						
2E5 Other (please specify)	NO	NO	NO	NO	NO	NO
2F Product Uses as Substitutes for Ozone Depleting Substances	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO
2F1 Refrigeration and Air Conditioning	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE
2F2 Foam Blowing Agents	NE	NE	NE	NE	NE	NE
2F3 Fire Protection	NE	NE	NE	NE	NE	NE
2F4 Aerosols						
2F5 Solvents						
2F6 Other Applications	NO	NO	NO	NO	NO	NO
2G Other Product Manufacture and Use	NO	NO	NO	NO	NO	NO
2G1 Electrical Equipment						
2G2 SF6 and PFCs from Other Product Uses						
2G3 N2O from Product Uses						
2G4 Other (Please specify)	NO	NO	NO	NO	NO	NO
2H Other	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
2H1 Pulp and Paper Industry	NE	NE	NE	NE	NE	NE
2H2 Food and Beverages Industry	NE	NE	NE	NE	NE	NE
2H3 Other (please specify)	NO	NO	NO	NO	NO	NO

Years: 2014-2019 (3 of 4)

Categories	2014	2015	2016	2017	2018	2019
3 AGRICULTURE, FORESTRY AND OTHER LAND USE	-249,368.19	-243,476.20	-214,843.22	-242,747.71	-240,661.33	-214,302.97
3A Livestock						
3A1 Enteric Fermentation						
3A2 Manure Management						
3B Land	-249,952.54	-244,032.12	-215,375.05	-243,369.73	-241,264.08	-214,714.54
3B1 Forest land	-236,691.14	-233,267.34	-233,641.29	-241,312.68	-241,438.33	-237,008.39
3B2 Cropland	-16,561.31	-16,772.64	-17,433.51	-17,803.85	-18,368.96	-18,561.09
3B3 Grassland	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
3B4 Wetlands	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO
3B5 Settlements	3,299.90	6,007.86	35,699.75	15,746.81	18,543.22	40,854.94
3B6 Other Land	NO	NO	NO	NO	NO	NO
3C Aggregate sources and non-CO2 emissions sources on land	584.35	555.92	531.83	622.02	602.74	411.57
3C1 Emissions from biomass burning	NA	NA	NA	NA	NA	NA
3C2 Liming	9.07	9.07	4.54	0.00	27.12	21.67
3C3 Urea application	575.28	546.84	527.29	622.02	575.62	389.89
3C4 Direct N2O Emissions from managed soils						
3C5 Indirect N2O Emissions from managed soils						
3C6 Indirect N2O Emissions from manure management						
3C7 Rice cultivations						
3C8 Other (please specify)	NO	NO	NO	NO	NO	NO
3D Other	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
3D1 Harvested Wood Products	NE	NE	NE	NE	NE	NE
3D2 Other (please specify)	NO	NO	NO	NO	NO	NO

Years: 2014-2019 (4 of 4)

Categories	2014	2015	2016	2017	2018	2019
4 WASTE	38.97	38.42	31.06	34.09	50.26	42.77
4A Solid Waste Disposal						
4A1 Managed Waste Disposal Sites						
4A2 Unmanaged Waste Disposal Sites						
4A3 Uncategorised Waste Disposal Sites						
4B Biological Treatment of Solid Waste						
4C Incineration and Open Burning of Waste	38.97	38.42	31.06	34.09	50.26	42.77
4C1 Waste Incineration	38.26	37.72	30.36	33.39	49.56	42.09
4C2 Open Burning of Waste	0.71	0.70	0.70	0.70	0.69	0.68
4D Wastewater Treatment and Discharge						
4D1 Domestic Wastewater Treatment and Discharge						
4D2 Industrial Wastewater Treatment and Discharge						
4E Other (please specify)	NO	NO	NO	NO	NO	NO
5 OTHER	NO	NO	NO	NO	NO	NO
5A Indirect N_2O emissions from the atmospheric deposition of nitrogen in NOx and NH3						
5B Other (please specify)	NO	NO	NO	NO	NO	NO
Memo items						
International Bunkers	8,601.03	8,539.96	8,231.15	9,312.21	9,209.31	9,431.48
International Aviation (International Bunkers)	7,930.95	7,869.88	7,561.08	8,062.07	7,866.22	8,141.80
International Water-borne Transport (International Bunkers)	670.08	670.08	670.08	1,250.14	1,343.09	1,289.68
Multilateral Operations	NO	NO	NO	NO	NO	NO
Information items						
CO_2 from Biomass Burning for Energy Production	757.30	790.50	824.43	905.36	1,341.88	1,123.10
CO_2 captured	NO	NO	NO	NO	NO	NO
For domestic storage	NO	NO	NO	NO	NO	NO
For storage in other countries	NO	NO	NO	NO	NO	NO
Long-term storage of carbon in waste disposal sites	12.76	25.01	16.17	-3.05	-65.70	-29.54
Annual change in total long-term storage of carbon stored	9.68	15.86	12.53	-2.49	-50.17	-22.58
Annual change in long-term storage of carbon in HWP waste	3.08	9.15	3.64	-0.56	-15.53	-6.96
Other (please specify)	NO	NO	NO	NO	NO	NO

Table A - 19: Trends of CH_4 (Gigagrams)

Years: 1990 – 2000 (1 of 4)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Total National Emissions and Removals	**831.02**	**880.98**	**913.03**	**1,060.42**	**1,089.30**	**1,186.65**	**1,296.32**	**1,412.72**	**1,393.44**	**1,513.40**	**1,600.45**
1 Energy	231.22	277.14	294.96	398.36	422.56	494.57	578.13	660.56	666.27	708.73	776.62
1A Fuel Combustion Activities	5.96	6.53	7.06	7.39	8.25	8.86	10.27	11.28	11.07	12.49	12.49
1A1 Energy Industries	0.73	0.83	0.89	0.87	0.85	0.85	1.01	1.39	1.05	1.14	1.26
1A2 Manufacturing Industries and Construction	0.66	0.74	0.79	0.80	0.83	0.92	1.03	1.07	1.05	0.96	1.15
1A3 Transport	4.36	4.71	5.01	5.45	6.14	6.63	7.63	8.35	8.55	9.99	9.65
1A4 Other Sectors	0.21	0.25	0.37	0.27	0.42	0.45	0.60	0.47	0.41	0.40	0.43
1A5 Non-Specified	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1B Fugitive emissions from fuels	225.25	270.61	287.90	390.97	414.32	485.71	567.86	649.28	655.21	696.24	764.12
1B1 Solid Fuels	0.09	0.06	0.07	0.21	0.14	0.10	0.07	0.09	0.28	0.24	0.30
1B2 Oil and Natural Gas	225.16	270.54	287.83	390.76	414.17	485.61	567.79	649.19	654.93	695.99	763.82
1B3 Other emissions from Energy Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1C Carbon dioxide Transport and Storage											
2 INDUSTRIAL PROCESSES AND PRODUCT USE	0.66	0.62	0.56	0.63	0.97	1.18	4.29	5.08	4.54	4.64	5.99
2A Mineral Industry	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2A1 Cement production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2A2 Lime production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2A3 Glass Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2A4 Other Process Uses of Carbonates	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2A5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B Chemical Industry	0.00	0.00	0.00	0.00	0.00	0.00	3.12	3.60	3.66	3.69	4.75
2B1 Ammonia Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2B2 Nitric Acid Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B3 Adipic Acid Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B4 Caprolactam, Glyoxal and Glyoxylic Acid Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B5 Carbide Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2B6 Titanium Dioxide Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B7 Soda Ash Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B8 Petrochemical and Carbon Black Production	0.00	0.00	0.00	0.00	0.00	0.00	3.12	3.60	3.66	3.69	4.75
2B9 Fluorochemical Production											
2B10 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years: 1990 – 2000 (2 of 4)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
2C Metal Industry	0.66	0.62	0.55	0.63	0.96	1.18	1.17	1.49	0.88	0.95	1.24
2C1 Iron and Steel Production	0.66	0.62	0.55	0.63	0.96	1.18	1.17	1.49	0.88	0.95	1.24
2C2 Ferroalloys Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C3 Aluminium production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C4 Magnesium production											
2C5 Lead Production											
2C6 Zinc Production											
2C7 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2D Non-Energy Products from Fuels and Solvent Use	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
2D1 Lubricant Use											
2D2 Paraffin Wax Use	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2D3 Solvent Use											
2D4 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E Electronics Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E1 Integrated Circuit or Semiconductor											
2E2 TFT Flat Panel Display											
2E3 Photovoltaics											
2E4 Heat Transfer Fluid											
2E5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F Product Uses as Substitutes for Ozone Depleting Substances	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F1 Refrigeration and Air Conditioning											
2F2 Foam Blowing Agents											
2F3 Fire Protection											
2F4 Aerosols											
2F5 Solvents											
2F6 Other Applications	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2G Other Product Manufacture and Use	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2G1 Electrical Equipment											
2G2 SF6 and PFCs from Other Product Uses											
2G3 N2O from Product Uses											
2G4 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2H Other	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
2H1 Pulp and Paper Industry	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2H2 Food and Beverages Industry	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2H3 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years: 1990 – 2000 (3 of 4)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
3 AGRICULTURE, FORESTRY AND OTHER LAND USE	161.54	159.41	161.24	163.32	170.03	168.22	165.11	169.36	167.73	159.34	160.53
3A Livestock	78.18	75.75	76.94	77.63	84.46	83.55	80.06	82.15	81.22	72.25	73.57
3A1 Enteric Fermentation	56.19	56.29	55.05	55.78	58.22	57.07	54.87	54.54	56.15	54.39	55.13
3A2 Manure Management	21.99	19.46	21.89	21.85	26.24	26.47	25.20	27.60	25.07	17.86	18.43
3B Land	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO
3B1 Forest land	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO
3B2 Cropland	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO
3B3 Grassland	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
3B4 Wetlands	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO
3B5 Settlements	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
3B6 Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3C Aggregate sources and Non-CO_2 emissions sources on land	83.36	83.65	84.30	85.69	85.57	84.67	85.05	87.21	86.50	87.09	86.96
3C1 Emissions from biomass burning	0.38	0.29	0.35	0.29	0.31	0.28	0.28	0.30	0.55	0.29	0.29
3C2 Liming											
3C3 Urea application											
3C4 Direct N_2O Emissions from managed soils											
3C5 Indirect N_2O Emissions from managed soils											
3C6 Indirect N_2O Emissions from manure management											
3C7 Rice cultivations	82.99	83.36	83.95	85.40	85.26	84.39	84.77	86.91	85.95	86.80	86.68
3C8 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3D Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3D1 Harvested Wood Products											
3D2 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4 WASTE	437.60	443.81	456.27	498.11	495.74	522.68	548.78	577.72	554.90	640.69	657.31
4A Solid Waste Disposal	139.40	143.58	147.76	152.02	156.39	160.85	165.38	169.98	174.65	179.40	184.23
4A1 Managed Waste Disposal Sites	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4A2 Unmanaged Waste Disposal Sites	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4A3 Uncategorised Waste Disposal Sites	139.40	143.58	147.76	152.02	156.39	160.85	165.38	169.98	174.65	179.40	184.23
4B Biological Treatment of Solid Waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4C Incineration and Open Burning of Waste	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
4C1 Waste Incineration	NO	NO	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00
4C2 Open Burning of Waste	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
4D Wastewater Treatment and Discharge	298.12	300.14	308.43	346.00	339.26	361.75	383.31	407.65	380.16	461.21	472.99
4D1 Domestic Wastewater Treatment and Discharge	66.57	66.89	67.13	67.50	67.54	68.69	69.15	69.62	70.13	70.65	71.15
4D2 Industrial Wastewater Treatment and Discharge	231.55	233.25	241.30	278.50	271.72	293.06	314.16	338.02	310.03	390.56	401.84
4E Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5 OTHER	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5A Indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3											
5B Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years: 1990 – 2000 (4 of 4)

Memo items	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
International Bunkers	0.04	0.04	0.03	0.03	0.09	0.07	0.08	0.07	0.16	0.14	0.09
International Aviation (International Bunkers)	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.02	0.03
International Water-borne Transport (International Bunkers)	0.03	0.03	0.02	0.02	0.07	0.05	0.05	0.05	0.13	0.11	0.06
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Information items (1)											
CO2 from Biomass Burning for Energy Production											
CO2 captured											
For domestic storage											
For storage in other countries											
Long-term storage of carbon in waste disposal sites											
Annual change in total long-term storage of carbon stored											
Annual change in long-term storage of carbon in HWP waste											
Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years: 2001 – 2010 (1 of 4)

Categories	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total National Emissions and Removals	**1,656.04**	**1,656.34**	**1,739.41**	**1,852.45**	**2,000.69**	**2,031.15**	**2,093.28**	**2,213.69**	**2,180.29**	**2,265.53**
1 Energy	793.40	775.27	787.70	862.00	960.99	928.31	968.80	1,008.72	968.87	1,070.36
1A Fuel Combustion Activities	13.22	13.69	14.54	15.97	16.90	15.54	17.31	18.15	17.78	19.39
1A1 Energy Industries	1.29	1.42	1.59	2.08	2.44	1.81	1.89	1.99	1.94	2.13
1A2 Manufacturing Industries and Construction	1.13	1.20	1.25	1.39	1.46	1.41	1.55	1.60	1.42	1.28
1A3 Transport	10.37	10.61	11.30	12.09	12.55	11.81	13.33	13.92	13.88	14.96
1A4 Other Sectors	0.42	0.45	0.39	0.41	0.44	0.51	0.53	0.63	0.54	1.01
1A5 Non-Specified	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1B Fugitive emissions from fuels	780.18	761.58	773.16	846.04	944.09	912.77	951.48	990.58	951.09	1,050.97
1B1 Solid Fuels	0.32	0.27	0.28	0.54	0.99	0.95	1.30	1.68	1.78	1.68
1B2 Oil and Natural Gas	779.86	761.31	772.88	845.50	943.11	911.81	950.18	988.90	949.31	1,049.30
1B3 Other emissions from Energy Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1C Carbon dioxide Transport and Storage										
2 INDUSTRIAL PROCESSES AND PRODUCT USE	6.43	8.50	10.06	9.76	9.46	10.42	10.41	10.72	12.34	13.50
2A Mineral Industry	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2A1 Cement production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2A2 Lime production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2A3 Glass Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2A4 Other Process Uses of Carbonates	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2A5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B Chemical Industry	5.41	7.44	8.46	8.05	8.11	9.14	8.54	8.76	9.95	11.11
2B1 Ammonia Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2B2 Nitric Acid Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B3 Adipic Acid Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B4 Caprolactam, Glyoxal and Glyoxylic Acid Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B5 Carbide Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2B6 Titanium Dioxide Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B7 Soda Ash Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B8 Petrochemical and Carbon Black Production	5.41	7.44	8.46	8.05	8.11	9.14	8.54	8.76	9.95	11.11
2B9 Fluorochemical Production										
2B10 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years: 2001 – 2010 (2 of 4)

Categories	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
2C Metal Industry	1.02	1.06	1.60	1.71	1.35	1.28	1.87	1.96	2.39	2.39
2C1 Iron and Steel Production	1.02	1.06	1.60	1.71	1.35	1.28	1.87	1.96	2.39	2.39
2C2 Ferroalloys Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C3 Aluminium production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C4 Magnesium production										
2C5 Lead Production										
2C6 Zinc Production										
2C7 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2D Non-Energy Products from Fuels and Solvent Use	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
2D1 Lubricant Use										
2D2 Paraffin Wax Use	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2D3 Solvent Use										
2D4 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E Electronics Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E1 Integrated Circuit or Semiconductor										
2E2 TFT Flat Panel Display										
2E3 Photovoltaics										
2E4 Heat Transfer Fluid										
2E5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F Product Uses as Substitutes for Ozone Depleting Substances	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F1 Refrigeration and Air Conditioning										
2F2 Foam Blowing Agents										
2F3 Fire Protection										
2F4 Aerosols										
2F5 Solvents										
2F6 Other Applications	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2G Other Product Manufacture and Use	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2G1 Electrical Equipment										
2G2 SF6 and PFCs from Other Product Uses										
2G3 N2O from Product Uses										
2G4 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years: 2001 – 2010 (3 of 4)

Categories	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
2H Other	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
2H1 Pulp and Paper Industry	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2H2 Food and Beverages Industry	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2H3 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3 AGRICULTURE, FORESTRY AND OTHER LAND USE	158.99	158.86	161.26	163.69	163.72	164.67	168.56	168.12	169.70	169.03
3A Livestock	75.17	73.49	76.37	79.34	78.36	78.42	82.47	83.09	82.73	82.52
3A1 Enteric Fermentation	55.92	53.34	55.73	58.17	58.08	57.98	61.81	62.61	63.01	61.74
3A2 Manure Management	19.25	20.15	20.64	21.16	20.27	20.44	20.66	20.48	19.73	20.78
3B Land	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO
3B1 Forest land	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO
3B2 Cropland	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO
3B3 Grassland	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
3B4 Wetlands	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO
3B5 Settlements	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
3B6 Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3C Aggregate sources and Non-CO_2 emissions sources on land	83.82	85.37	84.88	84.35	85.37	86.25	86.10	85.03	86.97	86.51
3C1 Emissions from biomass burning	0.33	0.50	0.49	0.49	0.64	0.49	0.50	0.29	0.53	0.68
3C2 Liming										
3C3 Urea application										
3C4 Direct N_2O Emissions from managed soils										
3C5 Indirect N_2O Emissions from managed soils										
3C6 Indirect N_2O Emissions from manure management										
3C7 Rice cultivations	83.49	84.87	84.39	83.87	84.73	85.75	85.60	84.74	86.44	85.83
3C8 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3D Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3D1 Harvested Wood Products										
3D2 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years: 2001 – 2010 (4 of 4)

Categories	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
4 WASTE	697.21	713.71	780.40	817.00	866.51	927.75	945.50	1,026.13	1,029.38	1,012.64
4A Solid Waste Disposal	189.15	202.98	216.65	230.31	243.84	270.64	294.35	312.89	333.90	347.39
4A1 Managed Waste Disposal Sites	NO	NO	NO	NO	4.88	5.41	5.89	15.64	16.69	17.37
4A2 Unmanaged Waste Disposal Sites	NO	NO	NO	NO	238.97	265.22	288.46	297.24	317.20	330.02
4A3 Uncategorised Waste Disposal Sites	189.15	202.98	216.65	230.31	NO	NO	NO	NO	NO	NO
4B Biological Treatment of Solid Waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
4C Incineration and Open Burning of Waste	0.09	0.09	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.08
4C1 Waste Incineration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4C2 Open Burning of Waste	0.09	0.09	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.08
4D Wastewater Treatment and Discharge	507.98	510.65	563.66	586.60	622.58	657.03	651.07	713.16	695.40	665.17
4D1 Domestic Wastewater Treatment and Discharge	71.57	70.35	70.05	68.76	69.24	69.09	69.09	68.85	70.06	70.18
4D2 Industrial Wastewater Treatment and Discharge	436.41	440.29	493.61	517.84	553.34	587.93	581.98	644.31	625.35	594.99
4E Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5 OTHER	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5A Indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3										
5B Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo items	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
International Bunkers	0.07	0.06	0.05	0.06	0.05	0.07	0.05	0.05	0.05	0.06
International Aviation (International Bunkers)	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.03	0.03	0.04
International Water-borne Transport (International Bunkers)	0.04	0.03	0.02	0.02	0.02	0.03	0.02	0.02	0.01	0.02
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Information items (1)										
CO2 from Biomass Burning for Energy Production										
CO2 captured										
For domestic storage										
For storage in other countries										
Long-term storage of carbon in waste disposal sites										
Annual change in total long-term storage of carbon stored										
Annual change in long-term storage of carbon in HWP waste										
Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years: 2011 – 2019 (1 of 4)

Categories	2011	2012	2013	2014	2015	2016	2017	2018	2019
Total National Emissions and Removals	**2,289.28**	**2,321.32**	**2,261.95**	**2,098.92**	**2,080.00**	**2,189.37**	**2,145.27**	**2,039.23**	**2,029.20**
1 Energy	1,045.00	1,080.44	993.38	803.46	766.70	960.16	838.89	748.13	739.75
1A Fuel Combustion Activities	17.66	21.36	23.92	24.08	24.01	24.59	24.19	23.87	25.13
1A1 Energy Industries	2.34	2.31	2.53	2.46	2.31	2.32	2.04	2.15	2.29
1A2 Manufacturing Industries and Construction	1.15	1.30	1.15	1.10	1.21	1.14	1.36	1.39	1.37
1A3 Transport	13.31	16.92	19.40	19.74	19.78	20.60	20.21	19.62	20.75
1A4 Other Sectors	0.85	0.82	0.82	0.77	0.69	0.51	0.57	0.69	0.70
1A5 Non-Specified	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1B Fugitive emissions from fuels	1,027.34	1,059.08	969.46	779.38	742.69	935.57	814.70	724.25	714.63
1B1 Solid Fuels	2.28	1.08	1.96	1.27	0.91	0.79	0.82	0.73	0.95
1B2 Oil and Natural Gas	1,025.06	1,058.00	967.51	778.11	741.78	934.78	813.87	723.52	713.68
1B3 Other emissions from Energy Production	NA	NA	NA	NA	NA	NA	NA	NA	NA
1C Carbon dioxide Transport and Storage									
2 INDUSTRIAL PROCESSES AND PRODUCT USE	11.79	12.98	10.23	10.61	11.65	13.52	13.13	13.70	14.08
2A Mineral Industry	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2A1 Cement production	NA	NA	NA	NA	NA	NA	NA	NA	NA
2A2 Lime production	NA	NA	NA	NA	NA	NA	NA	NA	NA
2A3 Glass Production	NA	NA	NA	NA	NA	NA	NA	NA	NA
2A4 Other Process Uses of Carbonates	NA	NA	NA	NA	NA	NA	NA	NA	NA
2A5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B Chemical Industry	8.97	11.01	9.22	10.02	10.70	12.87	12.68	13.13	13.11
2B1 Ammonia Production	NA	NA	NA	NA	NA	NA	NA	NA	NA
2B2 Nitric Acid Production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B3 Adipic Acid Production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B4 Caprolactam, Glyoxal and Glyoxylic Acid Production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B5 Carbide Production	NA	NA	NA	NA	NA	NA	NA	NA	NA
2B6 Titanium Dioxide Production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B7 Soda Ash Production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B8 Petrochemical and Carbon Black Production	8.97	11.01	9.22	10.02	10.70	12.87	12.68	13.13	13.11
2B9 Fluorochemical Production									
2B10 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years: 2011 – 2019 (2 of 4)

Categories	2011	2012	2013	2014	2015	2016	2017	2018	2019
2C Metal Industry	2.82	1.97	1.00	0.59	0.96	0.66	0.45	0.56	0.97
2C1 Iron and Steel Production	2.82	1.97	1.00	0.59	0.96	0.66	0.05	0.09	0.41
2C2 Ferroalloys Production	NO	NO	NO	NO	NO	NO	0.40	0.48	0.56
2C3 Aluminium production	NA	NA	NA	NA	NA	NA	NA	NA	NA
2C4 Magnesium production									
2C5 Lead Production									
2C6 Zinc Production									
2C7 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
2D Non-Energy Products from Fuels and Solvent Use	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
2D1 Lubricant Use									
2D2 Paraffin Wax Use	NE	NE	NE	NE	NE	NE	NE	NE	NE
2D3 Solvent Use									
2D4 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E Electronics Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E1 Integrated Circuit or Semiconductor									
2E2 TFT Flat Panel Display									
2E3 Photovoltaics									
2E4 Heat Transfer Fluid									
2E5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F Product Uses as Substitutes for Ozone Depleting Substances	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F1 Refrigeration and Air Conditioning									
2F2 Foam Blowing Agents									
2F3 Fire Protection									
2F4 Aerosols									
2F5 Solvents									
2F6 Other Applications	NO	NO	NO	NO	NO	NO	NO	NO	NO
2G Other Product Manufacture and Use	NO	NO	NO	NO	NO	NO	NO	NO	NO
2G1 Electrical Equipment									
2G2 SF6 and PFCs from Other Product Uses									
2G3 N2O from Product Uses									
2G4 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
2H Other	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
2H1 Pulp and Paper Industry	NE	NE	NE	NE	NE	NE	NE	NE	NE
2H2 Food and Beverages Industry	NE	NE	NE	NE	NE	NE	NE	NE	NE
2H3 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years: 2011 – 2019 (3 of 4)

Categories	2011	2012	2013	2014	2015	2016	2017	2018	2019
3 AGRICULTURE, FORESTRY AND OTHER LAND USE	164.49	162.23	160.75	165.95	166.57	169.19	166.19	164.70	162.06
3A Livestock	77.62	76.59	77.20	77.14	77.12	74.99	73.95	71.98	70.56
3A1 Enteric Fermentation	57.47	55.83	56.07	55.65	55.33	54.76	52.46	50.43	48.98
3A2 Manure Management	20.15	20.76	21.13	21.49	21.79	20.22	21.49	21.55	21.58
3B Land	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO
3B1 Forest land	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO
3B2 Cropland	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO
3B3 Grassland	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
3B4 Wetlands	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO
3B5 Settlements	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
3B6 Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO
3C Aggregate sources and Non-CO_2 emissions sources on land	86.88	85.64	83.55	88.80	89.45	94.20	92.24	92.72	91.50
3C1 Emissions from biomass burning	0.29	0.34	0.49	0.72	0.44	3.60	0.35	0.38	0.74
3C2 Liming									
3C3 Urea application									
3C4 Direct N_2O Emissions from managed soils									
3C5 Indirect N_2O Emissions from managed soils									
3C6 Indirect N_2O Emissions from manure management									
3C7 Rice cultivations	86.59	85.30	83.06	88.08	89.01	90.61	91.89	92.34	90.76
3C8 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
3D Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3D1 Harvested Wood Products									
3D2 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
4 WASTE	1,068.00	1,065.66	1,097.58	1,118.90	1,135.08	1,046.50	1,127.07	1,112.71	1,113.31
4A Solid Waste Disposal	360.19	371.13	394.97	413.13	431.19	439.47	451.47	463.09	467.25
4A1 Managed Waste Disposal Sites	18.01	18.56	19.75	20.66	43.12	48.34	103.84	55.57	65.41
4A2 Unmanaged Waste Disposal Sites	342.18	352.57	375.22	392.47	388.07	391.13	347.63	407.52	401.83
4A3 Uncategorised Waste Disposal Sites	NO	NO	NO	NO	NO	NO	NO	NO	NO
4B Biological Treatment of Solid Waste	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
4C Incineration and Open Burning of Waste	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
4C1 Waste Incineration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4C2 Open Burning of Waste	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
4D Wastewater Treatment and Discharge	707.72	694.45	702.52	705.68	703.80	606.94	675.52	649.54	645.98
4D1 Domestic Wastewater Treatment and Discharge	70.01	71.16	70.97	70.64	69.04	68.65	68.83	68.45	67.48
4D2 Industrial Wastewater Treatment and Discharge	637.71	623.29	631.55	635.05	634.76	538.30	606.68	581.09	578.50
4E Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years: 2011 – 2019 (4 of 4)

Categories	2011	2012	2013	2014	2015	2016	2017	2018	2019
5 OTHER	NO	NO	NO	NO	NO	NO	NO	NO	NO
5A Indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3									
5B Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo items	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
International Bunkers	0.10	0.06	0.15	0.12	0.12	0.11	0.17	0.18	0.18
International Aviation (International Bunkers)	0.04	0.04	0.05	0.06	0.06	0.05	0.06	0.06	0.06
International Water-borne Transport (International Bunkers)	0.06	0.02	0.10	0.06	0.06	0.06	0.11	0.12	0.12
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO
Information items (1)									
CO2 from Biomass Burning for Energy Production									
CO2 captured									
For domestic storage									
For storage in other countries									
Long-term storage of carbon in waste disposal sites									
Annual change in total long-term storage of carbon stored									
Annual change in long-term storage of carbon in HWP waste									
Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table A - 20: Trends of N_2O (Gigagrams)
Years: 1990 – 1998 (1 of 4)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998
Total National Emissions and Removals	**11.33**	**11.55**	**11.66**	**12.89**	**14.43**	**12.92**	**12.89**	**16.92**	**17.95**
1 Energy	1.00	1.08	1.16	1.19	1.28	1.36	1.55	1.77	1.62
1A Fuel Combustion Activities	0.99	1.07	1.14	1.16	1.25	1.33	1.51	1.73	1.58
1A1 Energy Industries	0.17	0.18	0.19	0.19	0.17	0.18	0.21	0.27	0.20
1A2 Manufacturing Industries and Construction	0.12	0.13	0.14	0.15	0.15	0.17	0.18	0.19	0.19
1A3 Transport	0.69	0.74	0.79	0.82	0.90	0.96	1.09	1.25	1.17
1A4 Other Sectors	0.01	0.01	0.02	0.01	0.02	0.02	0.03	0.02	0.02
1A5 Non-Specified	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1B Fugitive emissions from fuels	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.04	0.04
1B1 Solid Fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1B2 Oil and Natural Gas	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.04	0.04
1B3 Other emissions from Energy Production	NA	NA	NA	NA	NA	NA	NA	NA	NA
1C Carbon dioxide Transport and Storage									
2 INDUSTRIAL PROCESSES AND PRODUCT USE	0.48	0.51	0.52	0.53	0.53	0.54	0.55	0.56	0.57
2A Mineral Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2A1 Cement production									
2A2 Lime production									
2A3 Glass Production									
2A4 Other Process Uses of Carbonates									
2A5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B Chemical Industry	0.46	0.47	0.47	0.48	0.48	0.49	0.49	0.50	0.51
2B1 Ammonia Production	NA	NA	NA	NA	NA	NA	NA	NA	NA
2B2 Nitric Acid Production	0.46	0.47	0.47	0.48	0.48	0.49	0.49	0.50	0.51
2B3 Adipic Acid Production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B4 Caprolactam, Glyoxal and Glyoxylic Acid Production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B5 Carbide Production	NA	NA	NA	NA	NA	NA	NA	NA	NA
2B6 Titanium Dioxide Production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B7 Soda Ash Production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B8 Petrochemical and Carbon Black Production	NA	NA	NA	NA	NA	NA	NA	NA	NA
2B9 Fluorochemical Production									
2B10 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO

Year: 1990 – 1998 (2 of 4)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998
2C Metal Industry	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO
2C1 Iron and Steel Production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C2 Ferroalloys Production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C3 Aluminium production									
2C4 Magnesium production									
2C5 Lead Production									
2C6 Zinc Production									
2C7 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
2D Non-Energy Products from Fuels and Solvent Use	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
2D1 Lubricant Use									
2D2 Paraffin Wax Use	NE	NE	NE	NE	NE	NE	NE	NE	NE
2D3 Solvent Use									
2D4 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E Electronics Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E1 Integrated Circuit or Semiconductor	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E2 TFT Flat Panel Display									
2E3 Photovoltaics									
2E4 Heat Transfer Fluid									
2E5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F Product Uses as Substitutes for Ozone Depleting Substances	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F1 Refrigeration and Air Conditioning									
2F2 Foam Blowing Agents									
2F3 Fire Protection									
2F4 Aerosols									
2F5 Solvents									
2F6 Other Applications	NO	NO	NO	NO	NO	NO	NO	NO	NO
2G Other Product Manufacture and Use	0.02	0.04	0.05	0.05	0.05	0.05	0.05	0.06	0.06
2G1 Electrical Equipment									
2G2 SF6 and PFCs from Other Product Uses									
2G3 N2O from Product Uses	0.02	0.04	0.05	0.05	0.05	0.05	0.05	0.06	0.06
2G4 Other (Please specify)									

Year: 1990 – 1998 (3 of 4)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998
2H Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
2H1 Pulp and Paper Industry									
2H2 Food and Beverages Industry									
2H3 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
3 AGRICULTURE, FORESTRY AND OTHER LAND USE	9.26	9.36	9.34	10.49	11.88	10.25	9.99	13.74	14.90
3A Livestock	0.20	0.20	0.21	0.22	0.24	0.26	0.25	0.29	0.27
3A1 Enteric Fermentation									
3A2 Manure Management	0.20	0.20	0.21	0.22	0.24	0.26	0.25	0.29	0.27
3B Land	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO
3B1 Forest land	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO
3B2 Cropland	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO
3B3 Grassland	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
3B4 Wetlands	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO
3B5 Settlements	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
3B6 Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO
3C Aggregate sources and Non-CO_2 emissions sources on land	9.06	9.16	9.13	10.27	11.65	9.99	9.74	13.45	14.63
3C1 Emissions from biomass burning	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02
3C2 Liming									
3C3 Urea application									
3C4 Direct N2O Emissions from managed soils	6.00	6.15	6.05	6.88	7.77	6.43	6.27	8.91	9.94
3C5 Indirect N2O Emissions from managed soils	2.01	2.05	2.01	2.28	2.58	2.13	2.08	2.94	3.25
3C6 Indirect N2O Emissions from manure management	1.04	0.95	1.06	1.10	1.29	1.41	1.38	1.59	1.43
3C7 Rice cultivations	NA	NA	NA	NA	NA	NA	NA	NA	NA
3C8 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
3D Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3D1 Harvested Wood Products									
3D2 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO

Year: 1990 – 1998 (4 of 4)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998
4 WASTE	0.59	0.60	0.65	0.69	0.73	0.77	0.80	0.85	0.86
4A Solid Waste Disposal	NA	NA	NA	NA	NA	NA	NA	NA	NA
4A1 Managed Waste Disposal Sites	NA	NA	NA	NA	NA	NA	NA	NA	NA
4A2 Unmanaged Waste Disposal Sites	NA	NA	NA	NA	NA	NA	NA	NA	NA
4A3 Uncategorised Waste Disposal Sites	NA	NA	NA	NA	NA	NA	NA	NA	NA
4B Biological Treatment of Solid Waste	NO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4C Incineration and Open Burning of Waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4C1 Waste Incineration	NO	NO	NO	NO	NO	NO	NO	NO	0.00
4C2 Open Burning of Waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4D Wastewater Treatment and Discharge	0.58	0.60	0.64	0.69	0.73	0.77	0.80	0.85	0.86
4D1 Domestic Wastewater Treatment and Discharge	0.58	0.60	0.64	0.69	0.73	0.77	0.80	0.85	0.86
4D2 Industrial Wastewater Treatment and Discharge	NA	NA	NA	NA	NA	NA	NA	NA	NA
4E Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo items	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**
International Bunkers	0.05	0.05	0.06	0.06	0.08	0.09	0.10	0.11	0.14
International Aviation (International Bunkers)	0.04	0.05	0.05	0.06	0.06	0.08	0.09	0.09	0.11
International Water-borne Transport (International Bunkers)	0.01	0.01	0.01	0.01	0.02	0.01	0.02	0.01	0.04
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO
Information items (1)									
CO_2 from Biomass Burning for Energy Production									
CO_2 captured									
For domestic storage									
For storage in other countries									
Long-term storage of carbon in waste disposal sites									
Annual change in total long-term storage of carbon stored									
Annual change in long-term storage of carbon in HWP waste									
Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO

Year: 1999 – 2008 (1 of 4)

Categories	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Total National Emissions and Removals	**17.72**	**18.33**	**15.59**	**18.67**	**18.84**	**21.50**	**23.49**	**21.82**	**24.58**	**25.68**
1 Energy	1.88	2.01	2.16	2.27	2.49	2.81	2.87	2.72	2.94	3.10
1A Fuel Combustion Activities	1.83	1.96	2.11	2.22	2.44	2.75	2.81	2.66	2.87	3.04
1A1 Energy Industries	0.23	0.25	0.28	0.34	0.45	0.58	0.64	0.57	0.67	0.70
1A2 Manufacturing Industries and Construction	0.17	0.20	0.19	0.20	0.21	0.23	0.24	0.23	0.26	0.26
1A3 Transport	1.41	1.49	1.62	1.66	1.76	1.92	1.90	1.83	1.92	2.04
1A4 Other Sectors	0.01	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.02	0.03
1A5 Non-Specified	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
1B Fugitive emissions from fuels	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.07
1B1 Solid Fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1B2 Oil and Natural Gas	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.07
1B3 Other emissions from Energy Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1C Carbon dioxide Transport and Storage										
2 INDUSTRIAL PROCESSES AND PRODUCT USE	0.57	0.74	0.40	0.50	0.73	0.77	0.80	0.67	0.67	0.52
2A Mineral Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2A1 Cement production										
2A2 Lime production										
2A3 Glass Production										
2A4 Other Process Uses of Carbonates										
2A5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B Chemical Industry	0.51	0.68	0.33	0.43	0.66	0.70	0.73	0.59	0.59	0.44
2B1 Ammonia Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2B2 Nitric Acid Production	0.51	0.68	0.33	0.43	0.66	0.70	0.73	0.59	0.59	0.44
2B3 Adipic Acid Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B4 Caprolactam, Glyoxal and Glyoxylic Acid Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B5 Carbide Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2B6 Titanium Dioxide Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B7 Soda Ash Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B8 Petrochemical and Carbon Black Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2B9 Fluorochemical Production										
2B10 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Year: 1999 – 2008 (2 of 4)

Categories	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2C Metal Industry	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO
2C1 Iron and Steel Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C2 Ferroalloys Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C3 Aluminium production										
2C4 Magnesium production										
2C5 Lead Production										
2C6 Zinc Production										
2C7 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2D Non-Energy Products from Fuels and Solvent Use	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
2D1 Lubricant Use										
2D2 Paraffin Wax Use	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2D3 Solvent Use										
2D4 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E Electronics Industry	NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
2E1 Integrated Circuit or Semiconductor	NO	NA	NA	NA	NA	NA	NA	NA	NA	NA
2E2 TFT Flat Panel Display										
2E3 Photovoltaics										
2E4 Heat Transfer Fluid										
2E5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F Product Uses as Substitutes for Ozone Depleting Substances	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F1 Refrigeration and Air Conditioning										
2F2 Foam Blowing Agents										
2F3 Fire Protection										
2F4 Aerosols										
2F5 Solvents										
2F6 Other Applications	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Year: 1999 – 2008 (3 of 4)

Categories	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2G Other Product Manufacture and Use	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08
2G1 Electrical Equipment										
2G2 SF6 and PFCs from Other Product Uses										
2G3 N2O from Product Uses	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08
2G4 Other (Please specify)										
2H Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2H1 Pulp and Paper Industry										
2H2 Food and Beverages Industry										
2H3 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3 AGRICULTURE, FORESTRY AND OTHER LAND USE	14.38	14.67	12.11	14.95	14.65	16.93	18.78	17.36	19.89	20.97
3A Livestock	0.26	0.26	0.29	0.31	0.33	0.34	0.32	0.33	0.35	0.36
3A1 Enteric Fermentation										
3A2 Manure Management	0.26	0.26	0.29	0.31	0.33	0.34	0.32	0.33	0.35	0.36
3B Land	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO
3B1 Forest land	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO
3B2 Cropland	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO
3B3 Grassland	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
3B4 Wetlands	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO
3B5 Settlements	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
3B6 Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3C Aggregate sources and Non-CO_2 emissions sources on land	14.12	14.40	11.82	14.64	14.32	16.59	18.46	17.03	19.53	20.61
3C1 Emissions from biomass burning	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01
3C2 Liming										
3C3 Urea application										
3C4 Direct N2O Emissions from managed soils	9.74	9.98	7.93	9.97	9.67	11.39	12.93	11.84	13.68	14.52
3C5 Indirect N2O Emissions from managed soils	3.18	3.18	2.50	3.17	3.06	3.55	3.98	3.62	4.20	4.45
3C6 Indirect N2O Emissions from manure management	1.20	1.24	1.38	1.50	1.57	1.63	1.53	1.55	1.64	1.63
3C7 Rice cultivations	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3C8 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3D Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3D1 Harvested Wood Products										
3D2 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Year: 1999 – 2008 (4 of 4)

Categories	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
4 WASTE	0.88	0.91	0.92	0.95	0.96	0.99	1.03	1.07	1.09	1.08
4A Solid Waste Disposal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4A1 Managed Waste Disposal Sites	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4A2 Unmanaged Waste Disposal Sites	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4A3 Uncategorised Waste Disposal Sites	NA	NA	NA	NA	NA	NA	NO	NO	NO	NO
4B Biological Treatment of Solid Waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4C Incineration and Open Burning of Waste	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
4C1 Waste Incineration	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
4C2 Open Burning of Waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4D Wastewater Treatment and Discharge	0.88	0.90	0.91	0.94	0.96	0.99	1.03	1.06	1.08	1.08
4D1 Domestic Wastewater Treatment and Discharge	0.88	0.90	0.91	0.94	0.96	0.99	1.03	1.06	1.08	1.08
4D2 Industrial Wastewater Treatment and Discharge	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4E Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo items	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
International Bunkers	0.13	0.12	0.13	0.12	0.13	0.14	0.14	0.17	0.15	0.15
International Aviation (International Bunkers)	0.09	0.10	0.12	0.12	0.12	0.13	0.13	0.16	0.14	0.14
International Water-borne Transport (International Bunkers)	0.03	0.02	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Information items (1)										
CO_2 from Biomass Burning for Energy Production										
CO_2 captured										
For domestic storage										
For storage in other countries										
Long-term storage of carbon in waste disposal sites										
Annual change in total long-term storage of carbon stored										
Annual change in long-term storage of carbon in HWP waste										
Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Year: 2009 – 2019 (1 of 4)

Categories	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Total National Emissions and Removals	**21.29**	**22.87**	**22.81**	**26.30**	**25.44**	**26.99**	**25.62**	**25.87**	**27.00**	**26.00**	**24.41**
1 Energy	3.05	3.37	3.41	3.82	4.08	4.32	4.26	4.42	4.43	4.49	4.61
1A Fuel Combustion Activities	2.99	3.30	3.34	3.78	4.02	4.24	4.18	4.36	4.38	4.44	4.56
1A1 Energy Industries	0.76	1.01	1.06	1.11	1.10	1.10	1.17	1.28	1.28	1.40	1.36
1A2 Manufacturing Industries and Construction	0.23	0.20	0.17	0.20	0.18	0.16	0.18	0.17	0.21	0.21	0.21
1A3 Transport	1.97	2.03	2.06	2.41	2.69	2.93	2.78	2.88	2.85	2.79	2.95
1A4 Other Sectors	0.02	0.05	0.04	0.04	0.04	0.03	0.03	0.02	0.02	0.03	0.04
1A5 Non-Specified	0.01	0.01	0.01	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.02
1B Fugitive emissions from fuels	0.06	0.07	0.07	0.04	0.06	0.08	0.08	0.06	0.05	0.05	0.05
1B1 Solid Fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1B2 Oil and Natural Gas	0.06	0.07	0.07	0.04	0.06	0.08	0.08	0.06	0.05	0.05	0.05
1B3 Other emissions from Energy Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1C Carbon dioxide Transport and Storage											
2 INDUSTRIAL PROCESSES AND PRODUCT USE	0.08	0.09	0.09	0.09	0.09	0.09	0.24	0.24	0.21	0.20	0.20
2A Mineral Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2A1 Cement production											
2A2 Lime production											
2A3 Glass Production											
2A4 Other Process Uses of Carbonates											
2A5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B Chemical Industry	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
2B1 Ammonia Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2B2 Nitric Acid Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B3 Adipic Acid Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B4 Caprolactam, Glyoxal and Glyoxylic Acid Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B5 Carbide Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2B6 Titanium Dioxide Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B7 Soda Ash Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B8 Petrochemical and Carbon Black Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2B9 Fluorochemical Production											
2B10 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Year: 2009 – 2019 (2 of 4)

Categories	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
2C Metal Industry	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO
2C1 Iron and Steel Production	NO	NO	NO	NO	NO	NO	NO	NO	NA, NO	NA, NO	NA, NO
2C2 Ferroalloys Production	NO	NO	NO	NO	NO	NO	NO	NO	NA	NA	NA
2C3 Aluminium production											
2C4 Magnesium production											
2C5 Lead Production											
2C6 Zinc Production											
2C7 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2D Non-Energy Products from Fuels and Solvent Use	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
2D1 Lubricant Use											
2D2 Paraffin Wax Use	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2D3 Solvent Use											
2D4 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E Electronics Industry	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
2E1 Integrated Circuit or Semiconductor	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2E2 TFT Flat Panel Display											
2E3 Photovoltaics											
2E4 Heat Transfer Fluid											
2E5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F Product Uses as Substitutes for Ozone Depleting Substances	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F1 Refrigeration and Air Conditioning											
2F2 Foam Blowing Agents											
2F3 Fire Protection											
2F4 Aerosols											
2F5 Solvents											
2F6 Other Applications	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2G Other Product Manufacture and Use	0.08	0.09	0.09	0.09	0.09	0.09	0.24	0.24	0.21	0.20	0.20
2G1 Electrical Equipment											
2G2 SF6 and PFCs from Other Product Uses											
2G3 N2O from Product Uses	0.08	0.09	0.09	0.09	0.09	0.09	0.24	0.24	0.21	0.20	0.20
2G4 Other (Please specify)											
2H Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2H1 Pulp and Paper Industry											
2H2 Food and Beverages Industry											
2H3 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Year: 2009 – 2019 (3 of 4)

Categories	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
3 AGRICULTURE, FORESTRY AND OTHER LAND USE	17.05	18.27	18.14	21.19	20.04	21.35	19.89	19.97	21.10	20.03	18.32
3A Livestock	0.37	0.38	0.39	0.40	0.42	0.44	0.44	0.44	0.42	0.39	0.40
3A1 Enteric Fermentation											
3A2 Manure Management	0.37	0.38	0.39	0.40	0.42	0.44	0.44	0.44	0.42	0.39	0.40
3B Land	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO
3B1 Forest land	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO
3B2 Cropland	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO
3B3 Grassland	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
3B4 Wetlands	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO
3B5 Settlements	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
3B6 Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3C Aggregate sources and Non-CO_2 emissions sources on land	16.68	17.88	17.75	20.79	19.62	20.91	19.45	19.53	20.67	19.65	17.91
3C1 Emissions from biomass burning	0.01	0.02	0.01	0.01	0.01	0.02	0.01	0.10	0.01	0.01	0.02
3C2 Liming											
3C3 Urea application											
3C4 Direct N2O Emissions from managed soils	11.55	12.47	12.38	14.61	13.67	14.60	13.52	13.51	14.56	13.91	12.54
3C5 Indirect N2O Emissions from managed soils	3.48	3.67	3.62	4.32	3.98	4.27	3.89	3.88	4.23	4.02	3.53
3C6 Indirect N2O Emissions from manure management	1.64	1.73	1.74	1.85	1.95	2.03	2.03	2.03	1.87	1.71	1.82
3C7 Rice cultivations	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3C8 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3D Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3D1 Harvested Wood Products											
3D2 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Year: 2009 – 2019 (4 of 4)

Categories	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
4 WASTE	1.10	1.14	1.17	1.20	1.22	1.23	1.24	1.25	1.26	1.27	1.28
4A Solid Waste Disposal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4A1 Managed Waste Disposal Sites	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4A2 Unmanaged Waste Disposal Sites	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4A3 Uncategorised Waste Disposal Sites	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4B Biological Treatment of Solid Waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4C Incineration and Open Burning of Waste	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
4C1 Waste Incineration	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
4C2 Open Burning of Waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4D Wastewater Treatment and Discharge	1.10	1.14	1.16	1.19	1.22	1.22	1.23	1.24	1.25	1.26	1.27
4D1 Domestic Wastewater Treatment and Discharge	1.10	1.14	1.16	1.19	1.22	1.22	1.23	1.24	1.25	1.26	1.27
4D2 Industrial Wastewater Treatment and Discharge	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4E Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo items	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
International Bunkers	0.15	0.16	0.18	0.16	0.22	0.24	0.24	0.23	0.26	0.26	0.26
International Aviation (International Bunkers)	0.14	0.15	0.17	0.16	0.20	0.22	0.22	0.21	0.23	0.22	0.23
International Water-borne Transport (International Bunkers)	0.01	0.00	0.02	0.00	0.03	0.02	0.02	0.02	0.03	0.04	0.03
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Information items (1)											
CO_2 from Biomass Burning for Energy Production											
CO_2 captured											
For domestic storage											
For storage in other countries											
Long-term storage of carbon in waste disposal sites											
Annual change in total long-term storage of carbon stored											
Annual change in long-term storage of carbon in HWP waste											
Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table A - 21: Trends of HFCs (CO2 equivalents Gigagrams)

Years: 1990 – 1998 (1 of 2)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998
Total National Emissions and Removals	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	91.05	142.11
2 INDUSTRIAL PROCESSES AND PRODUCT USE	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	91.05	142.11
2A Mineral Industry									
2A1 Cement production									
2A2 Lime production									
2A3 Glass Production									
2A4 Other Process Uses of Carbonates									
2A5 Other (please specify)									
2B Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B1 Ammonia Production									
2B2 Nitric Acid Production									
2B3 Adipic Acid Production									
2B4 Caprolactam, Glyoxal and Glyoxylic Acid Production									
2B5 Carbide Production									
2B6 Titanium Dioxide Production									
2B7 Soda Ash Production									
2B8 Petrochemical and Carbon Black Production									
2B9 Fluorochemical Production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B10 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C Metal Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C1 Iron and Steel Production									
2C2 Ferroalloys Production									
2C3 Aluminium production									
2C4 Magnesium production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C5 Lead Production									
2C6 Zinc Production									
2C7 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years: 1990 – 1998 (1 of 2)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998
2D Non-Energy Products from Fuels and Solvent Use									
2D1 Lubricant Use									
2D2 Paraffin Wax Use									
2D3 Solvent Use									
2D4 Other (please specify)									
2E Electronics Industry	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
2E1 Integrated Circuit or Semiconductor	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E2 TFT Flat Panel Display	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E3 Photovoltaics	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E4 Heat Transfer Fluid									
2E5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F Product Uses as Substitutes for Ozone Depleting Substances	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	91.05	142.11
2F1 Refrigeration and Air Conditioning	NO	NO	NO	NO	NO	NO	NO	91.05	142.11
2F2 Foam Blowing Agents	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F3 Fire Protection	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F4 Aerosols	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F5 Solvents	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F6 Other Applications	NO	NO	NO	NO	NO	NO	NO	NO	NO
2G Other Product Manufacture and Use	NO	NO	NO	NO	NO	NO	NO	NO	NO
2G1 Electrical Equipment									
2G2 SF_6 and PFCs from Other Product Uses									
2G3 N_2O from Product Uses									
2G4 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
2H Other									
2H1 Pulp and Paper Industry									
2H2 Food and Beverages Industry									
2H3 Other (please specify)									

Years: 1999 – 2008 (1 of 2)

Categories	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Total National Emissions and Removals	193.17	190.87	411.29	511.39	327.71	449.76	518.83	504.49	563.03	642.19
2 INDUSTRIAL PROCESSES AND PRODUCT USE	193.17	190.87	411.29	511.39	327.71	449.76	518.83	504.49	563.03	642.19
2A Mineral Industry										
2A1 Cement production										
2A2 Lime production										
2A3 Glass Production										
2A4 Other Process Uses of Carbonates										
2A5 Other (please specify)										
2B Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B1 Ammonia Production										
2B2 Nitric Acid Production										
2B3 Adipic Acid Production										
2B4 Caprolactam, Glyoxal and Glyoxylic Acid Production										
2B5 Carbide Production										
2B6 Titanium Dioxide Production										
2B7 Soda Ash Production										
2B8 Petrochemical and Carbon Black Production										
2B9 Fluorochemical Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B10 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C Metal Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C1 Iron and Steel Production										
2C2 Ferroalloys Production										
2C3 Aluminium production										
2C4 Magnesium production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C5 Lead Production										
2C6 Zinc Production										
2C7 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years: 1999 – 2008 (2 of 2)

Categories	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2D Non-Energy Products from Fuels and Solvent Use										
2D1 Lubricant Use										
2D2 Paraffin Wax Use										
2D3 Solvent Use										
2D4 Other (please specify)										
2E Electronics Industry	NE, NO	39.49	39.49	39.49	39.49	39.49	39.49	39.49	39.49	39.49
2E1 Integrated Circuit or Semiconductor	NO	39.49	39.49	39.49	39.49	39.49	39.49	39.49	39.49	39.49
2E2 TFT Flat Panel Display	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E3 Photovoltaics	NO	NA	NA	NA	NA	NA	NA	NA	NA	NA
2E4 Heat Transfer Fluid										
2E5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F Product Uses as Substitutes for Ozone Depleting Substances	193.17	151.38	371.80	471.90	288.22	410.27	479.34	464.99	523.54	602.70
2F1 Refrigeration and Air Conditioning	193.17	151.38	371.80	471.90	288.22	410.27	479.34	464.99	523.54	602.70
2F2 Foam Blowing Agents	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F3 Fire Protection	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F4 Aerosols	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F5 Solvents	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F6 Other Applications	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2G Other Product Manufacture and Use	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2G1 Electrical Equipment										
2G2 SF_6 and PFCs from Other Product Uses										
2G3 N_2O from Product Uses										
2G4 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2H Other										
2H1 Pulp and Paper Industry										
2H2 Food and Beverages Industry										
2H3 Other (please specify)										

Years: 2009 – 2019 (1 of 2)

Categories	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Total National Emissions and Removals	678.73	723.02	688.57	717.37	743.32	764.47	760.40	757.00	904.82	936.96	973.53
2 INDUSTRIAL PROCESSES AND PRODUCT USE	678.73	723.02	688.57	717.37	743.32	764.47	760.40	757.00	904.82	936.96	973.53
2A Mineral Industry											
2A1 Cement production											
2A2 Lime production											
2A3 Glass Production											
2A4 Other Process Uses of Carbonates											
2A5 Other (please specify)											
2B Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B1 Ammonia Production											
2B2 Nitric Acid Production											
2B3 Adipic Acid Production											
2B4 Caprolactam, Glyoxal and Glyoxylic Acid Production											
2B5 Carbide Production											
2B6 Titanium Dioxide Production											
2B7 Soda Ash Production											
2B8 Petrochemical and Carbon Black Production											
2B9 Fluorochemical Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B10 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C Metal Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C1 Iron and Steel Production											
2C2 Ferroalloys Production											
2C3 Aluminium production											
2C4 Magnesium production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C5 Lead Production											
2C6 Zinc Production											
2C7 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years: 2009 – 2019 (2 of 2)

Categories	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
2D Non-Energy Products from Fuels and Solvent Use											
2D1 Lubricant Use											
2D2 Paraffin Wax Use											
2D3 Solvent Use											
2D4 Other (please specify)											
2E Electronics Industry	39.49	39.49	39.49	38.97	40.48	39.03	39.03	43.75	43.75	43.75	43.75
2E1 Integrated Circuit or Semiconductor	39.49	39.49	39.49	38.97	40.48	39.03	39.03	43.75	43.75	43.75	43.75
2E2 TFT Flat Panel Display	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E3 Photovoltaics	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2E4 Heat Transfer Fluid											
2E5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F Product Uses as Substitutes for Ozone Depleting Substances	639.24	683.53	649.08	678.39	702.85	725.44	721.37	713.25	861.06	893.20	929.77
2F1 Refrigeration and Air Conditioning	639.24	683.53	649.08	678.39	702.85	725.44	721.37	713.25	861.06	893.20	929.77
2F2 Foam Blowing Agents	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F3 Fire Protection	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F4 Aerosols	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F5 Solvents	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F6 Other Applications	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2G Other Product Manufacture and Use	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2G1 Electrical Equipment											
2G2 SF_6 and PFCs from Other Product Uses											
2G3 N_2O from Product Uses											
2G4 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2H Other											
2H1 Pulp and Paper Industry											
2H2 Food and Beverages Industry											
2H3 Other (please specify)											

Table A - 22: Trends of PFCs (CO_2 equivalents Gigagrams)

Years: 1990 – 1998 (1 of 2)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998
Total National Emissions and Removals	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
2 INDUSTRIAL PROCESSES AND PRODUCT USE	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
2A Mineral Industry									
2A1 Cement production									
2A2 Lime production									
2A3 Glass Production									
2A4 Other Process Uses of Carbonates									
2A5 Other (please specify)									
2B Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B1 Ammonia Production									
2B2 Nitric Acid Production									
2B3 Adipic Acid Production									
2B4 Caprolactam, Glyoxal and Glyoxylic Acid Production									
2B5 Carbide Production									
2B6 Titanium Dioxide Production									
2B7 Soda Ash Production									
2B8 Petrochemical and Carbon Black Production									
2B9 Fluorochemical Production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B10 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C Metal Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C1 Iron and Steel Production									
2C2 Ferroalloys Production									
2C3 Aluminium production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C4 Magnesium production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C5 Lead Production									
2C6 Zinc Production									
2C7 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years: 1990 – 1998 (2 of 2)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998
2D Non-Energy Products from Fuels and Solvent Use									
2D1 Lubricant Use									
2D2 Paraffin Wax Use									
2D3 Solvent Use									
2D4 Other (please specify)									
2E Electronics Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E1 Integrated Circuit or Semiconductor	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E2 TFT Flat Panel Display	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E3 Photovoltaics	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E4 Heat Transfer Fluid									
2E5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F Product Uses as Substitutes for Ozone Depleting Substances	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO
2F1 Refrigeration and Air Conditioning	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE
2F2 Foam Blowing Agents	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F3 Fire Protection	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F4 Aerosols	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F5 Solvents	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F6 Other Applications (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
2G Other Product Manufacture and Use	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
2G1 Electrical Equipment	NE	NE	NE	NE	NE	NE	NE	NE	NE
2G2 SF6 and PFCs from Other Product Uses	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
2G3 N_2O from Product Uses									
2G4 Other (Please specify)									
2H Other									
2H1 Pulp and Paper Industry									
2H2 Food and Beverages Industry									
2H3 Other (please specify)									

Years: 1999 – 2008 (1 of 2)

Categories	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Total National Emissions and Removals	NE, NO	140.64	240.45	340.27	440.08	539.90	639.71	739.53	839.34	939.16
2 INDUSTRIAL PROCESSES AND PRODUCT USE	NE, NO	140.64	240.45	340.27	440.08	539.90	639.71	739.53	839.34	939.16
2A Mineral Industry										
2A1 Cement production										
2A2 Lime production										
2A3 Glass Production										
2A4 Other Process Uses of Carbonates										
2A5 Other (please specify)										
2B Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B1 Ammonia Production										
2B2 Nitric Acid Production										
2B3 Adipic Acid Production										
2B4 Caprolactam, Glyoxal and Glyoxylic Acid Production										
2B5 Carbide Production										
2B6 Titanium Dioxide Production										
2B7 Soda Ash Production										
2B8 Petrochemical and Carbon Black Production										
2B9 Fluorochemical Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B10 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C Metal Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C1 Iron and Steel Production										
2C2 Ferroalloys Production										
2C3 Aluminium production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C4 Magnesium production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C5 Lead Production										
2C6 Zinc Production										
2C7 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years: 1999 – 2008 (2 of 2)

Categories	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2D Non-Energy Products from Fuels and Solvent Use										
2D1 Lubricant Use										
2D2 Paraffin Wax Use										
2D3 Solvent Use										
2D4 Other (please specify)										
2E Electronics Industry	NO	140.64	240.45	340.27	440.08	539.90	639.71	739.53	839.34	939.16
2E1 Integrated Circuit or Semiconductor	NO	140.64	240.45	340.27	440.08	539.90	639.71	739.53	839.34	939.16
2E2 TFT Flat Panel Display	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E3 Photovoltaics	NO	IE	IE	IE	IE	IE	IE	IE	IE	IE
2E4 Heat Transfer Fluid										
2E5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F Product Uses as Substitutes for Ozone Depleting Substances	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO
2F1 Refrigeration and Air Conditioning	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE
2F2 Foam Blowing Agents	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F3 Fire Protection	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F4 Aerosols	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F5 Solvents	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F6 Other Applications (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2G Other Product Manufacture and Use	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
2G1 Electrical Equipment	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2G2 SF6 and PFCs from Other Product Uses	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
) from Product Uses										
2G4 Other (Please specify)										
2H Other										
2H1 Pulp and Paper Industry										
2H2 Food and Beverages Industry										
2H3 Other (please specify)										

Years: 2009 – 2019 (1 of 2)

Categories	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Total National Emissions and Removals	1,038.97	1,138.79	1,445.24	2,576.01	2,668.57	3,023.58	4,694.46	4,976.28	4,976.28	4,976.28	4,976.28
2 INDUSTRIAL PROCESSES AND PRODUCT USE	1,038.97	1,138.79	1,445.24	2,576.01	2,668.57	3,023.58	4,694.46	4,976.28	4,976.28	4,976.28	4,976.28
2A Mineral Industry											
2A1 Cement production											
2A2 Lime production											
2A3 Glass Production											
2A4 Other Process Uses of Carbonates											
2A5 Other (please specify)											
2B Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B1 Ammonia Production											
2B2 Nitric Acid Production											
2B3 Adipic Acid Production											
2B4 Caprolactam, Glyoxal and Glyoxylic Acid Production											
2B5 Carbide Production											
2B6 Titanium Dioxide Production											
2B7 Soda Ash Production											
2B8 Petrochemical and Carbon Black Production											
2B9 Fluorochemical Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B10 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C Metal Industry	NO	NO	206.64	1,239.84	1,239.84	1,239.84	2,617.44	2,617.44	2,617.44	2,617.44	2,617.44
2C1 Iron and Steel Production											
2C2 Ferroalloys Production											
2C3 Aluminium production	NO	NO	206.64	1,239.84	1,239.84	1,239.84	2,617.44	2,617.44	2,617.44	2,617.44	2,617.44
2C4 Magnesium production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C5 Lead Production											
2C6 Zinc Production											
2C7 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years: 2009 – 2019 (2 of 2)

Categories	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
2D Non-Energy Products from Fuels and Solvent Use											
2D1 Lubricant Use											
2D2 Paraffin Wax Use											
2D3 Solvent Use											
2D4 Other (please specify)											
2E Electronics Industry	1,038.97	1,138.79	1,238.60	1,336.17	1,428.73	1,783.74	2,077.02	2,358.84	2,358.84	2,358.84	2,358.84
2E1 Integrated Circuit or Semiconductor	1,038.97	1,138.79	1,238.60	1,270.06	1,318.91	1,271.98	1,272.02	1,425.89	1,425.89	1,425.89	1,425.89
2E2 TFT Flat Panel Display	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E3 Photovoltaics	IE	IE	IE	66.11	109.82	511.75	805.00	932.95	932.95	932.95	932.95
2E4 Heat Transfer Fluid											
2E5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F Product Uses as Substitutes for Ozone Depleting Substances	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO
2F1 Refrigeration and Air Conditioning	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE
2F2 Foam Blowing Agents	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F3 Fire Protection	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F4 Aerosols	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F5 Solvents	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2F6 Other Applications (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2G Other Product Manufacture and Use	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
2G1 Electrical Equipment	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2G2 SF6 and PFCs from Other Product Uses	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
2G3 N_2O from Product Uses											
2G4 Other (Please specify)											
2H Other											
2H1 Pulp and Paper Industry											
2H2 Food and Beverages Industry											
2H3 Other (please specify)											

Table A - 23: Trends of SF_6 (CO_2 equivalents Gigagrams)
Years: 1990 – 1998 (1 of 2)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998
Total National Emissions and Removals	0.23	0.23	0.23	0.23	0.23	0.23	0.50	0.78	1.05
2 INDUSTRIAL PROCESSES AND PRODUCT USE	0.23	0.23	0.23	0.23	0.23	0.23	0.50	0.78	1.05
2A Mineral Industry									
2A1 Cement production									
2A2 Lime production									
2A3 Glass Production									
2A4 Other Process Uses of Carbonates									
2A5 Other (please specify)									
2B Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B1 Ammonia Production									
2B2 Nitric Acid Production									
2B3 Adipic Acid Production									
2B4 Caprolactam, Glyoxal and Glyoxylic Acid Production									
2B5 Carbide Production									
2B6 Titanium Dioxide Production									
2B7 Soda Ash Production									
2B8 Petrochemical and Carbon Black Production									
2B9 Fluorochemical Production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B10 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C Metal Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C1 Iron and Steel Production									
2C2 Ferroalloys Production									
2C3 Aluminium production									
2C4 Magnesium production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C5 Lead Production									
2C6 Zinc Production									
2C7 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years: 1990 – 1998 (2 of 2)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998
2D Non-Energy Products from Fuels and Solvent Use									
2D1 Lubricant Use									
2D2 Paraffin Wax Use									
2D3 Solvent Use									
2D4 Other (please specify)									
2E Electronics Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E1 Integrated Circuit or Semiconductor	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E2 TFT Flat Panel Display	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E3 Photovoltaics	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E4 Heat Transfer Fluid									
2E5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F Product Uses as Substitutes for Ozone Depleting Substances									
2F1 Refrigeration and Air Conditioning									
2F2 Foam Blowing Agents									
2F3 Fire Protection									
2F4 Aerosols									
2F5 Solvents									
2F6 Other Applications (please specify)									
2G Other Product Manufacture and Use	0.23	0.23	0.23	0.23	0.23	0.23	0.50	0.78	1.05
2G1 Electrical Equipment	0.23	0.23	0.23	0.23	0.23	0.23	0.50	0.78	1.05
2G2 SF6 and PFCs from Other Product Uses	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
2G3 N2O from Product Uses									
2G4 Other (Please specify)									
2H Other									
2H1 Pulp and Paper Industry									
2H2 Food and Beverages Industry									
2H3 Other (please specify)									

Years: 1999 – 2008 (1 of 2)

Categories	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Total National Emissions and Removals	1.32	310.12	306.02	306.48	306.48	306.93	319.02	313.27	311.48	311.47
2 INDUSTRIAL PROCESSES AND PRODUCT USE	1.32	310.12	306.02	306.48	306.48	306.93	319.02	313.27	311.48	311.47
2A Mineral Industry										
2A1 Cement production										
2A2 Lime production										
2A3 Glass Production										
2A4 Other Process Uses of Carbonates										
2A5 Other (please specify)										
2B Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B1 Ammonia Production										
2B2 Nitric Acid Production										
2B3 Adipic Acid Production										
2B4 Caprolactam, Glyoxal and Glyoxylic Acid Production										
2B5 Carbide Production										
2B6 Titanium Dioxide Production										
2B7 Soda Ash Production										
2B8 Petrochemical and Carbon Black Production										
2B9 Fluorochemical Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B10 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C Metal Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C1 Iron and Steel Production										
2C2 Ferroalloys Production										
2C3 Aluminium production										
2C4 Magnesium production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C5 Lead Production										
2C6 Zinc Production										
2C7 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years: 1999 – 2008 (2 of 2)

Categories	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2D Non-Energy Products from Fuels and Solvent Use										
2D1 Lubricant Use										
2D2 Paraffin Wax Use										
2D3 Solvent Use										
2D4 Other (please specify)										
2E Electronics Industry	NO	304.20	304.20	304.20	304.20	304.20	304.20	304.20	304.20	304.20
2E1 Integrated Circuit or Semiconductor	NO	304.20	304.20	304.20	304.20	304.20	304.20	304.20	304.20	304.20
2E2 TFT Flat Panel Display	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E3 Photovoltaics	NO	NA	NA	NA	NA	NA	NA	NA	NA	NA
2E4 Heat Transfer Fluid										
2E5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F Product Uses as Substitutes for Ozone Depleting Substances										
2F1 Refrigeration and Air Conditioning										
2F2 Foam Blowing Agents										
2F3 Fire Protection										
2F4 Aerosols										
2F5 Solvents										
2F6 Other Applications (please specify)										
2G Other Product Manufacture and Use	1.32	5.93	1.82	2.28	2.28	2.74	14.82	9.07	7.28	7.27
2G1 Electrical Equipment	1.32	5.93	1.82	2.28	2.28	2.74	14.82	9.07	7.28	7.27
2G2 SF6 and PFCs from Other Product Uses	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
2G3 N2O from Product Uses										
2G4 Other (Please specify)										
2H Other										
2H1 Pulp and Paper Industry										
2H2 Food and Beverages Industry										
2H3 Other (please specify)										

Years: 2009 – 2019 (1 of 2)

Categories	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Total National Emissions and Removals	313.85	315.42	317.42	309.54	324.41	316.50	311.02	348.17	468.83	476.30	483.76
2 INDUSTRIAL PROCESSES AND PRODUCT USE	313.85	315.42	317.42	309.54	324.41	316.50	311.02	348.17	468.83	476.30	483.76
2A Mineral Industry											
2A1 Cement production											
2A2 Lime production											
2A3 Glass Production											
2A4 Other Process Uses of Carbonates											
2A5 Other (please specify)											
2B Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B1 Ammonia Production											
2B2 Nitric Acid Production											
2B3 Adipic Acid Production											
2B4 Caprolactam, Glyoxal and Glyoxylic Acid Production											
2B5 Carbide Production											
2B6 Titanium Dioxide Production											
2B7 Soda Ash Production											
2B8 Petrochemical and Carbon Black Production											
2B9 Fluorochemical Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B10 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C Metal Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C1 Iron and Steel Production											
2C2 Ferroalloys Production											
2C3 Aluminium production											
2C4 Magnesium production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C5 Lead Production											
2C6 Zinc Production											
2C7 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years: 2009 – 2019 (2 of 2)

Categories	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
2D Non-Energy Products from Fuels and Solvent Use											
2D1 Lubricant Use											
2D2 Paraffin Wax Use											
2D3 Solvent Use											
2D4 Other (please specify)											
2E Electronics Industry	304.20	304.20	304.20	300.19	311.74	300.50	300.66	337.03	337.03	337.03	337.03
2E1 Integrated Circuit or Semiconductor	304.20	304.20	304.20	300.19	311.74	300.50	300.66	337.03	337.03	337.03	337.03
2E2 TFT Flat Panel Display	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E3 Photovoltaics	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2E4 Heat Transfer Fluid											
2E5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F Product Uses as Substitutes for Ozone Depleting Substances											
2F1 Refrigeration and Air Conditioning											
2F2 Foam Blowing Agents											
2F3 Fire Protection											
2F4 Aerosols											
2F5 Solvents											
2F6 Other Applications (please specify)											
2G Other Product Manufacture and Use	9.65	11.23	13.22	9.35	12.67	16.00	10.36	11.14	131.81	139.27	146.74
2G1 Electrical Equipment	9.65	11.23	13.22	9.35	12.67	16.00	10.36	11.14	131.81	139.27	146.74
2G2 SF6 and PFCs from Other Product Uses	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
2G3 N2O from Product Uses											
2G4 Other (Please specify)											
2H Other											
2H1 Pulp and Paper Industry											
2H2 Food and Beverages Industry											
2H3 Other (please specify)											

Table A - 24: Trends of Other Gases (NF_3) (CO_2 equivalents Gigagrams)
Years: 1990 – 1998 (1 of 2)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998
Total National Emissions and Removals	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
2 INDUSTRIAL PROCESSES AND PRODUCT USE	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
2A Mineral Industry									
2A1 Cement production									
2A2 Lime production									
2A3 Glass Production									
2A4 Other Process Uses of Carbonates									
2A5 Other (please specify)									
2B Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B1 Ammonia Production									
2B2 Nitric Acid Production									
2B3 Adipic Acid Production									
2B4 Caprolactam, Glyoxal and Glyoxylic Acid Production									
2B5 Carbide Production									
2B6 Titanium Dioxide Production									
2B7 Soda Ash Production									
2B8 Petrochemical and Carbon Black Production									
2B9 Fluorochemical Production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B10 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C Metal Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C1 Iron and Steel Production									
2C2 Ferroalloys Production									
2C3 Aluminium production									
2C4 Magnesium production	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C5 Lead Production									
2C6 Zinc Production									
2C7 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years: 1990 – 1998 (2 of 2)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998
2D Non-Energy Products from Fuels and Solvent Use									
2D1 Lubricant Use									
2D2 Paraffin Wax Use									
2D3 Solvent Use									
2D4 Other (please specify)									
2E Electronics Industry	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
2E1 Integrated Circuit or Semiconductor	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E2 TFT Flat Panel Display	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E3 Photovoltaics	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E4 Heat Transfer Fluid	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F Product Uses as Substitutes for Ozone Depleting Substances	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2F1 Refrigeration and Air Conditioning	NA	NA	NA	NA	NA	NA	NA	NA	NA
2F2 Foam Blowing Agents	NA	NA	NA	NA	NA	NA	NA	NA	NA
2F3 Fire Protection	NA	NA	NA	NA	NA	NA	NA	NA	NA
2F4 Aerosols	NA	NA	NA	NA	NA	NA	NA	NA	NA
2F5 Solvents	NA	NA	NA	NA	NA	NA	NA	NA	NA
2F6 Other Applications	NO	NO	NO	NO	NO	NO	NO	NO	NO
2G Other Product Manufacture and Use	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2G1 Electrical Equipment	NA	NA	NA	NA	NA	NA	NA	NA	NA
2G2 SF6 and PFCs from Other Product Uses	NA,NO	NA	NA	NA	NA	NA	NA	NA	NA
2G3 N2O from Product Uses									
2G4 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO
2H Other									
2H1 Pulp and Paper Industry									
2H2 Food and Beverages Industry									
2H3 Other (please specify)									

Years: 1999 – 2008 (1 of 2)

Categories	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Total National Emissions and Removals	NA, NO	45.90	45.90	45.90	45.90	45.90	45.90	45.90	45.90	45.90
2 INDUSTRIAL PROCESSES AND PRODUCT USE	NA, NO	45.90	45.90	45.90	45.90	45.90	45.90	45.90	45.90	45.90
2A Mineral Industry										
2A1 Cement production										
2A2 Lime production										
2A3 Glass Production										
2A4 Other Process Uses of Carbonates										
2A5 Other (please specify)										
2B Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B1 Ammonia Production										
2B2 Nitric Acid Production										
2B3 Adipic Acid Production										
2B4 Caprolactam, Glyoxal and Glyoxylic Acid Production										
2B5 Carbide Production										
2B6 Titanium Dioxide Production										
2B7 Soda Ash Production										
2B8 Petrochemical and Carbon Black Production										
2B9 Fluorochemical Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B10 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C Metal Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C1 Iron and Steel Production										
2C2 Ferroalloys Production										
2C3 Aluminium production										
2C4 Magnesium production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C5 Lead Production										
2C6 Zinc Production										
2C7 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years: 1999 – 2008 (2 of 2)

Categories	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2D Non-Energy Products from Fuels and Solvent Use										
2D1 Lubricant Use										
2D2 Paraffin Wax Use										
2D3 Solvent Use										
2D4 Other (please specify)										
2E Electronics Industry	NA, NO	45.90	45.90	45.90	45.90	45.90	45.90	45.90	45.90	45.90
2E1 Integrated Circuit or Semiconductor	NO	45.90	45.90	45.90	45.90	45.90	45.90	45.90	45.90	45.90
2E2 TFT Flat Panel Display	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E3 Photovoltaics	NO	NA	NA	NA	NA	NA	NA	NA	NA	NA
2E4 Heat Transfer Fluid	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F Product Uses as Substitutes for Ozone Depleting Substances	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2F1 Refrigeration and Air Conditioning	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2F2 Foam Blowing Agents	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2F3 Fire Protection	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2F4 Aerosols	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2F5 Solvents	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2F6 Other Applications	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2G Other Product Manufacture and Use	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2G1 Electrical Equipment	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2G2 SF6 and PFCs from Other Product Uses	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2G3 N2O from Product Uses										
2G4 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2H Other										
2H1 Pulp and Paper Industry										
2H2 Food and Beverages Industry										
2H3 Other (please specify)										

Years: 2009 – 2019 (1 of 2)

Categories	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Total National Emissions and Removals	45.90	45.90	45.90	45.29	47.03	45.36	45.36	50.85	50.85	50.85	50.85
2 INDUSTRIAL PROCESSES AND PRODUCT USE	45.90	45.90	45.90	45.29	47.03	45.36	45.36	50.85	50.85	50.85	50.85
2A Mineral Industry											
2A1 Cement production											
2A2 Lime production											
2A3 Glass Production											
2A4 Other Process Uses of Carbonates											
2A5 Other (please specify)											
2B Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B1 Ammonia Production											
2B2 Nitric Acid Production											
2B3 Adipic Acid Production											
2B4 Caprolactam, Glyoxal and Glyoxylic Acid Production											
2B5 Carbide Production											
2B6 Titanium Dioxide Production											
2B7 Soda Ash Production											
2B8 Petrochemical and Carbon Black Production											
2B9 Fluorochemical Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B10 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C Metal Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C1 Iron and Steel Production											
2C2 Ferroalloys Production											
2C3 Aluminium production											
2C4 Magnesium production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C5 Lead Production											
2C6 Zinc Production											
2C7 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Years: 2009 – 2019 (2 of 2)

Categories	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
2D Non-Energy Products from Fuels and Solvent Use											
2D1 Lubricant Use											
2D2 Paraffin Wax Use											
2D3 Solvent Use											
2D4 Other (please specify)											
2E Electronics Industry	45.90	45.90	45.90	45.29	47.03	45.36	45.36	50.85	50.85	50.85	50.85
2E1 Integrated Circuit or Semiconductor	45.90	45.90	45.90	45.29	47.03	45.36	45.36	50.85	50.85	50.85	50.85
2E2 TFT Flat Panel Display	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E3 Photovoltaics	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2E4 Heat Transfer Fluid	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F Product Uses as Substitutes for Ozone Depleting Substances	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2F1 Refrigeration and Air Conditioning	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2F2 Foam Blowing Agents	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2F3 Fire Protection	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2F4 Aerosols	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2F5 Solvents	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2F6 Other Applications	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2G Other Product Manufacture and Use	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2G1 Electrical Equipment	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2G2 SF6 and PFCs from Other Product Uses	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2G3 N2O from Product Uses											
2G4 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2H Other											
2H1 Pulp and Paper Industry											
2H2 Food and Beverages Industry											
2H3 Other (please specify)											

Table A - 25a: Approach 1 Level Assessment for Greenhouse Gas Inventory Year 2019 - Excluding LULUCF Year 2019 (1 of 4)

Sector	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2019 Year Estimate (Gg CO_2 Eq)	Level Assessment (%)	Cumulative (%)
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Solid Fuels	CO2	73,653.01	22.29%	22.29%
ENERGY	1.A.3.b	Road Transportation - Liquid Fuels	CO2	53,995.92	16.34%	38.64%
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Gaseous Fuels	CO2	33,811.76	10.23%	48.87%
ENERGY	1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	CO2	18,087.71	5.48%	54.35%
WASTE	4.D.2	Industrial Wastewater Treatment and Discharge	CH4	14,462.46	4.38%	58.73%
ENERGY	1.A.1.c	Manufacturing of Solid Fuels and Other Energy Industries - Gaseous Fuels	CO2	13,724.22	4.15%	62.88%
WASTE	4.A	Solid Waste Disposal	CH4	11,681.20	3.54%	66.42%
ENERGY	1.B.2.a	Oil	CH4	10,750.91	3.25%	69.67%
IPPU	2.A.1	Cement production	CO2	9,120.65	2.76%	72.43%
ENERGY	1.A.2	Manufacturing Industries and Construction - Liquid Fuels	CO2	8,535.30	2.58%	75.02%
ENERGY	1.A.1.b	Petroleum Refining - Liquid Fuels	CO2	8,200.82	2.48%	77.50%
IPPU	2.C.1	Iron and Steel Production	CO2	7,543.24	2.28%	79.78%
ENERGY	1.B.2.b	Natural Gas	CH4	7,091.00	2.15%	81.93%
ENERGY	1.A.2	Manufacturing Industries and Construction - Solid Fuels	CO2	6,859.53	2.08%	84.01%
ENERGY	1.A.3.d	Domestic Water-borne Navigation - Liquid Fuels	CO2	5,650.38	1.71%	85.72%
ENERGY	1.B.2.a	Oil	CO2	4,335.70	1.31%	87.03%
IPPU	2.B.8	Petrochemical and Carbon Black Production	CO2	4,170.48	1.26%	88.29%
AFOLU-Agriculture	3.C.4	Direct N2O Emissions from managed soils	N2O	3,736.73	1.13%	89.42%
ENERGY	1.A.4.c	Agriculture/ Fishery/ Forestry - Liquid Fuels	CO2	2,686.54	0.81%	90.23%
ENERGY	1.A.3.e	Other tranportation	CO2	2,377.14	0.72%	90.95%
AFOLU-Agriculture	3.C.7	Rice cultivation	CH4	2,268.98	0.69%	91.64%
IPPU	2.C.3	Aluminium production	PFC-14	2,246.56	0.68%	92.32%
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Liquid Fuels	CO2	1,884.53	0.57%	92.89%
WASTE	4.D.1	Domestic Wastewater Treatment and Discharge	CH4	1,687.08	0.51%	93.40%
IPPU	2C2	Ferroalloys Production	CO2	1,680.43	0.51%	93.91%
ENERGY	1.A.4.b	Residential - Liquid Fuels	CO2	1,647.73	0.50%	94.41%
ENERGY	1.A.4.a	Commercial/Institutional - Liquid Fuels	CO2	1,646.37	0.50%	94.91%
ENERGY	1.A.3.a	Domestic Aviation - Liquid Fuels	CO2	1,276.23	0.39%	95.29%

Year 2019 (2 of 4)

Sector	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2019 Year Estimate (Gg CO_2 Eq)	Level Assessment (%)	Cumulative (%)
AFOLU-Agriculture	3.A.1	Enteric Fermentation	CH4	1,224.46	0.37%	95.66%
IPPU	2.B.1	Ammonia Production	CO2	1,224.16	0.37%	96.04%
IPPU	2.C.3	Aluminium production	CO2	1,216.00	0.37%	96.40%
AFOLU-Agriculture	3.C.5	Indirect N2O Emissions from managed soils	N2O	1,053.28	0.32%	96.72%
IPPU	2.F.1.b	Refrigeration and Air Conditioning - Mobile Air Conditioning	HFC-134a	929.77	0.28%	97.00%
IPPU	2.E.1	Electronic Industry - Integrated Circuit or Semiconductor	PFC-116	901.69	0.27%	97.28%
IPPU	2.E.3	Electronic Industry - Photovoltaics	PFC-14	875.15	0.26%	97.54%
ENERGY	1.A.3.b	Road Transportation - Liquid Fuels	N2O	775.24	0.23%	97.78%
AFOLU-Agriculture	3.C.6	Indirect N2O Emissions from manure management	N2O	541.90	0.16%	97.94%
AFOLU-Agriculture	3.A.2	Manure Management	CH4	539.49	0.16%	98.10%
IPPU	2.A.4	Other Process Uses of Carbonates - Limestone and Dolomite	CO2	494.90	0.15%	98.25%
IPPU	2.E.1	Electronic Industry - Integrated Circuit or Semiconductor	PFC-14	491.57	0.15%	98.40%
ENERGY	1.A.5	Non-Specified - Liquid Fuels	CO2	487.76	0.15%	98.55%
ENERGY	1.A.3.b	Road Transportation - Liquid Fuels	CH4	465.40	0.14%	98.69%
AFOLU-Agriculture	3.C.3	Urea application	CO2	389.89	0.12%	98.81%
WASTE	4.D.1	Domestic Wastewater Treatment and Discharge	N2O	378.14	0.11%	98.92%
IPPU	2.C.3	Aluminium production	PFC-116	370.88	0.11%	99.04%
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Solid Fuels	N2O	343.98	0.10%	99.14%
IPPU	2.A.3	Glass Production	CO2	340.52	0.10%	99.24%
IPPU	2.E.1	Electronic Industry - Integrated Circuit or Semiconductor	SF6	337.03	0.10%	99.34%
IPPU	2.B.8	Petrochemical and Carbon Black Production	CH4	327.77	0.10%	99.44%
ENERGY	1.B.2.b	Natural Gas	CO2	264.54	0.08%	99.52%
ENERGY	1.A.3.b	Road Transportation - Gaseous Fuels	CO2	230.03	0.07%	99.59%
IPPU	2.G.1	Other Product Manufacture and Use - Electrical Equipment	SF6	146.74	0.04%	99.64%
IPPU	2.A.2	Lime production	CO2	128.96	0.04%	99.68%
AFOLU-Agriculture	3.A.2	Manure Management	N2O	120.61	0.04%	99.71%
IPPU	2.G.3.b	Other Product Manufacture and Use - N2O in Medical Applications	N2O	60.07	0.02%	99.73%
IPPU	2.E.3	Electronic Industry - Photovoltaics	PFC-116	57.79	0.02%	99.75%

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Sector	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2019 Year Estimate (Gg CO_2 Eq)	Level Assessment (%)	Cumulative (%)
ENERGY	1.A.4.a	Commercial/Institutional - Gaseous Fuels	CO2	53.99	0.02%	99.77%
IPPU	2.E.1	Electronic Industry - Integrated Circuit or Semiconductor	NF3	50.85	0.02%	99.78%
ENERGY	1.A.3.c	Railways - Liquid Fuels	CO2	46.69	0.01%	99.80%
ENERGY	1.A.3.d	Domestic Water-borne Navigation - Liquid Fuels	N2O	45.45	0.01%	99.81%
IPPU	2.E.1	Electronic Industry - Integrated Circuit or Semiconductor	HFC-23	43.75	0.01%	99.82%
WASTE	4.C.1	Waste Incineration	CO2	42.09	0.01%	99.84%
IPPU	2.B.5	Carbide Production	CO2	38.02	0.01%	99.85%
ENERGY	1.A.3.e	Other tranportation	N2O	32.71	0.01%	99.86%
IPPU	2.E.1	Electronic Industry - Integrated Circuit or Semiconductor	PFC-218	32.63	0.01%	99.87%
ENERGY	1.A.2	Manufacturing Industries and Construction - Solid Fuels	N2O	31.91	0.01%	99.88%
ENERGY	1.A.3.e	Other tranportation	CH4	28.30	0.01%	99.88%
ENERGY	1.B.1	Solid	CH4	23.75	0.01%	99.89%
AFOLU-Agriculture	3.C.2	Liming	CO2	21.67	0.01%	99.90%
ENERGY	1.A.1.b	Petroleum Refining - Liquid Fuels	N2O	20.00	0.01%	99.90%
ENERGY	1.A.2	Manufacturing Industries and Construction - Liquid Fuels	N2O	19.84	0.01%	99.91%
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Solid Fuels	CH4	19.24	0.01%	99.92%
AFOLU-Agriculture	3.C.1	Emissions from biomass burning in croplands	CH4	18.52	0.01%	99.92%
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Gaseous Fuels	N2O	17.96	0.01%	99.93%
ENERGY	1.A.2	Manufacturing Industries and Construction - Solid Fuels	CH4	17.84	0.01%	99.93%
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Gaseous Fuels	CH4	15.07	0.00%	99.94%
ENERGY	1.B.2.a	Oil	N2O	14.85	0.00%	99.94%
IPPU	2C2	Ferroalloys Production	CH4	13.94	0.00%	99.95%
ENERGY	1.A.3.d	Domestic Water-borne Navigation - Liquid Fuels	CH4	13.34	0.00%	99.95%
ENERGY	1.A.3.a	Domestic Aviation - Liquid Fuels	N2O	10.64	0.00%	99.95%
ENERGY	1.A.1.a	Electricity Generation - Biomass	N2O	10.32	0.00%	99.96%
IPPU	2.C.1	Iron and Steel Production	CH4	10.26	0.00%	99.96%
ENERGY	1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	N2O	9.61	0.00%	99.96%
ENERGY	1.A.3.b	Road Transportation - Gaseous Fuels	CH4	9.43	0.00%	99.97%
ENERGY	1.A.4.c	Agriculture/ Fishery/ Forestry - Liquid Fuels	CH4	9.10	0.00%	99.97%
ENERGY	1.A.1.b	Petroleum Refining - Liquid Fuels	CH4	8.39	0.00%	99.97%
ENERGY	1.A.2	Manufacturing Industries and Construction - Liquid Fuels	CH4	8.39	0.00%	99.97%

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Sector	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2019 Year Estimate ($Gg\ CO_2\ Eq$)	Level Assessment (%)	Cumulative (%)
ENERGY	1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	CH4	8.06	0.00%	99.98%
ENERGY	1.A.1.c	Manufacturing of Solid Fuels and Other Energy Industries - Gaseous Fuels	N2O	7.29	0.00%	99.98%
ENERGY	1.A.1.a	Electricity Generation - Biomass	CH4	6.52	0.00%	99.98%
ENERGY	1.A.4.c	Agriculture/ Fishery/ Forestry - Liquid Fuels	N2O	6.51	0.00%	99.98%
AFOLU-Agriculture	3.C.1	Emissions from biomass burning in croplands	N2O	6.18	0.00%	99.98%
ENERGY	1.A.1.c	Manufacturing of Solid Fuels and Other Energy Industries - Gaseous Fuels	CH4	6.12	0.00%	99.99%
ENERGY	1.A.3.c	Railways - Liquid Fuels	N2O	5.37	0.00%	99.99%
ENERGY	1.A.4.a	Commercial/Institutional - Liquid Fuels	CH4	4.93	0.00%	99.99%
ENERGY	1.A.3.b	Road Transportation - Biomass	N2O	4.85	0.00%	99.99%
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Liquid Fuels	N2O	4.54	0.00%	99.99%
ENERGY	1.A.7	Non-Specified - Liquid Fuels	N2O	4.48	0.00%	99.99%
ENERGY	1.A.3.b	Road Transportation - Gaseous Fuels	N2O	3.67	0.00%	99.99%
ENERGY	1.A.4.b	Residential - Liquid Fuels	CH4	3.30	0.00%	99.99%
ENERGY	1.A.4.a	Commercial/Institutional - Liquid Fuels	N2O	3.12	0.00%	100.00%
WASTE	4.C.1	Waste Incineration	N2O	2.42	0.00%	100.00%
ENERGY	1.A.4.b	Residential -Gaseous Fuels	CO2	2.35	0.00%	100.00%
ENERGY	1.A.3.b	Road Transportation - Biomass	CH4	2.03	0.00%	100.00%
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Liquid Fuels	CH4	1.90	0.00%	100.00%
WASTE	4.C.2	Open Burning of Waste	CH4	1.88	0.00%	100.00%
ENERGY	1.B.2.b	Natural Gas	N2O	0.87	0.00%	100.00%
ENERGY	1.A.4.b	Residential - Liquid Fuels	N2O	0.83	0.00%	100.00%
WASTE	4.C.2	Open Burning of Waste	**CO2**	0.68	0.00%	100.00%
ENERGY	1.A.6	Non-Specified - Liquid Fuels	CH4	0.35	0.00%	100.00%
WASTE	4.B	Biological Treatment of Solid Waste	CH4	0.24	0.00%	100.00%
ENERGY	1.A.3.a	Domestic Aviation - Liquid Fuels	CH4	0.22	0.00%	100.00%
WASTE	4.C.2	Open Burning of Waste	N2O	0.22	0.00%	100.00%
WASTE	4.B	Biological Treatment of Solid Waste	N2O	0.17	0.00%	100.00%
ENERGY	1.A.4.a	Commercial/Institutional - Gaseous Fuels	CH4	0.12	0.00%	100.00%
ENERGY	1.A.3.c	Railways - Liquid Fuels	CH4	0.07	0.00%	100.00%
ENERGY	1.A.4.a	Commercial/Institutional - Gaseous Fuels	N2O	0.03	0.00%	100.00%
ENERGY	1.A.4.b	Residential -Gaseous Fuels	CH4	0.01	0.00%	100.00%
ENERGY	1.A.4.b	Residential - Gaseous Fuels	N2O	0.00	0.00%	100.00%
IPPU	2.B.2	Nitric Acid Production	N2O	0.00	0.00%	100.00%

Table A – 25b: Approach 1 Level Assessment for Greenhouse Gas Inventory Year 2019 - Including LULUCF Year 2019 (1 of 4)

Name	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2019 Year Estimate ($Gg\ CO_2\ Eq$)	|D|	Level Assessment (%)	Cumulative (%)
AFOLU-LULUCF	3.B.1	Forest land Remaining Forest land	CO2	-237,008.39	237,008.39	37.80%	37.80%
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Solid Fuels	CO2	73,653.01	73,653.01	11.75%	49.55%
ENERGY	1.A.3.b	Road Transportation - Liquid Fuels	CO2	53,995.92	53,995.92	8.61%	58.16%
AFOLU-LULUCF	3.B.5.b	Forest land converted to settlement	CO2	35,564.03	35,564.03	5.67%	63.83%
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Gaseous Fuels	CO2	33,811.76	33,811.76	5.39%	69.23%
AFOLU-LULUCF	3.B.2	Cropland Remaining Cropland	CO2	-18,662.58	18,662.58	2.98%	72.20%
ENERGY	1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	CO2	18,087.71	18,087.71	2.88%	75.09%
WASTE	4.D.2	Industrial Wastewater Treatment and Discharge	CH4	14,462.46	14,462.46	2.31%	77.39%
ENERGY	1.A.1.c	Manufacturing of Solid Fuels and Other Energy Industries - Gaseous Fuels	CO2	13,724.22	13,724.22	2.19%	79.58%
WASTE	4.A	Solid Waste Disposal	CH4	11,681.20	11,681.20	1.86%	81.45%
ENERGY	1.B.2.a	Oil	CH4	10,750.91	10,750.91	1.71%	83.16%
IPPU	2.A.1	Cement production	CO2	9,120.65	9,120.65	1.45%	84.61%
ENERGY	1.A.2	Manufacturing Industries and Construction - Liquid Fuels	CO2	8,535.30	8,535.30	1.36%	85.98%
ENERGY	1.A.1.b	Petroleum Refining - Liquid Fuels	CO2	8,200.82	8,200.82	1.31%	87.28%
IPPU	2.C.1	Iron and Steel Production	CO2	7,543.24	7,543.24	1.20%	88.49%
ENERGY	1.B.2.b	Natural Gas	CH4	7,091.00	7,091.00	1.13%	89.62%
ENERGY	1.A.2	Manufacturing Industries and Construction - Solid Fuels	CO2	6,859.53	6,859.53	1.09%	90.71%
ENERGY	1.A.3.d	Domestic Water-borne Navigation - Liquid Fuels	CO2	5,650.38	5,650.38	0.90%	91.61%
AFOLU-LULUCF	3.B.5.b	Cropland converted to settlement	CO2	5,290.91	5,290.91	0.84%	92.46%
ENERGY	1.B.2.a	Oil	CO2	4,335.70	4,335.70	0.69%	93.15%
IPPU	2.B.8	Petrochemical and Carbon Black Production	CO2	4,170.48	4,170.48	0.67%	93.81%
AFOLU-Agriculture	3.C.4	Direct N2O Emissions from managed soils	N2O	3,736.73	3,736.73	0.60%	94.41%
ENERGY	1.A.4.c	Agriculture/ Fishery/ Forestry - Liquid Fuels	CO2	2,686.54	2,686.54	0.43%	94.84%
ENERGY	1.A.3.e	Other tranportation	CO2	2,377.14	2,377.14	0.38%	95.22%

Year 2019 (2 of 4)

Name	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2019 Year Estimate ($Gg\ CO_2\ Eq$)	|D|	Level Assessment (%)	Cumulative (%)
AFOLU-Agriculture	3.C.7	Rice cultivation	CH4	2,268.98	2,268.98	0.36%	95.58%
IPPU	2.C.3	Aluminium production	PFC-14	2,246.56	2,246.56	0.36%	95.94%
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Liquid Fuels	CO2	1,884.53	1,884.53	0.30%	96.24%
WASTE	4.D.1	Domestic Wastewater Treatment and Discharge	CH4	1,687.08	1,687.08	0.27%	96.51%
IPPU	2C2	Ferroalloys Production	CO2	1,680.43	1,680.43	0.27%	96.78%
ENERGY	1.A.4.b	Residential - Liquid Fuels	CO2	1,647.73	1,647.73	0.26%	97.04%
ENERGY	1.A.4.a	Commercial/Institutional - Liquid Fuels	CO2	1,646.37	1,646.37	0.26%	97.30%
ENERGY	1.A.3.a	Domestic Aviation - Liquid Fuels	CO2	1,276.23	1,276.23	0.20%	97.50%
AFOLU-Agriculture	3.A.1	Enteric Fermentation	CH4	1,224.46	1,224.46	0.20%	97.70%
IPPU	2.B.1	Ammonia Production	CO2	1,224.16	1,224.16	0.20%	97.89%
IPPU	2.C.3	Aluminium production	CO2	1,216.00	1,216.00	0.19%	98.09%
AFOLU-Agriculture	3.C.5	Indirect N2O Emissions from managed soils	N2O	1,053.28	1,053.28	0.17%	98.26%
IPPU	2.F.1.b	Refrigeration and Air Conditioning - Mobile Air Conditioning	HFC-134a	929.77	929.77	0.15%	98.41%
IPPU	2.E.1	Electronic Industry - Integrated Circuit or Semiconductor	PFC-116	901.69	901.69	0.14%	98.55%
IPPU	2.E.3	Electronic Industry - Photovoltaics	PFC-14	875.15	875.15	0.14%	98.69%
ENERGY	1.A.3.b	Road Transportation - Liquid Fuels	N2O	775.24	775.24	0.12%	98.81%
AFOLU-Agriculture	3.C.6	Indirect N2O Emissions from manure management	N2O	541.90	541.90	0.09%	98.90%
AFOLU-Agriculture	3.A.2	Manure Management	CH4	539.49	539.49	0.09%	98.98%
IPPU	2.A.4	Other Process Uses of Carbonates - Limestone and Dolomite	CO2	494.90	494.90	0.08%	99.06%
IPPU	2.E.1	Electronic Industry - Integrated Circuit or Semiconductor	PFC-14	491.57	491.57	0.08%	99.14%
ENERGY	1.A.5	Non-Specified - Liquid Fuels	CO2	487.76	487.76	0.08%	99.22%
ENERGY	1.A.3.b	Road Transportation - Liquid Fuels	CH4	465.40	465.40	0.07%	99.29%
AFOLU-Agriculture	3.C.3	Urea application	CO2	389.89	389.89	0.06%	99.36%
WASTE	4.D.1	Domestic Wastewater Treatment and Discharge	N2O	378.14	378.14	0.06%	99.42%
IPPU	2.C.3	Aluminium production	PFC-116	370.88	370.88	0.06%	99.48%
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Solid Fuels	N2O	343.98	343.98	0.05%	99.53%
IPPU	2.A.3	Glass Production	CO2	340.52	340.52	0.05%	99.58%
IPPU	2.E.1	Electronic Industry - Integrated Circuit or Semiconductor	SF6	337.03	337.03	0.05%	99.64%
IPPU	2.B.8	Petrochemical and Carbon Black Production	CH4	327.77	327.77	0.05%	99.69%
ENERGY	1.B.2.b	Natural Gas	CO2	264.54	264.54	0.04%	99.73%
ENERGY	1.A.3.b	Road Transportation - Gaseous Fuels	CO2	230.03	230.03	0.04%	99.77%
IPPU	2.G.1	Other Product Manufacture and Use - Electrical Equipment	SF6	146.74	146.74	0.02%	99.79%
IPPU	2.A.2	Lime production	CO2	128.96	128.96	0.02%	99.81%
AFOLU-Agriculture	3.A.2	Manure Management	N2O	120.61	120.61	0.02%	99.83%
AFOLU-LULUCF	3.B.2.b	Forest land converted to Cropland	CO2	101.49	101.49	0.02%	99.85%

Year 2019 (3 of 4)

Name	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2019 Year Estimate ($Gg\ CO_2\ Eq$)	|D|	Level Assessment (%)	Cumulative (%)
IPPU	2.G.3.b	Other Product Manufacture and Use - N2O in Medical Applications	N2O	60.07	60.07	0.01%	99.86%
IPPU	2.E.3	Electronic Industry - Photovoltaics	PFC-116	57.79	57.79	0.01%	99.87%
ENERGY	1.A.4.a	Commercial/Institutional - Gaseous Fuels	CO2	53.99	53.99	0.01%	99.88%
IPPU	2.E.1	Electronic Industry - Integrated Circuit or Semiconductor	NF3	50.85	50.85	0.01%	99.88%
ENERGY	1.A.3.c	Railways - Liquid Fuels	CO2	46.69	46.69	0.01%	99.89%
ENERGY	1.A.3.d	Domestic Water-borne Navigation - Liquid Fuels	N2O	45.45	45.45	0.01%	99.90%
IPPU	2.E.1	Electronic Industry - Integrated Circuit or Semiconductor	HFC-23	43.75	43.75	0.01%	99.91%
WASTE	4.C.1	Waste Incineration	CO2	42.09	42.09	0.01%	99.91%
IPPU	2.B.5	Carbide Production	CO2	38.02	38.02	0.01%	99.92%
ENERGY	1.A.3.e	Other tranportation	N2O	32.71	32.71	0.01%	99.92%
IPPU	2.E.1	Electronic Industry - Integrated Circuit or Semiconductor	PFC-218	32.63	32.63	0.01%	99.93%
ENERGY	1.A.2	Manufacturing Industries and Construction - Solid Fuels	N2O	31.91	31.91	0.01%	99.93%
ENERGY	1.A.3.e	Other tranportation	CH4	28.30	28.30	0.00%	99.94%
ENERGY	1.B.1	Solid	CH4	23.75	23.75	0.00%	99.94%
AFOLU-Agriculture	3.C.2	Liming	CO2	21.67	21.67	0.00%	99.95%
ENERGY	1.A.1.b	Petroleum Refining - Liquid Fuels	N2O	20.00	20.00	0.00%	99.95%
ENERGY	1.A.2	Manufacturing Industries and Construction - Liquid Fuels	N2O	19.84	19.84	0.00%	99.95%
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Solid Fuels	CH4	19.24	19.24	0.00%	99.96%
AFOLU-Agriculture	3.C.1	Emissions from biomass burning in croplands	CH4	18.52	18.52	0.00%	99.96%
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Gaseous Fuels	N2O	17.96	17.96	0.00%	99.96%
ENERGY	1.A.2	Manufacturing Industries and Construction - Solid Fuels	CH4	17.84	17.84	0.00%	99.96%
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Gaseous Fuels	CH4	15.07	15.07	0.00%	99.97%
ENERGY	1.B.2.a	Oil	N2O	14.85	14.85	0.00%	99.97%
IPPU	2C2	Ferroalloys Production	CH4	13.94	13.94	0.00%	99.97%
ENERGY	1.A.3.d	Domestic Water-borne Navigation - Liquid Fuels	CH4	13.34	13.34	0.00%	99.97%
ENERGY	1.A.3.a	Domestic Aviation - Liquid Fuels	N2O	10.64	10.64	0.00%	99.98%
ENERGY	1.A.1.a	Electricity Generation - Biomass	N2O	10.32	10.32	0.00%	99.98%
IPPU	2.C.1	Iron and Steel Production	CH4	10.26	10.26	0.00%	99.98%
ENERGY	1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	N2O	9.61	9.61	0.00%	99.98%
ENERGY	1.A.3.b	Road Transportation - Gaseous Fuels	CH4	9.43	9.43	0.00%	99.98%
ENERGY	1.A.4.c	Agriculture/ Fishery/ Forestry - Liquid Fuels	CH4	9.10	9.10	0.00%	99.98%
ENERGY	1.A.1.b	Petroleum Refining - Liquid Fuels	CH4	8.39	8.39	0.00%	99.98%
ENERGY	1.A.2	Manufacturing Industries and Construction - Liquid Fuels	CH4	8.39	8.39	0.00%	99.99%
ENERGY	1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	CH4	8.06	8.06	0.00%	99.99%

Year 2019 (4 of 4)

Name	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2019 Year Estimate ($Gg\ CO_2\ Eq$)	|D|	Level Assessment (%)	Cumulative (%)
ENERGY	1.A.1.c	Manufacturing of Solid Fuels and Other Energy Industries - Gaseous Fuels	N2O	7.29	7.29	0.00%	99.99%
ENERGY	1.A.1.a	Electricity Generation - Biomass	CH4	6.52	6.52	0.00%	99.99%
ENERGY	1.A.4.c	Agriculture/ Fishery/ Forestry - Liquid Fuels	N2O	6.51	6.51	0.00%	99.99%
AFOLU-Agriculture	3.C.1	Emissions from biomass burning in croplands	N2O	6.18	6.18	0.00%	99.99%
ENERGY	1.A.1.c	Manufacturing of Solid Fuels and Other Energy Industries - Gaseous Fuels	CH4	6.12	6.12	0.00%	99.99%
ENERGY	1.A.3.c	Railways - Liquid Fuels	N2O	5.37	5.37	0.00%	99.99%
ENERGY	1.A.4.a	Commercial/Institutional - Liquid Fuels	CH4	4.93	4.93	0.00%	99.99%
ENERGY	1.A.3.b	Road Transportation - Biomass	N2O	4.85	4.85	0.00%	99.99%
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Liquid Fuels	N2O	4.54	4.54	0.00%	100.00%
ENERGY	1.A.7	Non-Specified - Liquid Fuels	N2O	4.48	4.48	0.00%	100.00%
ENERGY	1.A.3.b	Road Transportation - Gaseous Fuels	N2O	3.67	3.67	0.00%	100.00%
ENERGY	1.A.4.b	Residential - Liquid Fuels	CH4	3.30	3.30	0.00%	100.00%
ENERGY	1.A.4.a	Commercial/Institutional - Liquid Fuels	N2O	3.12	3.12	0.00%	100.00%
WASTE	4.C.1	Waste Incineration	N2O	2.42	2.42	0.00%	100.00%
ENERGY	1.A.4.b	Residential -Gaseous Fuels	CO2	2.35	2.35	0.00%	100.00%
ENERGY	1.A.3.b	Road Transportation - Biomass	CH4	2.03	2.03	0.00%	100.00%
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Liquid Fuels	CH4	1.90	1.90	0.00%	100.00%
WASTE	4.C.2	Open Burning of Waste	CH4	1.88	1.88	0.00%	100.00%
ENERGY	1.B.2.b	Natural Gas	N2O	0.87	0.87	0.00%	100.00%
ENERGY	1.A.4.b	Residential - Liquid Fuels	N2O	0.83	0.83	0.00%	100.00%
WASTE	4.C.2	Open Burning of Waste	CO2	0.68	0.68	0.00%	100.00%
ENERGY	1.A.6	Non-Specified - Liquid Fuels	CH4	0.35	0.35	0.00%	100.00%
WASTE	4.B	Biological Treatment of Solid Waste	CH4	0.24	0.24	0.00%	100.00%
ENERGY	1.A.3.a	Domestic Aviation - Liquid Fuels	CH4	0.22	0.22	0.00%	100.00%
WASTE	4.C.2	Open Burning of Waste	N2O	0.22	0.22	0.00%	100.00%
WASTE	4.B	Biological Treatment of Solid Waste	N2O	0.17	0.17	0.00%	100.00%
ENERGY	1.A.4.a	Commercial/Institutional - Gaseous Fuels	CH4	0.12	0.12	0.00%	100.00%
ENERGY	1.A.3.c	Railways - Liquid Fuels	CH4	0.07	0.07	0.00%	100.00%
ENERGY	1.A.4.a	Commercial/Institutional - Gaseous Fuels	N2O	0.03	0.03	0.00%	100.00%
ENERGY	1.A.4.b	Residential -Gaseous Fuels	CH4	0.01	0.01	0.00%	100.00%
ENERGY	1.A.4.b	Residential - Gaseous Fuels	N2O	0.00	0.00	0.00%	100.00%
IPPU	2.B.2	Nitric Acid Production	N2O	0.00	0.00	0.00%	100.00%

Table A - 26a: Approach 1 Trend Assessment for Greenhouse Gas Inventory Year 2019 - Excluding LULUCF Year 2019 (1 of 4)

Sector	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2005 Base Year Estimate (Gg CO_2 Eq)	2019 Year (Gg CO_2 Eq)	Trend Assessment (Txt)	Contribution to Trend (%)	Cumulative (%)
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Solid Fuels	CO2	22,279.39	73,653.01	0.18	28.33%	28.33%
ENERGY	1.A.1.c	Manufacturing of Solid Fuels and Other Energy Industries - Gaseous Fuels	CO2	26,744.27	13,724.22	0.09	13.85%	42.17%
ENERGY	1.A.2	Manufacturing Industries and Construction - Liquid Fuels	CO2	17,297.09	8,535.30	0.06	9.17%	51.35%
ENERGY	1.B.2.a	Oil	CH4	17,012.21	10,750.91	0.05	7.51%	58.86%
ENERGY	1.A.3.b	Road Transportation - Liquid Fuels	CO2	33,600.15	53,995.92	0.04	6.15%	65.01%
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Gaseous Fuels	CO2	30,969.27	33,811.76	0.03	4.55%	69.56%
IPPU	2.C.1	Iron and Steel Production	CO3	1,367.98	7,543.24	0.02	3.67%	73.24%
ENERGY	1.A.1.b	Petroleum Refining - Liquid Fuels	CO2	9,936.67	8,200.82	0.02	3.16%	76.40%
WASTE	4.D.2	Industrial Wastewater Treatment and Discharge	CH4	13,833.55	14,462.46	0.02	2.44%	78.84%
WASTE	4.A	Solid Waste Disposal	CH4	6,096.11	11,681.20	0.01	2.32%	81.16%
ENERGY	1.B.2.a	Oil	CO2	5,387.14	4,335.70	0.01	1.78%	82.95%
ENERGY	1.A.4.c	Agriculture/ Fishery/ Forestry - Liquid Fuels	CO2	313.42	2,686.54	0.01	1.46%	84.40%
IPPU	2.C.3	Aluminium production	PFC-14	0.00	2,246.56	0.01	1.44%	85.84%
IPPU	2C2	Ferroalloys Production	CO2	0.00	1,680.43	0.01	1.08%	86.92%
ENERGY	1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	CO2	12,480.19	18,087.71	0.01	1.02%	87.94%
ENERGY	1.B.2.b	Natural Gas	CH4	6,565.43	7,091.00	0.01	1.01%	88.96%
AFOLU-Agriculture	3.C.4	Direct N2O Emissions from managed soils	N2O	3,852.49	3,736.73	0.01	0.87%	89.82%
IPPU	2.C.3	Aluminium production	CO2	0.00	1,216.00	0.00	0.78%	90.60%
ENERGY	1.A.4.a	Commercial/Institutional - Liquid Fuels	CO2	2,156.27	1,646.37	0.00	0.77%	91.37%
ENERGY	1.A.4.b	Residential - Liquid Fuels	CO2	2,085.98	1,647.73	0.00	0.71%	92.08%
IPPU	2.A.1	Cement production	CO2	7,615.98	9,120.65	0.00	0.60%	92.69%
IPPU	2.E.1	Electronic Industry - Integrated Circuit or Semiconductor	PFC-116	0.00	901.69	0.00	0.58%	93.26%
IPPU	2.E.3	Electronic Industry - Photovoltaics	PFC-14	0.00	875.15	0.00	0.56%	93.83%
AFOLU-Agriculture	3.A.1	Enteric Fermentation	CH4	1,452.12	1,224.46	0.00	0.44%	94.27%
IPPU	2.B.8	Petrochemical and Carbon Black Production	CO2	2,633.90	4,170.48	0.00	0.44%	94.71%
WASTE	4.D.1	Domestic Wastewater Treatment and Discharge	CH4	1,731.03	1,687.08	0.00	0.38%	95.10%

Year 2019 (2 of 4)

Sector	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2005 Base Year Estimate ($Gg\ CO_2\ Eq$)	2019 Year ($Gg\ CO_2\ Eq$)	Trend Assessment (Txt)	Contribution to Trend (%)	Cumulative (%)
AFOLU-Agriculture	3.C.7	Rice cultivation	CH4	2,118.20	2,268.98	0.00	0.34%	95.44%
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Liquid Fuels	CO2	1,820.67	1,884.53	0.00	0.33%	95.77%
ENERGY	1.A.3.e	Other tranportation	CO2	1,409.64	2,377.14	0.00	0.33%	96.10%
AFOLU-Agriculture	3.C.5	Indirect N2O Emissions from managed soils	N2O	1,185.79	1,053.28	0.00	0.33%	96.43%
ENERGY	1.A.3.d	Domestic Water-borne Navigation - Liquid Fuels	CO2	3,947.29	5,650.38	0.00	0.28%	96.71%
IPPU	2.C.3	Aluminium production	PFC-116	0.00	370.88	0.00	0.24%	96.94%
AFOLU-Agriculture	3.C.3	Urea application	CO2	575.07	389.89	0.00	0.24%	97.18%
IPPU	2.E.1	Electronic Industry - Integrated Circuit or Semiconductor	PFC-14	639.71	491.57	0.00	0.23%	97.41%
ENERGY	1.A.3.a	Domestic Aviation - Liquid Fuels	CO2	1,202.61	1,276.23	0.00	0.20%	97.61%
IPPU	2.A.3	Glass Production	CO2	28.34	340.52	0.00	0.19%	97.80%
ENERGY	1.A.2	Manufacturing Industries and Construction - Solid Fuels	CO2	5,420.07	6,859.53	0.00	0.19%	98.00%
IPPU	2.F.1.b	Refrigeration and Air Conditioning - Mobile Air Conditioning	HFC-134a	479.34	929.77	0.00	0.19%	98.19%
IPPU	2.B.2	Nitric Acid Production	N2O	217.09	0.00	0.00	0.18%	98.37%
IPPU	2.A.4	Other Process Uses of Carbonates - Limestone and Dolomite	CO2	178.68	494.90	0.00	0.17%	98.54%
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Solid Fuels	N2O	103.63	343.98	0.00	0.13%	98.67%
ENERGY	1.B.2.b	Natural Gas	CO2	58.49	264.54	0.00	0.12%	98.79%
IPPU	2.A.2	Lime production	CO2	239.24	128.96	0.00	0.12%	98.91%
ENERGY	1.A.5	Non-Specified - Liquid Fuels	CO2	240.69	487.76	0.00	0.11%	99.02%
ENERGY	1.A.3.c	Railways - Liquid Fuels	CO2	158.12	46.69	0.00	0.10%	99.12%
ENERGY	1.A.3.b	Road Transportation - Liquid Fuels	N2O	484.51	775.24	0.00	0.09%	99.21%
AFOLU-Agriculture	3.A.2	Manure Management	CH4	506.79	539.49	0.00	0.08%	99.29%
IPPU	2.G.1	Other Product Manufacture and Use - Electrical Equipment	SF6	14.82	146.74	0.00	0.08%	99.37%
ENERGY	1.A.3.b	Road Transportation - Liquid Fuels	CH4	278.06	465.40	0.00	0.06%	99.44%
IPPU	2.B.1	Ammonia Production	CO2	988.52	1,224.16	0.00	0.05%	99.49%
IPPU	2.E.1	Electronic Industry - Integrated Circuit or Semiconductor	SF6	304.20	337.03	0.00	0.04%	99.53%
ENERGY	1.A.3.b	Road Transportation - Gaseous Fuels	CO2	222.99	230.03	0.00	0.04%	99.57%
AFOLU-Agriculture	3.C.6	Indirect N2O Emissions from manure management	N2O	456.57	541.90	0.00	0.04%	99.61%
IPPU	2.B.8	Petrochemical and Carbon Black Production	CH4	202.86	327.77	0.00	0.04%	99.65%
IPPU	2.E.3	Electronic Industry - Photovoltaics	PFC-116	0.00	57.79	0.00	0.04%	99.69%
IPPU	2.C.1	Iron and Steel Production	CH4	33.73	10.26	0.00	0.02%	99.71%
ENERGY	1.A.2	Manufacturing Industries and Construction - Liquid Fuels	N2O	40.06	19.84	0.00	0.02%	99.73%
IPPU	2.E.1	Electronic Industry - Integrated Circuit or Semiconductor	PFC-218	0.00	32.63	0.00	0.02%	99.75%
IPPU	2.G.3.b	Other Product Manufacture and Use - N2O in Medical Applications	N2O	22.35	60.07	0.00	0.02%	99.77%
IPPU	2.B.5	Carbide Production	CO2	49.49	38.02	0.00	0.02%	99.79%
ENERGY	1.A.1.a	Electricity Generation - Biomass	N2O	27.71	10.32	0.00	0.02%	99.80%
WASTE	4.D.1	Domestic Wastewater Treatment and Discharge	N2O	305.57	378.14	0.00	0.02%	99.82%

Year 2019 (3 of 4)

Sector	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2005 Base Year Estimate (Gg CO_2 Eq)	2019 Year (Gg CO_2 Eq)	Trend Assessment (Txt)	Contribution to Trend (%)	Cumulative (%)
AFOLU-Agriculture	3.C.2	Liming	CO2	0.00	21.67	0.00	0.01%	99.83%
ENERGY	1.A.3.c	Railways - Liquid Fuels	N2O	18.19	5.37	0.00	0.01%	99.85%
ENERGY	1.A.4.a	Commercial/Institutional - Gaseous Fuels	CO2	53.99	53.99	0.00	0.01%	99.86%
ENERGY	1.A.1.a	Electricity Generation - Biomass	CH4	17.43	6.52	0.00	0.01%	99.87%
ENERGY	1.A.2	Manufacturing Industries and Construction - Liquid Fuels	CH4	16.92	8.39	0.00	0.01%	99.88%
IPPU	2C2	Ferroalloys Production	CH4	0.00	13.94	0.00	0.01%	99.88%
ENERGY	1.A.4.b	Residential -Gaseous Fuels	CO2	11.74	2.35	0.00	0.01%	99.89%
ENERGY	1.A.1.b	Petroleum Refining - Liquid Fuels	N2O	24.24	20.00	0.00	0.01%	99.90%
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Solid Fuels	CH4	5.80	19.24	0.00	0.01%	99.91%
ENERGY	1.A.1.c	Manufacturing of Solid Fuels and Other Energy Industries - Gaseous Fuels	N2O	14.21	7.29	0.00	0.01%	99.92%
IPPU	2.E.1	Electronic Industry - Integrated Circuit or Semiconductor	NF3	45.90	50.85	0.00	0.01%	99.92%
ENERGY	1.A.1.c	Manufacturing of Solid Fuels and Other Energy Industries - Gaseous Fuels	CH4	11.92	6.12	0.00	0.01%	99.93%
ENERGY	1.B.2.a	Oil	N2O	18.45	14.85	0.00	0.01%	99.93%
ENERGY	1.B.1	Solid	CH4	24.73	23.75	0.00	0.01%	99.94%
IPPU	2.E.1	Electronic Industry - Integrated Circuit or Semiconductor	HFC-23	39.49	43.75	0.00	0.01%	99.95%
ENERGY	1.A.4.c	Agriculture/ Fishery/ Forestry - Liquid Fuels	CH4	1.06	9.10	0.00	0.00%	99.95%
AFOLU-Agriculture	3.A.2	Manure Management	N2O	96.78	120.61	0.00	0.00%	99.96%
ENERGY	1.A.3.e	Other tranportation	N2O	19.40	32.71	0.00	0.00%	99.96%
ENERGY	1.A.3.e	Other tranportation	CH4	16.78	28.30	0.00	0.00%	99.96%
ENERGY	1.A.4.c	Agriculture/ Fishery/ Forestry - Liquid Fuels	N2O	0.76	6.51	0.00	0.00%	99.97%
ENERGY	1.A.1.b	Petroleum Refining - Liquid Fuels	CH4	10.17	8.39	0.00	0.00%	99.97%
ENERGY	1.A.3.b	Road Transportation - Biomass	N2O	0.00	4.85	0.00	0.00%	99.97%
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Gaseous Fuels	N2O	16.45	17.96	0.00	0.00%	99.98%
ENERGY	1.A.3.d	Domestic Water-borne Navigation - Liquid Fuels	N2O	31.74	45.45	0.00	0.00%	99.98%
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Gaseous Fuels	CH4	13.80	15.07	0.00	0.00%	99.98%
WASTE	4.C.1	Waste Incineration	CO2	29.61	42.09	0.00	0.00%	99.98%
ENERGY	1.A.3.b	Road Transportation - Gaseous Fuels	CH4	9.14	9.43	0.00	0.00%	99.98%
ENERGY	1.A.3.a	Domestic Aviation - Liquid Fuels	N2O	10.02	10.64	0.00	0.00%	99.99%
AFOLU-Agriculture	3.C.1	Emissions from biomass burning in croplands	CH4	15.94	18.52	0.00	0.00%	99.99%
ENERGY	1.A.4.b	Residential - Liquid Fuels	CH4	4.36	3.30	0.00	0.00%	99.99%
ENERGY	1.A.4.a	Commercial/Institutional - Liquid Fuels	CH4	5.36	4.93	0.00	0.00%	99.99%
ENERGY	1.A.3.b	Road Transportation - Biomass	CH4	0.00	2.03	0.00	0.00%	99.99%
ENERGY	1.A.2	Manufacturing Industries and Construction - Solid Fuels	N2O	25.21	31.91	0.00	0.00%	99.99%

Year 2019 (4 of 4)

Sector	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2005 Base Year Estimate ($Gg\ CO_2\ Eq$)	2019 Year ($Gg\ CO_2\ Eq$)	Trend Assessment (Txt)	Contribution to Trend (%)	Cumulative (%)
ENERGY	1.A.7	Non-Specified - Liquid Fuels	N2O	2.34	4.48	0.00	0.00%	99.99%
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Liquid Fuels	N2O	4.30	4.54	0.00	0.00%	99.99%
ENERGY	1.A.3.d	Domestic Water-borne Navigation - Liquid Fuels	CH4	9.32	13.34	0.00	0.00%	99.99%
ENERGY	1.A.3.b	Road Transportation - Gaseous Fuels	N2O	3.55	3.67	0.00	0.00%	100.00%
WASTE	4.C.2	Open Burning of Waste	CH4	2.11	1.88	0.00	0.00%	100.00%
ENERGY	1.A.4.b	Residential - Liquid Fuels	N2O	1.29	0.83	0.00	0.00%	100.00%
ENERGY	1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	N2O	6.63	9.61	0.00	0.00%	100.00%
AFOLU-Agriculture	3.C.1	Emissions from biomass burning in croplands	N2O	5.29	6.18	0.00	0.00%	100.00%
ENERGY	1.A.2	Manufacturing Industries and Construction - Solid Fuels	CH4	14.10	17.84	0.00	0.00%	100.00%
ENERGY	1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	CH4	5.56	8.06	0.00	0.00%	100.00%
ENERGY	1.B.2.b	Natural Gas	N2O	0.16	0.87	0.00	0.00%	100.00%
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Liquid Fuels	CH4	1.80	1.90	0.00	0.00%	100.00%
ENERGY	1.A.4.a	Commercial/Institutional - Liquid Fuels	N2O	2.61	3.12	0.00	0.00%	100.00%
WASTE	4.C.2	Open Burning of Waste	CO2	0.77	0.68	0.00	0.00%	100.00%
WASTE	4.B	Biological Treatment of Solid Waste	CH4	0.01	0.24	0.00	0.00%	100.00%
ENERGY	1.A.3.c	Railways - Liquid Fuels	CH4	0.22	0.07	0.00	0.00%	100.00%
WASTE	4.B	Biological Treatment of Solid Waste	N2O	0.01	0.17	0.00	0.00%	100.00%
WASTE	4.C.1	Waste Incineration	N2O	1.74	2.42	0.00	0.00%	100.00%
WASTE	4.C.2	Open Burning of Waste	N2O	0.25	0.22	0.00	0.00%	100.00%
ENERGY	1.A.3.a	Domestic Aviation - Liquid Fuels	CH4	0.21	0.22	0.00	0.00%	100.00%
ENERGY	1.A.4.a	Commercial/Institutional - Gaseous Fuels	CH4	0.12	0.12	0.00	0.00%	100.00%
ENERGY	1.A.4.b	Residential -Gaseous Fuels	CH4	0.03	0.01	0.00	0.00%	100.00%
ENERGY	1.A.6	Non-Specified - Liquid Fuels	CH4	0.27	0.35	0.00	0.00%	100.00%
ENERGY	1.A.4.a	Commercial/Institutional - Gaseous Fuels	N2O	0.03	0.03	0.00	0.00%	100.00%
ENERGY	1.A.4.b	Residential - Gaseous Fuels	N2O	0.01	0.00	0.00	0.00%	100.00%

Table A – 26b: Approach 1 Trend Assessment for Greenhouse Gas Inventory Year 2019 - Including LULUCF

2019 (1 of 4)

Sector	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2005 Base Year Estimate (Gg CO_2 Eq)	2019 Year (Gg CO_2 Eq)	Trend Assessment (Txt)	Contribution to Trend (%)	Cumulative (%)
AFOLU-LULUCF	**3.B.1**	**Forest land Remaining Forest land**	**CO2**	**-215,490.65**	**-237,008.39**	**0.53**	**43.30%**	**43.30%**
ENERGY	**1.A.1.c**	**Manufacturing of Solid Fuels and Other Energy Industries - Gaseous Fuels**	**CO2**	**26,744.27**	**13,724.22**	**0.09**	**6.99%**	**50.29%**
AFOLU-LULUCF	**3.B.5.b**	**Forest land converted to settlement**	**CO2**	**36,437.78**	**35,564.03**	**0.08**	**6.89%**	**57.18%**
ENERGY	**1.A.1.a**	**Main Activity Electricity and Heat Production - Gaseous Fuels**	**CO2**	**30,969.27**	**33,811.76**	**0.06**	**5.29%**	**62.48%**
ENERGY	**1.A.2**	**Manufacturing Industries and Construction - Liquid Fuels**	**CO2**	**17,297.09**	**8,535.30**	**0.06**	**4.58%**	**67.05%**
ENERGY	**1.B.2.a**	**Oil**	**CH4**	**17,012.21**	**10,750.91**	**0.05**	**4.13%**	**71.19%**
ENERGY	**1.A.1.a**	**Main Activity Electricity and Heat Production - Solid Fuels**	**CO2**	**22,279.39**	**73,653.01**	**0.05**	**3.92%**	**75.10%**
AFOLU-LULUCF	**3.B.2**	**Cropland Remaining Cropland**	**CO2**	**-20,215.98**	**-18,662.58**	**0.04**	**3.50%**	**78.61%**
ENERGY	**1.A.3.b**	**Road Transportation - Liquid Fuels**	**CO2**	**33,600.15**	**53,995.92**	**0.04**	**3.03%**	**81.64%**
WASTE	**4.D.2**	**Industrial Wastewater Treatment and Discharge**	**CH4**	**13,833.55**	**14,462.46**	**0.03**	**2.46%**	**84.10%**
ENERGY	**1.A.1.b**	**Petroleum Refining - Liquid Fuels**	**CO2**	**9,936.67**	**8,200.82**	**0.03**	**2.11%**	**86.22%**
ENERGY	**1.A.2**	**Manufacturing Industries and Construction - Gaseous Fuels**	**CO2**	**12,480.19**	**18,087.71**	**0.02**	**1.43%**	**87.65%**
IPPU	**2.A.1**	**Cement production**	**CO2**	**7,615.98**	**9,120.65**	**0.01**	**1.18%**	**88.83%**
ENERGY	**1.B.2.a**	**Oil**	**CO2**	**5,387.14**	**4,335.70**	**0.01**	**1.16%**	**89.99%**
ENERGY	**1.B.2.b**	**Natural Gas**	**CH4**	**6,565.43**	**7,091.00**	**0.01**	**1.13%**	**91.12%**
ENERGY	**1.A.2**	**Manufacturing Industries and Construction - Solid Fuels**	**CO2**	**5,420.07**	**6,859.53**	**0.01**	**0.78%**	**91.90%**
AFOLU-Agriculture	**3.C.4**	**Direct N2O Emissions from managed soils**	N2O	**3,852.49**	**3,736.73**	**0.01**	**0.73%**	**92.63%**
IPPU	**2.C.1**	**Iron and Steel Production**	**CO2**	**1,367.98**	**7,543.24**	**0.01**	**0.71%**	**93.35%**
ENERGY	**1.A.4.a**	**Commercial/Institutional - Liquid Fuels**	**CO2**	**2,156.27**	**1,646.37**	**0.01**	**0.48%**	**93.83%**
ENERGY	**1.A.3.d**	**Domestic Water-borne Navigation - Liquid Fuels**	**CO2**	**3,947.29**	**5,650.38**	**0.01**	**0.46%**	**94.29%**
ENERGY	**1.A.4.b**	**Residential - Liquid Fuels**	**CO2**	**2,085.98**	**1,647.73**	**0.01**	**0.46%**	**94.75%**
AFOLU-Agriculture	**3.C.7**	**Rice cultivation**	**CH4**	**2,118.20**	**2,268.98**	**0.00**	**0.37%**	**95.12%**
IPPU	2.C.3	Aluminium production	PFC-14	0.00	2,246.56	0.00	0.35%	0.95
WASTE	4.D.1	Domestic Wastewater Treatment and Discharge	CH4	1,731.03	1,687.08	0.00	0.33%	0.96
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Liquid Fuels	CO2	1,820.67	1,884.53	0.00	0.33%	0.96
ENERGY	1.A.4.c	Agriculture/ Fishery/ Forestry - Liquid Fuels	CO2	313.42	2,686.54	0.00	0.31%	0.96
AFOLU-Agriculture	3.A.1	Enteric Fermentation	CH4	1,452.12	1,224.46	0.00	0.30%	0.97

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Sector	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2005 Base Year Estimate ($Gg\ CO_2\ Eq$)	2019 Year ($Gg\ CO_2\ Eq$)	Trend Assessment (Txt)	Contribution to Trend (%)	Cumulative (%)
IPPU	2C2	Ferroalloys Production	CO2	0.00	1,680.43	0.00	0.26%	0.97
WASTE	4.A	Solid Waste Disposal	CH4	6,096.11	11,681.20	0.00	0.26%	0.97
IPPU	2.B.8	Petrochemical and Carbon Black Production	CO2	2,633.90	4,170.48	0.00	0.25%	0.98
AFOLU-Agriculture	3.C.5	Indirect N2O Emissions from managed soils	N2O	1,185.79	1,053.28	0.00	0.24%	0.98
ENERGY	1.A.3.a	Domestic Aviation - Liquid Fuels	CO2	1,202.61	1,276.23	0.00	0.21%	0.98
IPPU	2.C.3	Aluminium production	CO2	0.00	1,216.00	0.00	0.19%	0.98
IPPU	2.B.1	Ammonia Production	CO2	988.52	1,224.16	0.00	0.15%	0.98
IPPU	2.E.1	Electronic Industry - Integrated Circuit or Semiconductor	PFC-14	639.71	491.57	0.00	0.14%	0.98
IPPU	2.E.1	Electronic Industry - Integrated Circuit or Semiconductor	PFC-116	0.00	901.69	0.00	0.14%	0.99
IPPU	2.E.3	Electronic Industry - Photovoltaics	PFC-14	0.00	875.15	0.00	0.14%	0.99
AFOLU-Agriculture	3.C.3	Urea application	CO2	575.07	389.89	0.00	0.14%	0.99
ENERGY	1.A.3.e	Other tranportation	CO2	1,409.64	2,377.14	0.00	0.11%	0.99
AFOLU-Agriculture	3.A.2	Manure Management	CH4	506.79	539.49	0.00	0.09%	0.99
AFOLU-LULUCF	3.B.5.b	Cropland converted to settlement	CO2	2,192.08	5,290.91	0.00	0.08%	0.99
IPPU	2.B.2	Nitric Acid Production	N2O	217.09	0.00	0.00	0.07%	0.99
AFOLU-Agriculture	3.C.6	Indirect N2O Emissions from manure management	N2O	456.57	541.90	0.00	0.07%	0.99
IPPU	2.A.2	Lime production	CO2	239.24	128.96	0.00	0.06%	0.99
IPPU	2.C.3	Aluminium production	PFC-116	0.00	370.88	0.00	0.06%	0.99
IPPU	2.E.1	Electronic Industry - Integrated Circuit or Semiconductor	SF6	304.20	337.03	0.00	0.05%	0.99
ENERGY	1.A.3.c	Railways - Liquid Fuels	CO2	158.12	46.69	0.00	0.05%	0.99
WASTE	4.D.1	Domestic Wastewater Treatment and Discharge	N2O	305.57	378.14	0.00	0.05%	1.00
ENERGY	1.A.3.b	Road Transportation - Liquid Fuels	N2O	484.51	775.24	0.00	0.04%	1.00
IPPU	2.A.3	Glass Production	CO2	28.34	340.52	0.00	0.04%	1.00
ENERGY	1.A.3.b	Road Transportation - Gaseous Fuels	CO2	222.99	230.03	0.00	0.04%	1.00
ENERGY	1.A.3.b	Road Transportation - Liquid Fuels	CH4	278.06	465.40	0.00	0.02%	1.00
ENERGY	1.B.2.b	Natural Gas	CO2	58.49	264.54	0.00	0.02%	1.00
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Solid Fuels	N2O	103.63	343.98	0.00	0.02%	1.00
IPPU	2.F.1.b	Refrigeration and Air Conditioning - Mobile Air Conditioning	HFC-134a	479.34	929.77	0.00	0.02%	1.00
IPPU	2.B.8	Petrochemical and Carbon Black Production	CH4	202.86	327.77	0.00	0.02%	1.00
IPPU	2.G.1	Other Product Manufacture and Use - Electrical Equipment	SF6	14.82	146.74	0.00	0.02%	1.00
IPPU	2.A.4	Other Process Uses of Carbonates - Limestone and Dolomite	CO2	178.68	494.90	0.00	0.02%	1.00
AFOLU-LULUCF	3.B.2.b	Forest land converted to Cropland	CO2	0.00	101.49	0.00	0.02%	1.00

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Sector	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2005 Base Year Estimate ($Gg\ CO_2\ Eq$)	2019 Year ($Gg\ CO_2\ Eq$)	Trend Assessment (Txt)	Contribution to Trend (%)	Cumulative (%)
AFOLU-Agriculture	3.A.2	Manure Management	N2O	96.78	120.61	0.00	0.01%	1.00
IPPU	2.B.5	Carbide Production	CO2	49.49	38.02	0.00	0.01%	1.00
ENERGY	1.A.2	Manufacturing Industries and Construction - Liquid Fuels	N2O	40.06	19.84	0.00	0.01%	1.00
ENERGY	1.A.4.a	Commercial/Institutional - Gaseous Fuels	CO2	53.99	53.99	0.00	0.01%	1.00
IPPU	2.C.1	Iron and Steel Production	CH4	33.73	10.26	0.00	0.01%	1.00
IPPU	2.E.3	Electronic Industry - Photovoltaics	PFC-116	0.00	57.79	0.00	0.01%	1.00
ENERGY	1.A.1.a	Electricity Generation - Biomass	N2O	27.71	10.32	0.00	0.01%	1.00
IPPU	2.E.1	Electronic Industry - Integrated Circuit or Semiconductor	NF3	45.90	50.85	0.00	0.01%	1.00
IPPU	2.E.1	Electronic Industry - Integrated Circuit or Semiconductor	HFC-23	39.49	43.75	0.00	0.01%	1.00
ENERGY	1.A.5	Non-Specified - Liquid Fuels	CO2	240.69	487.76	0.00	0.01%	1.00
ENERGY	1.A.3.c	Railways - Liquid Fuels	N2O	18.19	5.37	0.00	0.01%	1.00
ENERGY	1.A.1.b	Petroleum Refining - Liquid Fuels	N2O	24.24	20.00	0.00	0.01%	1.00
IPPU	2.E.1	Electronic Industry - Integrated Circuit or Semiconductor	PFC-218	0.00	32.63	0.00	0.01%	1.00
ENERGY	1.A.1.a	Electricity Generation - Biomass	CH4	17.43	6.52	0.00	0.00%	1.00
ENERGY	1.B.1	Solid	CH4	24.73	23.75	0.00	0.00%	1.00
ENERGY	1.A.2	Manufacturing Industries and Construction - Liquid Fuels	CH4	16.92	8.39	0.00	0.00%	1.00
ENERGY	1.B.2.a	Oil	N2O	18.45	14.85	0.00	0.00%	1.00
ENERGY	1.A.3.d	Domestic Water-borne Navigation - Liquid Fuels	N2O	31.74	45.45	0.00	0.00%	1.00
ENERGY	1.A.1.c	Manufacturing of Solid Fuels and Other Energy Industries - Gaseous Fuels	N2O	14.21	7.29	0.00	0.00%	1.00
ENERGY	1.A.4.b	Residential -Gaseous Fuels	CO2	11.74	2.35	0.00	0.00%	1.00
ENERGY	1.A.2	Manufacturing Industries and Construction - Solid Fuels	N2O	25.21	31.91	0.00	0.00%	1.00
WASTE	4.C.1	Waste Incineration	CO2	29.61	42.09	0.00	0.00%	1.00
AFOLU-Agriculture	3.C.2	Liming	CO2	0.00	21.67	0.00	0.00%	1.00
ENERGY	1.A.1.c	Manufacturing of Solid Fuels and Other Energy Industries - Gaseous Fuels	CH4	11.92	6.12	0.00	0.00%	1.00
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Gaseous Fuels	N2O	16.45	17.96	0.00	0.00%	1.00
AFOLU-Agriculture	3.C.1	Emissions from biomass burning in croplands	CH4	15.94	18.52	0.00	0.00%	1.00
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Gaseous Fuels	CH4	13.80	15.07	0.00	0.00%	1.00
IPPU	2C2	Ferroalloys Production	CH4	0.00	13.94	0.00	0.00%	1.00
ENERGY	1.A.1.b	Petroleum Refining - Liquid Fuels	CH4	10.17	8.39	0.00	0.00%	1.00
ENERGY	1.A.2	Manufacturing Industries and Construction - Solid Fuels	CH4	14.10	17.84	0.00	0.00%	1.00

2019 (4 of 4)

Sector	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2005 Base Year Estimate ($Gg\ CO_2\ Eq$)	2019 Year ($Gg\ CO_2\ Eq$)	Trend Assessment (Txt)	Contribution to Trend (%)	Cumulative (%)
IPPU	2.G.3.b	Other Product Manufacture and Use - N2O in Medical Applications	N2O	22.35	60.07	0.00	0.00%	1.00
ENERGY	1.A.3.a	Domestic Aviation - Liquid Fuels	N2O	10.02	10.64	0.00	0.00%	1.00
ENERGY	1.A.3.b	Road Transportation - Gaseous Fuels	CH4	9.14	9.43	0.00	0.00%	1.00
ENERGY	1.A.3.e	Other tranportation	N2O	19.40	32.71	0.00	0.00%	1.00
ENERGY	1.A.3.e	Other tranportation	CH4	16.78	28.30	0.00	0.00%	1.00
ENERGY	1.A.3.d	Domestic Water-borne Navigation - Liquid Fuels	CH4	9.32	13.34	0.00	0.00%	1.00
ENERGY	1.A.4.c	Agriculture/ Fishery/ Forestry - Liquid Fuels	CH4	1.06	9.10	0.00	0.00%	1.00
ENERGY	1.A.4.a	Commercial/Institutional - Liquid Fuels	CH4	5.36	4.93	0.00	0.00%	1.00
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Solid Fuels	CH4	5.80	19.24	0.00	0.00%	1.00
ENERGY	1.A.4.b	Residential - Liquid Fuels	CH4	4.36	3.30	0.00	0.00%	1.00
AFOLU-Agriculture	3.C.1	Emissions from biomass burning in croplands	N2O	5.29	6.18	0.00	0.00%	1.00
ENERGY	1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	N2O	6.63	9.61	0.00	0.00%	1.00
ENERGY	1.A.4.c	Agriculture/ Fishery/ Forestry - Liquid Fuels	N2O	0.76	6.51	0.00	0.00%	1.00
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Liquid Fuels	N2O	4.30	4.54	0.00	0.00%	1.00
ENERGY	1.A.3.b	Road Transportation - Biomass	N2O	0.00	4.85	0.00	0.00%	1.00
ENERGY	1.A.3.b	Road Transportation - Gaseous Fuels	N2O	3.55	3.67	0.00	0.00%	1.00
ENERGY	1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	CH4	5.56	8.06	0.00	0.00%	1.00
WASTE	4.C.2	Open Burning of Waste	CH4	2.11	1.88	0.00	0.00%	1.00
ENERGY	1.A.4.a	Commercial/Institutional - Liquid Fuels	N2O	2.61	3.12	0.00	0.00%	1.00
ENERGY	1.A.1.a	Main Activity Electricity and Heat Production - Liquid Fuels	CH4	1.80	1.90	0.00	0.00%	1.00
ENERGY	1.A.3.b	Road Transportation - Biomass	CH4	0.00	2.03	0.00	0.00%	1.00
ENERGY	1.A.4.b	Residential - Liquid Fuels	N2O	1.29	0.83	0.00	0.00%	1.00
WASTE	4.C.1	Waste Incineration	N2O	1.74	2.42	0.00	0.00%	1.00
WASTE	4.C.2	Open Burning of Waste	CO2	0.77	0.68	0.00	0.00%	1.00
ENERGY	1.A.7	Non-Specified - Liquid Fuels	N2O	2.34	4.48	0.00	0.00%	1.00
ENERGY	1.B.2.b	Natural Gas	N2O	0.16	0.87	0.00	0.00%	1.00
ENERGY	1.A.3.c	Railways - Liquid Fuels	CH4	0.22	0.07	0.00	0.00%	1.00
WASTE	4.C.2	Open Burning of Waste	N2O	0.25	0.22	0.00	0.00%	1.00
ENERGY	1.A.6	Non-Specified - Liquid Fuels	CH4	0.27	0.35	0.00	0.00%	1.00
ENERGY	1.A.3.a	Domestic Aviation - Liquid Fuels	CH4	0.21	0.22	0.00	0.00%	1.00
WASTE	4.B	Biological Treatment of Solid Waste	CH4	0.01	0.24	0.00	0.00%	1.00
WASTE	4.B	Biological Treatment of Solid Waste	N2O	0.01	0.17	0.00	0.00%	1.00
ENERGY	1.A.4.a	Commercial/Institutional - Gaseous Fuels	CH4	0.12	0.12	0.00	0.00%	1.00
ENERGY	1.A.4.b	Residential -Gaseous Fuels	CH4	0.03	0.01	0.00	0.00%	1.00
ENERGY	1.A.4.a	Commercial/Institutional - Gaseous Fuels	N2O	0.03	0.03	0.00	0.00%	1.00
ENERGY	1.A.4.b	Residential - Gaseous Fuels	N2O	0.01	0.00	0.00	0.00%	1.00

Table A - 27a: Approach 1 Uncertainty Analysis for Greenhouse Gas Inventory Year 2019 - Excluding LULUCF

Year 2019 (1 of 5)

Sector	IPCC category		Gas	Base year (2005) emissions or removals (Gg CO_2 equivalent)	Year t (2019) emissions or removals (Gg CO_2 equivalent)	Activity data uncertainty %	Emission factor uncertainty / estimation parameter uncertainty %	Combined uncertainty %	Contribution to variance by source/sink category in year *t*	Type A sensitivity %	Type B sensitivity %	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty %	Uncertainty in trend in national emissions introduced by activity data uncertainty %	Uncertainty introduced into the trend in total national emissions %
ENERGY	**1A Fuel Combustion Activities**													
	1A1 Energy Industries													
	1A1a Main Activity Electricity and Heat Production	Liquids	CO_2	1,820.67	1,884.53	0.01	0.01	0.01	0.00	0.00	0.01	0.00%	0.01%	0.00%
			CH_4	1.80	1.90	0.01	2.26	2.26	0.00	0.00	0.00	0.00%	0.00%	0.00%
			N_2O	4.30	4.54	0.01	2.27	2.27	0.00	0.00	0.00	0.00%	0.00%	0.00%
		Solids	CO_2	22,279.39	73,653.01	0.01	0.14	0.14	0.00	0.18	0.29	2.45%	0.29%	0.06%
			CH_4	5.80	19.24	0.01	1.38	1.38	0.00	0.00	0.00	0.01%	0.00%	0.00%
			N_2O	103.63	343.98	0.01	1.62	1.62	0.00	0.00	0.00	0.13%	0.00%	0.00%
		Gas	CO_2	30,969.27	33,811.76	0.01	0.04	0.04	0.00	0.03	0.14	0.11%	0.19%	0.00%
			CH_4	13.80	15.07	0.01	2.00	2.00	0.00	0.00	0.00	0.00%	0.00%	0.00%
			N_2O	16.45	17.96	0.01	2.00	2.00	0.00	0.00	0.00	0.00%	0.00%	0.00%
		Biomass & Biogas	CH_4	17.43	6.52	0.01	2.00	2.00	0.00	0.00	0.00	0.01%	0.00%	0.00%
			N_2O	27.71	10.32	0.01	2.75	2.75	0.00	0.00	0.00	0.03%	0.00%	0.00%
	1A1b Petroleum Refining	Liquids	CO_2	9,936.67	8,200.82	0.01	0.03	0.03	0.00	0.02	0.03	0.06%	0.05%	0.00%
			CH_4	10.17	8.39	0.01	2.33	2.33	0.00	0.00	0.00	0.00%	0.00%	0.00%
			N_2O	24.24	20.00	0.01	2.33	2.33	0.00	0.00	0.00	0.01%	0.00%	0.00%
	1A1c Manufacture of Solid Fuels and Other Energy Industries (LNG)	Gas	CO_2	26,744.27	13,724.22	0.01	0.04	0.04	0.00	0.09	0.05	0.34%	0.08%	0.00%
			CH_4	11.92	6.12	0.01	2.00	2.00	0.00	0.00	0.00	0.01%	0.00%	0.00%
			N_2O	14.21	7.29	0.01	2.00	2.00	0.00	0.00	0.00	0.01%	0.00%	0.00%

Year 2019 (2 of 5)

Sector	IPCC category		Gas	Base year (2005) emissions or removals (Gg CO_2 equivalent)	Year t (2019) emissions or removals (Gg CO_2 equivalent)	Activity data uncertainty %	Emission factor uncertainty / estimation parameter uncertainty %	Combined uncertainty %	Contribution to variance by source/sink category in year *t*	Type A sensitivity %	Type B sensitivity %	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty %	Uncertainty in trend in national emissions introduced by activity data uncertainty %	Uncertainty introduced into the trend in total national emissions %
ENERGY (cont.)	1A2 Manufaturing Industries and Construction	Liquids	CO_2	17,297.09	8,535.30	0.02	0.01	0.03	0.00	0.06	0.03	0.05%	0.12%	0.00%
			CH_4	16.92	8.39	0.03	0.04	0.05	0.00	0.00	0.00	0.00%	0.00%	0.00%
			N_2O	40.06	19.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00%	0.00%
		Solids	CO_2	5,420.07	6,859.53	0.02	1.90	1.90	0.00	0.00	0.03	0.23%	0.10%	0.00%
			CH_4	14.10	17.84	0.03	2.00	2.00	0.00	0.00	0.00	0.00%	0.00%	0.00%
			N_2O	25.21	31.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00%	0.00%
		Gas	CO_2	12,480.19	18,087.71	0.02	1.92	1.92	0.01	0.01	0.07	1.23%	0.25%	0.02%
			CH_4	5.56	8.06	0.03	2.33	2.33	0.00	0.00	0.00	0.00%	0.00%	0.00%
			N_2O	6.63	9.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00%	0.00%
	1A3a Civil Aviation	Liquids	CO_2	1,202.61	1,276.23	0.05	0.04	0.06	0.00	0.00	0.01	0.01%	0.04%	0.00%
			CH_4	0.21	0.22	0.05	2.33	2.33	0.00	0.00	0.00	0.00%	0.00%	0.00%
			N_2O	10.02	10.64	0.05	2.33	2.33	0.00	0.00	0.00	0.00%	0.00%	0.00%
	1A3b Road Transportation	Liquids	CO_2	33,600.15	53,995.92	0.01	0.04	0.04	0.00	0.04	0.22	0.14%	0.23%	0.00%
			CH_4	278.06	465.40	0.01	2.22	2.22	0.00	0.00	0.00	0.09%	0.00%	0.00%
			N_2O	484.51	775.24	5.76	1.73	6.01	0.00	0.00	0.00	0.09%	2.53%	0.06%
		Gas	CO_2	222.99	230.03	0.01	0.04	0.04	0.00	0.00	0.00	0.00%	0.00%	0.00%
			CH_4	9.14	9.43	0.01	2.00	2.00	0.00	0.00	0.00	0.00%	0.00%	0.00%
			N_2O	3.55	3.67	0.01	2.00	2.00	0.00	0.00	0.00	0.00%	0.00%	0.00%
		Biomass	CH_4	0.00	2.03	0.01	2.22	2.22	0.00	0.00	0.00	0.00%	0.00%	0.00%
			N_2O	0.00	4.85	5.76	1.73	6.01	0.00	0.00	0.00	0.00%	0.02%	0.00%
	1A3c Railway	Liquids	CO_2	158.12	46.69	0.05	0.01	0.05	0.00	0.00	0.00	0.00%	0.00%	0.00%
			CH_4	0.22	0.07	0.05	2.33	2.33	0.00	0.00	0.00	0.00%	0.00%	0.00%
			N_2O	18.19	5.37	0.05	2.33	2.33	0.00	0.00	0.00	0.02%	0.00%	0.00%
	1A3d Water-Borne Navigation	Liquids	CO_2	3,947.29	5,650.38	0.05	0.01	0.05	0.00	0.00	0.02	0.00%	0.16%	0.00%
			CH_4	9.32	13.34	0.05	2.33	2.33	0.00	0.00	0.00	0.00%	0.00%	0.00%
			N_2O	31.74	45.45	0.05	2.33	2.33	0.00	0.00	0.00	0.00%	0.00%	0.00%

Year 2019 (3 of 5)

Sector	IPCC category		Gas	Base year (2005) emissions or removals (Gg CO_2 equivalent)	Year t (2019) emissions or removals (Gg CO_2 equivalent)	Activity data uncertainty %	Emission factor uncertainty / estimation parameter uncertainty %	Combined uncertainty %	Contribution to variance by source/sink category in year *t*	Type A sensitivity %	Type B sensitivity %	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty %	Uncertainty in trend in national emissions introduced by activity data uncertainty %	Uncertainty introduced into the trend in total national emissions %
ENERGY (cont.)	1A3e Off Road	Liquids	CO2	1,409.64	2,377.14	0.05	0.05	0.07	0.00	0.00	0.01	0.01%	0.07%	0.00%
			CH4	16.78	28.30	0.05	2.33	2.33	0.00	0.00	0.00	0.01%	0.00%	0.00%
			N2O	19.40	32.71	0.05	2.33	2.33	0.00	0.00	0.00	0.01%	0.00%	0.00%
	1A4a Commercial & Institutional	Liquids	CO_2	2,156.27	1,646.37	0.03	0.01	0.04	0.00	0.00	0.01	0.01%	0.03%	0.00%
			CH_4	5.36	4.93	0.04	1.74	1.74	0.00	0.00	0.00	0.00%	0.00%	0.00%
			N_2O	2.61	3.12	0.04	0.13	0.14	0.00	0.00	0.00	0.00%	0.00%	0.00%
		Gas	CO_2	53.99	53.99	0.05	0.04	0.06	0.00	0.00	0.00	0.00%	0.00%	0.00%
			CH_4	0.12	0.12	0.05	2.00	2.00	0.00	0.00	0.00	0.00%	0.00%	0.00%
			N_2O	0.03	0.03	0.05	0.04	0.06	0.00	0.00	0.00	0.00%	0.00%	0.00%
	1A4b Residential	Liquids	CO_2	2,085.98	1,647.73	0.05	0.04	0.06	0.00	0.00	0.01	0.02%	0.05%	0.00%
			CH_4	4.36	3.30	0.05	1.95	1.95	0.00	0.00	0.00	0.00%	0.00%	0.00%
			N_2O	1.29	0.83	0.05	1.86	1.86	0.00	0.00	0.00	0.00%	0.00%	0.00%
		Gas	CO_2	11.74	2.35	0.05	0.04	0.06	0.00	0.00	0.00	0.00%	0.00%	0.00%
			CH_4	0.03	0.01	0.05	2.00	2.00	0.00	0.00	0.00	0.00%	0.00%	0.00%
			N_2O	0.01	0.00	0.05	2.00	2.00	0.00	0.00	0.00	0.00%	0.00%	0.00%
	1A4c Agriculture	Liquids	CO_2	313.42	2,686.54	0.04	0.02	0.04	0.00	0.01	0.01	0.02%	0.06%	0.00%
			CH_4	1.06	9.10	0.04	1.61	1.61	0.00	0.00	0.00	0.00%	0.00%	0.00%
			N_2O	0.76	6.51	0.04	1.88	1.88	0.00	0.00	0.00	0.00%	0.00%	0.00%
	1A5 Non Specified	Liquids	CO_2	240.69	487.76	0.04	0.03	0.05	0.00	0.00	0.00	0.00%	0.01%	0.00%
			CH_4	0.27	0.35	0.03	1.29	1.30	0.00	0.00	0.00	0.00%	0.00%	0.00%
			N_2O	2.34	4.48	0.03	1.61	1.61	0.00	0.00	0.00	0.00%	0.00%	0.00%
	1B Fugitive Emissions from Fuels													
	1B1 Solid Fuel	Solids	CH_4	24.73	23.75	0.05	2.00	2.00	0.00	0.00	0.00	0.01%	0.00%	0.00%
	1B2 Oil and Natural Gas	Liquids	CO_2	5,387.14	4,335.70	0.05	0.03	0.06	0.00	0.01	0.02	0.03%	0.12%	0.00%
			CH_4	17,012.21	10,750.91	0.05	2.33	2.33	0.01	0.05	0.04	10.93%	0.30%	1.20%
			N2O	18.45	14.85	0.05	2.33	2.33	0.00	0.00	0.00	0.01%	0.00%	0.00%
		Gas	CO_2	58.49	264.54	0.05	0.04	0.06	0.00	0.00	0.00	0.00%	0.01%	0.00%
			CH_4	6,565.43	7,091.00	0.05	2.00	2.00	0.00	0.01	0.03	1.27%	0.20%	0.02%
			N2O	0.16	0.87	0.00	2.00	2.00	0.00	0.00	0.00	0.00%	0.00%	0.00%

Year 2019 (4 of 5)

Sector	IPCC category		Gas	Base year (2005) emissions or removals (Gg CO_2 equivalent)	Year t (2019) emissions or removals (Gg CO_2 equivalent)	Activity data uncertainty %	Emission factor uncertainty / estimation parameter uncertainty %	Combined uncertainty %	Contribution to variance by source/sink category in year *t*	Type A sensitivity %	Type B sensitivity %	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty %	Uncertainty in trend in national emissions introduced by activity data uncertainty %	Uncertainty introduced into the trend in total national emissions %
IPPU	2A Mineral Industry	2A1 Cement production	CO_2	7,615.98	9,120.65	0.02	0.08	0.08	0.00	0.00	0.04	0.03%	0.10%	0.00%
		2A2 Lime production	CO_2	239.24	128.96	0.08	0.02	0.08	0.00	0.00	0.00	0.00%	0.01%	0.00%
		2A3 Glass production	CO_2	28.34	340.52	0.05	0.10	0.11	0.00	0.00	0.00	0.01%	0.01%	0.00%
		2A4d Limestone and dolomite	CO_2	178.68	494.90	0.03	0.05	0.06	0.00	0.00	0.00	0.01%	0.01%	0.00%
	2B Chemical Industry	2B1 Ammonia production	CO_2	988.52	1,224.16	0.05	0.06	0.08	0.00	0.00	0.00	0.00%	0.03%	0.00%
		2B2 Nitric acid production	N_2O	217.09	0.00	0.02	0.40	0.40	0.00	0.00	0.00	0.05%	0.00%	0.00%
		2B5 Carbide production	CO_2	49.49	38.02	0.05	0.10	0.11	0.00	0.00	0.00	0.00%	0.00%	0.00%
		2B8 Petrochemicals and Carbon Black	CO_2	2,633.90	4,170.48	0.05	0.30	0.30	0.00	0.00	0.02	0.08%	0.12%	0.00%
			CH_4	202.86	327.77	0.05	0.60	0.60	0.00	0.00	0.00	0.01%	0.01%	0.00%
	2C Metal Industry	2C1 Iron and Steel production	CO_2	1,367.98	7,543.24	0.10	0.25	0.27	0.00	0.02	0.03	0.57%	0.43%	0.01%
			CH_4	33.73	10.26	0.10	0.25	0.27	0.00	0.00	0.00	0.00%	0.00%	0.00%
		2.C.2 Ferroalloys Production	CO_2	0.00	1,680.43	0.05	0.25	0.25	0.00	0.01	0.01	0.17%	0.05%	0.00%
			CH_4	0.00	13.94	0.05	0.25	0.25	0.00	0.00	0.00	0.00%	0.00%	0.00%
		2C3 Aluminium production	CO_2	0.00	1,216.00	0.01	0.10	0.10	0.00	0.00	0.00	0.05%	0.01%	0.00%
			PFC	0.00	2,617.44	0.01	0.10	0.10	0.00	0.01	0.01	0.10%	0.01%	0.00%
	2E Electronics Industry	2E1 Integrated Circuit or Semiconductor	PFC, HFC, SF_6, NH_3	1,029.30	1,857.52	0.10	0.10	0.14	0.00	0.00	0.01	0.02%	0.11%	0.00%
		2E3 Photovoltaics	PFC	0.00	932.95	0.10	0.10	0.14	0.00	0.00	0.00	0.04%	0.05%	0.00%
	2F Product Uses as Substitutes for Ozone Depleting Substances	2F1b Mobile Air-Conditioning	HFC134a	479.34	929.77	0.10	0.10	0.14	0.00	0.00	0.00	0.01%	0.05%	0.00%
	2G Other Product Manufacture and Use	2G1 Electrical Equipment	SF_6	14.82	146.74	0.10	0.10	0.14	0.00	0.00	0.00	0.01%	0.01%	0.00%
		2G3b N_2O in Medical Applications	N_2O	22.35	60.07	0.10	0.01	0.10	0.00	0.00	0.00	0.00%	0.00%	0.00%

Year 2019 (5 of 5)

Sector	IPCC category		Gas	Base year (2005) emissions or removals (Gg CO_2 equivalent)	Year t (2019) emissions or removals (Gg CO_2 equivalent)	Activity data uncertainty %	Emission factor uncertainty / estimation parameter uncertainty %	Combined uncertainty %	Contribution to variance by source/sink category in year *t*	Type A sensitivity %	Type B sensitivity %	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty %	Uncertainty in trend in national emissions introduced by activity data uncertainty %	Uncertainty introduced into the trend in total national emissions %
AFOLU - Agriculture	3A Livestock	3A1 Enteric Fermentation	CH_4	1,452.12	1,224.46	0.13	0.97	0.98	0.00	0.00	0.00	0.27%	0.09%	0.00%
		3A2 Manure Management	CH_4	506.79	539.49	0.15	0.94	0.95	0.00	0.00	0.00	0.05%	0.05%	0.00%
			N_2O	96.78	120.61	0.15	1.41	1.42	0.00	0.00	0.00	0.00%	0.01%	0.00%
	3C Aggregate Sources and Non-CO2 Emissions Sources on Land	3C1b Biomass Burning In Croplands	CH_4	15.94	18.52	0.10	0.00	0.10	0.00	0.00	0.00	0.00%	0.00%	0.00%
			N_2O	5.29	6.18	0.10	0.00	0.10	0.00	0.00	0.00	0.00%	0.00%	0.00%
		3C2 Liming	CO_2	0.00	21.67	0.50	0.50	0.71	0.00	0.00	0.00	0.00%	0.01%	0.00%
		3C3 Urea application	CO_2	575.07	389.89	0.50	0.50	0.71	0.00	0.00	0.00	0.07%	0.11%	0.00%
		3C4 Direct N2O Emissions from managed soils	N_2O	3,852.49	3,736.73	1.14	1.13	1.60	0.00	0.01	0.01	0.61%	2.40%	0.06%
		3C5 Indirect N2O Emissions from managed soils	N_2O	1,185.79	1,053.28	0.91	0.21	0.93	0.00	0.00	0.00	0.04%	0.54%	0.00%
		3C6 Indirect N2O Emissions from manure management	N_2O	456.57	541.90	0.17	0.20	0.26	0.00	0.00	0.00	0.00%	0.05%	0.00%
		3C7 Rice cultivations	CH_4	2,118.20	2,268.98	0.10	0.63	0.63	0.00	0.00	0.01	0.13%	0.13%	0.00%
WASTE	4A Solid Waste Disposal Sites		CH_4	6,096.11	11,681.20	0.52	0.35	0.63	0.00	0.01	0.05	0.51%	3.43%	0.12%
	4B Biological Treatment of Solid Waste		CH_4	0.01	0.24	1.54	1.00	1.84	0.00	0.00	0.00	0.00%	0.00%	0.00%
			N_2O	0.01	0.17	1.54	1.50	2.15	0.00	0.00	0.00	0.00%	0.00%	0.00%
	4 C Incineration and Open Burning of Waste	4C1 Waste Incineration	CO_2	29.61	42.09	0.10	0.70	0.71	0.00	0.00	0.00	0.00%	0.00%	0.00%
			N_2O	1.74	2.42	0.10	1.00	1.00	0.00	0.00	0.00	0.00%	0.00%	0.00%
		4C2 Open Burning of Waste	CO_2	0.77	0.68	0.55	0.66	0.85	0.00	0.00	0.00	0.00%	0.00%	0.00%
			CH_4	2.11	1.88	0.55	1.13	1.25	0.00	0.00	0.00	0.00%	0.00%	0.00%
			N_2O	0.25	0.22	0.55	1.00	1.14	0.00	0.00	0.00	0.00%	0.00%	0.00%
	4 D Wastewater Treatment and Discharge	4D1 Domestic Wastewater	CH_4	1,731.03	1,687.08	0.60	0.58	0.84	0.00	0.00	0.01	0.14%	0.57%	0.00%
			N_2O	305.57	378.14	0.15	0.50	0.52	0.00	0.00	0.00	0.01%	0.03%	0.00%
		4D2 Industrial Wastewater	CH_4	13,833.55	14,462.46	0.29	0.39	0.48	0.00	0.02	0.06	0.60%	2.35%	0.06%
Total				**250,043.80**	**330,358.22**				**0.02**					**0.02**
							Percentage uncertainty in total inventory		**15.12%**				**Trend Uncertainty**	**12.70%**

Table A – 27b: Approach 1 Uncertainty Analysis for Greenhouse Gas Inventory Year 2019 - Including LULUCF

Year 2019 (1 of 5)

Sector	IPCC category		Gas	Base year (2005) emissions or removals	Year t (2019) emissions or removals	Activity data uncertainty	Emission factor uncertainty / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by source/ sink category in year *t*	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
				($Gg\ CO_2$ equivalent)	($Gg\ CO_2$ equivalent)	%	%	%		%	%	%	%	%
1. Energy														
	1A Fuel Combustion Activities													
	1A1 Energy Industries													
	1A1a Main Activity Electricity and Heat Production	Liquids	CO_2	1,820.67	1,884.53	0.97%	0.92%	1.33%	0.00	0.04	0.04	0.04%	0.05%	0.00%
			CH_4	1.80	1.90	0.97%	226.15%	226.15%	0.00	0.00	0.00	0.01%	0.00%	0.00%
			N_2O	4.30	4.54	0.97%	226.86%	226.86%	0.00	0.00	0.00	0.02%	0.00%	0.00%
		Solids	CO_2	22,279.39	73,653.01	0.69%	13.86%	13.88%	0.01	0.47	1.39	6.52%	1.36%	0.44%
			CH_4	5.80	19.24	0.69%	138.46%	138.47%	0.00	0.00	0.00	0.02%	0.00%	0.00%
			N_2O	103.63	343.98	0.69%	161.79%	161.80%	0.00	0.00	0.01	0.36%	0.01%	0.00%
		Gas	CO_2	30,969.27	33,811.76	1.00%	3.92%	4.05%	0.00	0.63	0.64	2.49%	0.90%	0.07%
			CH_4	13.80	15.07	1.00%	200.00%	200.00%	0.00	0.00	0.00	0.06%	0.00%	0.00%
			N_2O	16.45	17.96	1.00%	200.00%	200.00%	0.00	0.00	0.00	0.07%	0.00%	0.00%
		Biomass & Biogas	CH_4	17.43	6.52	1.00%	200.00%	200.00%	0.00	0.00	0.00	0.12%	0.00%	0.00%
			N_2O	27.71	10.32	1.00%	275.00%	275.00%	0.00	0.00	0.00	0.26%	0.00%	0.00%
	1A1b Petroleum Refining	Liquids	CO_2	9,936.67	8,200.82	1.00%	3.00%	3.16%	0.00	0.25	0.15	0.76%	0.22%	0.01%
			CH_4	10.17	8.39	1.00%	233.33%	233.34%	0.00	0.00	0.00	0.06%	0.00%	0.00%
			N_2O	24.24	20.00	1.00%	233.33%	233.34%	0.00	0.00	0.00	0.15%	0.00%	0.00%
	1A1c Manufacture of Solid Fuels and Other Energy Industries (LNG)	Gas	CO_2	26,744.27	13,724.22	1.00%	3.92%	4.05%	0.00	0.84	0.26	3.29%	0.37%	0.11%
			CH_4	11.92	6.12	1.00%	200.00%	200.00%	0.00	0.00	0.00	0.08%	0.00%	0.00%
			N_2O	14.21	7.29	1.00%	200.00%	200.00%	0.00	0.00	0.00	0.09%	0.00%	0.00%
	1A2 Manufaturing Industries and Construction	Liquids	CO_2	17,297.09	8,535.30	2.38%	0.82%	2.52%	0.00	0.55	0.16	0.45%	0.54%	0.00%
			CH_4	16.92	8.39	3.00%	4.06%	5.05%	0.00	0.00	0.00	0.00%	0.00%	0.00%
			N_2O	40.06	19.84	0.00%	0.00%	0.00%	0.00	0.00	0.00	0.00%	0.00%	0.00%
		Solids	CO_2	5,420.07	6,859.53	2.45%	190.47%	190.48%	0.01	0.09	0.13	17.87%	0.45%	3.19%
			CH_4	14.10	17.84	3.00%	200.00%	200.02%	0.00	0.00	0.00	0.05%	0.00%	0.00%
			N_2O	25.21	31.91	0.00%	0.00%	0.00%	0.00	0.00	0.00	0.00%	0.00%	0.00%
		Gas	CO_2	12,480.19	18,087.71	2.47%	192.01%	192.03%	0.09	0.17	0.34	33.13%	1.19%	10.99%
			CH_4	5.56	8.06	3.00%	233.33%	233.35%	0.00	0.00	0.00	0.02%	0.00%	0.00%
			N_2O	6.63	9.61	0.00%	0.00%	0.00%	0.00	0.00	0.00	0.00%	0.00%	0.00%

Year 2019 (2 of 5)

Sector	IPCC category		Gas	Base year (2005) emissions or removals	Year t (2019) emissions or removals	Activity data uncertainty	Emission factor uncertainty / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by source/ sink category in year *t*	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
				(Gg CO_2 equivalent)	(Gg CO_2 equivalent)	%	%	%		%	%	%	%	%
	1A3a Civil Aviation	Liquids	CO_2	1,202.61	1,276.23	5.00%	4.06%	6.44%	0.00	0.03	0.02	0.10%	0.17%	0.00%
			CH_4	0.21	0.22	5.00%	233.33%	233.38%	0.00	0.00	0.00	0.00%	0.00%	0.00%
			N_2O	10.02	10.64	5.00%	233.33%	233.38%	0.00	0.00	0.00	0.05%	0.00%	0.00%
	1A3b Road Transportation	Liquids	CO_2	33,600.15	53,995.92	0.76%	3.69%	3.77%	0.00	0.36	1.02	1.34%	1.09%	0.03%
			CH_4	278.06	465.40	0.95%	221.59%	221.59%	0.00	0.00	0.01	0.59%	0.01%	0.00%
			N_2O	484.51	775.24	575.91%	172.54%	601.20%	0.00	0.01	0.01	0.92%	11.92%	1.43%
		Gas	CO_2	222.99	230.03	1.00%	3.92%	4.05%	0.00	0.00	0.00	0.02%	0.01%	0.00%
			CH_4	9.14	9.43	1.00%	200.00%	200.00%	0.00	0.00	0.00	0.04%	0.00%	0.00%
			N_2O	3.55	3.67	1.00%	200.00%	200.00%	0.00	0.00	0.00	0.02%	0.00%	0.00%
		Biomass (Biodiesel)	CH_4	0.00	2.03	0.95%	221.59%	221.59%	0.00	0.00	0.00	0.01%	0.00%	0.00%
			N_2O	0.00	4.85	575.91%	172.54%	601.20%	0.00	0.00	0.00	0.02%	0.07%	0.00%
	1A3c Railway	Liquids	CO_2	158.12	46.69	5.00%	0.94%	5.09%	0.00	0.01	0.00	0.01%	0.01%	0.00%
			CH_4	0.22	0.07	5.00%	233.33%	233.39%	0.00	0.00	0.00	0.00%	0.00%	0.00%
			N_2O	18.19	5.37	5.00%	233.33%	233.39%	0.00	0.00	0.00	0.15%	0.00%	0.00%
	1A3d Water-Borne Navigation	Liquids	CO_2	3,947.29	5,650.38	5.00%	0.94%	5.09%	0.00	0.06	0.11	0.05%	0.75%	0.01%
			CH_4	9.32	13.34	5.00%	233.33%	233.39%	0.00	0.00	0.00	0.03%	0.00%	0.00%
			N_2O	31.74	45.45	5.00%	233.33%	233.39%	0.00	0.00	0.00	0.11%	0.01%	0.00%
	1A3e Off Road	Liquids	CO2	1,409.64	2,377.14	5.00%	5.34%	7.31%	0.00	0.01	0.04	0.07%	0.32%	0.00%
			CH4	16.78	28.30	5.00%	233.33%	233.39%	0.00	0.00	0.00	0.04%	0.00%	0.00%
			N2O	19.40	32.71	5.00%	233.33%	233.39%	0.00	0.00	0.00	0.04%	0.00%	0.00%
	1A4a Commercial & Institutional	Liquids	CO_2	2,156.27	1,646.37	3.49%	1.21%	3.70%	0.00	0.06	0.03	0.07%	0.15%	0.00%
			CH_4	5.36	4.93	3.75%	174%	173.59%	0.00	0.00	0.00	0.02%	0.00%	0.00%
			N_2O	2.61	3.12	4.13%	13%	13.69%	0.00	0.00	0.00	0.00%	0.00%	0.00%
		Gas	CO_2	53.99	53.99	5.00%	3.92%	6.35%	0.00	0.00	0.00	0.00%	0.01%	0.00%
			CH_4	0.12	0.12	5.00%	200.00%	200.06%	0.00	0.00	0.00	0.00%	0.00%	0.00%
			N_2O	0.03	0.03	5.00%	3.92%	6.35%	0.00	0.00	0.00	0.00%	0.00%	0.00%
	1A4b Residential	Liquids	CO_2	2,085.98	1,647.73	4.93%	3.90%	6.29%	0.00	0.05	0.03	0.21%	0.22%	0.00%
			CH_4	4.36	3.30	4.87%	195.02%	195.08%	0.00	0.00	0.00	0.02%	0.00%	0.00%
			N_2O	1.29	0.83	4.65%	186.29%	186.35%	0.00	0.00	0.00	0.01%	0.00%	0.00%
		Gas	CO_2	11.74	2.35	5.00%	3.92%	6.35%	0.00	0.00	0.00	0.00%	0.00%	0.00%
			CH_4	0.03	0.01	5.00%	200.00%	200.06%	0.00	0.00	0.00	0.00%	0.00%	0.00%
			N_2O	0.01	0.00	5.00%	200.00%	200.06%	0.00	0.00	0.00	0.00%	0.00%	0.00%
	1A4c Agriculture	Liquids	CO_2	313.42	2,686.54	4.07%	1.92%	4.50%	0.00	0.04	0.05	0.07%	0.29%	0.00%
			CH_4	1.06	9.10	4.03%	161.16%	161.21%	0.00	0.00	0.00	0.02%	0.00%	0.00%
			N_2O	0.76	6.51	4.03%	188.02%	188.06%	0.00	0.00	0.00	0.02%	0.00%	0.00%
	1A5 Non Specified	Liquids	CO_2	240.69	487.76	3.64%	2.77%	4.58%	0.00	0.00	0.01	0.00%	0.05%	0.00%
			CH_4	0.27	0.35	3.24%	129.47%	129.51%	0.00	0.00	0.00	0.00%	0.00%	0.00%
			N_2O	2.34	4.48	3.45%	160.94%	160.98%	0.00	0.00	0.00	0.00%	0.00%	0.00%

Year 2019 (3 of 5)

Sector	IPCC category		Gas	Base year (2005) emissions or removals	Year t (2019) emissions or removals	Activity data uncertainty	Emission factor uncertainty / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by source/ sink category in year *t*	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
				($Gg\ CO_2$ equivalent)	($Gg\ CO_2$ equivalent)	%	%	%		%	%	%	%	%
	1B Fugitive Emissions from Fuels													
	1B1 Solid Fuel	Solids	CH_4	24.73	23.75	5.00%	200.00%	200.06%	0.00	0.00	0.00	0.11%	0.00%	0.00%
	1B2 Oil and Natural Gas	Liquids	CO_2	5,387.14	4,335.70	5.00%	3.00%	5.83%	0.00	0.14	0.08	0.42%	0.58%	0.01%
			CH_4	17,012.21	10,750.91	5.00%	233.33%	233.39%	0.05	0.50	0.20	115.89%	1.44%	134.33%
			N2O	18.45	14.85	5.00%	233.33%	233.39%	0.00	0.00	0.00	0.11%	0.00%	0.00%
		Gas	CO_2	58.49	264.54	5.00%	3.92%	6.35%	0.00	0.00	0.00	0.01%	0.04%	0.00%
			CH_4	6,565.43	7,091.00	5.00%	200.00%	200.06%	0.02	0.14	0.13	27.32%	0.95%	7.47%
			N2O	0.16	0.87	0.00%	200.00%	200.00%	0.00	0.00	0.00	0.00%	0.00%	0.00%
2. IPPU														
	2A Mineral Industry	2A1 Cement production	CO_2	7,615.98	9,120.65	2.00%	8.00%	8.25%	0.00	0.14	0.17	1.13%	0.49%	0.02%
		2A2 Lime production	CO_2	239.24	128.96	8.00%	2.00%	8.25%	0.00	0.01	0.00	0.01%	0.03%	0.00%
		2A3 Glass production	CO_2	28.34	340.52	5.00%	10.00%	11.18%	0.00	0.01	0.01	0.05%	0.05%	0.00%
		2A4d Limestone and dolomite	CO_2	178.68	494.90	3.00%	5.00%	5.83%	0.00	0.00	0.01	0.01%	0.04%	0.00%
	2B Chemical Industry	2B1 Ammonia production	CO_2	988.52	1,224.16	5.00%	6.00%	7.81%	0.00	0.02	0.02	0.11%	0.16%	0.00%
		2B2 Nitric acid production	N_2O	217.09	0.00	2.00%	40.00%	40.05%	0.00	0.01	0.00	0.36%	0.00%	0.00%
		2B5 Carbide production	CO_2	49.49	38.02	5.00%	10.00%	11.18%	0.00	0.00	0.00	0.01%	0.01%	0.00%
		2B8 Petrochemicals and Carbon Black	CO_2	2,633.90	4,170.48	5.00%	30.00%	30.41%	0.00	0.03	0.08	0.89%	0.56%	0.01%
			CH_4	202.86	327.77	5.00%	60.00%	60.21%	0.00	0.00	0.01	0.13%	0.04%	0.00%
	2C Metal Industry	2C1 Iron and Steel production	CO_2	1,367.98	7,543.24	10.00%	25.00%	26.93%	0.00	0.09	0.14	2.15%	2.01%	0.09%
			CH_4	33.73	10.26	10.00%	25.00%	26.93%	0.00	0.00	0.00	0.03%	0.00%	0.00%
		2.C.2 Ferroalloys Production	CO_2	0.00	1,680.43	5.00%	25.00%	25.50%	0.00	0.03	0.03	0.79%	0.22%	0.01%
			CH_4	0.00	13.94	5.00%	25.00%	25.50%	0.00	0.00	0.00	0.01%	0.00%	0.00%
		2C3 Aluminium production	CO_2	0.00	1,216.00	1.00%	10.00%	10.05%	0.00	0.02	0.02	0.23%	0.03%	0.00%
			PFC	0.00	2,617.44	1.00%	10.00%	10.05%	0.00	0.05	0.05	0.49%	0.07%	0.00%
	2E Electronics Industry	2E1 Integrated Circuit or Semiconductor	PFC, HFC, SF_6, NH_3	1,029.30	1,857.52	10.00%	10.00%	14.14%	0.00	0.01	0.04	0.07%	0.50%	0.00%
		2E3 Photovoltaics	PFC	0.00	932.95	10.00%	10.00%	14.14%	0.00	0.02	0.02	0.18%	0.25%	0.00%
	2F Product Uses as Substitutes for Ozone Depleting Substances	2F1b Mobile Air-Conditioning	HFC134a	479.34	929.77	10.00%	10.00%	14.14%	0.00	0.00	0.02	0.02%	0.25%	0.00%
	2G Other Product Manufacture and Use	2G1 Electrical Equipment	SF_6	14.82	146.74	10.00%	10.00%	14.14%	0.00	0.00	0.00	0.02%	0.04%	0.00%
		2G3b N_2O in Medical Applications	N_2O	22.35	60.07	10.00%	1.00%	10.05%	0.00	0.00	0.00	0.00%	0.02%	0.00%

Year 2019 (4 of 5)

Sector	IPCC category		Gas	Base year (2005) emissions or removals	Year t (2019) emissions or removals	Activity data uncertainty	Emission factor uncertainty / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by source/ sink category in year *t*	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
				(Gg CO_2 equivalent)	(Gg CO_2 equivalent)	%	%	%		%	%	%	%	%
3. AFOLU														
	3A Livestock	3A1 Enteric Fermentation	CH_4	1,452.12	1,224.46	13.23%	97.47%	98.36%	0.00	0.04	0.02	3.58%	0.43%	0.13%
		3A2 Manure Management	CH_4	506.79	539.49	15.00%	93.81%	95.00%	0.00	0.01	0.01	1.00%	0.22%	0.01%
			N_2O	96.78	120.61	15.00%	141.42%	142.21%	0.00	0.00	0.00	0.24%	0.05%	0.00%
	3B Land	3.B.1 Forest land Remaining Forest land	Carbon Dioxide (CO2)	-215,490.65	-237,008.39	15.00%	10.00%	18.03%	0.14	4.59	4.47	45.95%	94.92%	111.21%
		3.B.5.b. Forest land converted to settlement	Carbon Dioxide (CO2)	36,437.78	35,564.03	15.00%	20.00%	25.00%	0.01	0.82	0.67	16.50%	14.24%	4.75%
		3.B.2 Cropland Remaining Cropland	Carbon Dioxide (CO2)	-20,215.98	-18,662.58	20.00%	10.00%	22.36%	0.00	0.48	0.35	4.83%	9.97%	1.23%
		3.B.5.b Cropland converted to settlement	Carbon Dioxide (CO2)	2,192.08	5,290.91	15.00%	10.00%	18.03%	0.00	0.01	0.10	0.10%	2.12%	0.04%
		3.B.2.b Forest land converted to Cropland	Carbon Dioxide (CO2)	0.00	101.49	15.00%	20.00%	25.00%	0.00	0.00	0.00	0.04%	0.04%	0.00%
	3C Aggregate Sources and Non-CO2 Emissions Sources on Land	3C1b Biomass Burning In Croplands	CH_4	15.94	18.52	10.00%	0.00%	10.00%	0.00	0.00	0.00	0.00%	0.00%	0.00%
			N_2O	5.29	6.18	10.00%	0.00%	10.00%	0.00	0.00	0.00	0.00%	0.00%	0.00%
		3C2 Liming	CO_2	0.00	21.67	50.00%	50.00%	70.71%	0.00	0.00	0.00	0.02%	0.03%	0.00%
		3C3 Urea application	CO_2	575.07	389.89	50.00%	50.00%	70.71%	0.00	0.02	0.01	0.82%	0.52%	0.01%
		3C4 Direct N2O Emissions from managed soils	N_2O	3,852.49	3,736.73	113.58%	112.85%	160.11%	0.00	0.09	0.07	9.95%	11.33%	2.27%
		3C5 Indirect N2O Emissions from managed soils	N_2O	1,185.79	1,053.28	90.880%	21.08%	93.29%	0.00	0.03	0.02	0.61%	2.56%	0.07%
		3C6 Indirect N2O Emissions from manure management	N_2O	456.57	541.90	16.58%	20.00%	25.98%	0.00	0.01	0.01	0.17%	0.24%	0.00%
		3C7 Rice cultivations	CH_4	2,118.20	2,268.98	10.00%	62.50%	63.29%	0.00	0.04	0.04	2.78%	0.61%	0.08%

Year 2019 (5 of 5)

Sector	IPCC category		Gas	Base year (2005) emissions or removals	Year t (2019) emissions or removals	Activity data uncertainty	Emission factor uncertainty / estimation parameter uncertainty	Combined uncertainty	Contribution to variance by source/ sink category in year *t*	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor / estimation parameter uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
				($Gg\ CO_2$ equivalent)	($Gg\ CO_2$ equivalent)	%	%	%		%	%	%	%	%
4. Waste														
	4A Solid Waste Disposal Sites		CH_4	6,096.11	11,681.20	51.96%	35.00%	62.65%	0.00	0.03	0.22	1.07%	16.21%	2.64%
	4B Biological Treatment of Solid Waste		CH_4	0.01	0.24	154.00%	100.00%	183.62%	0.00	0.00	0.00	0.00%	0.00%	0.00%
			N_2O	0.01	0.17	154.00%	150.00%	214.98%	0.00	0.00	0.00	0.00%	0.00%	0.00%
	4 C Incineration and Open Burning of Waste	4C1 Waste Incineration	CO_2	29.61	42.09	10.00%	70.00%	70.71%	0.00	0.00	0.00	0.03%	0.01%	0.00%
			N_2O	1.74	2.42	10.00%	100.00%	100.50%	0.00	0.00	0.00	0.00%	0.00%	0.00%
		4C2 Open Burning of Waste	CO_2	0.77	0.68	54.77%	65.57%	85.44%	0.00	0.00	0.00	0.00%	0.00%	0.00%
			CH_4	2.11	1.88	54.77%	112.69%	125.30%	0.00	0.00	0.00	0.01%	0.00%	0.00%
			N_2O	0.25	0.22	54.77%	100.00%	114.02%	0.00	0.00	0.00	0.00%	0.00%	0.00%
	4 D Wastewater Treatment and Discharge	4D1 Domestic Wastewater	CH_4	1,731.03	1,687.08	60.00%	58.31%	83.67%	0.00	0.04	0.03	2.30%	2.70%	0.13%
			N_2O	305.57	378.14	15.48%	50.00%	52.34%	0.00	0.01	0.01	0.27%	0.16%	0.00%
		4D2 Industrial Wastewater	CH_4	13,833.55	14,462.46	28.72%	39.05%	48.48%	0.00	0.30	0.27	11.57%	11.09%	2.57%
Total				**52,967.03**	**115,643.68**				**0.33**					**2.83**
							Percentage uncertainty in total inventory		**57.47%**				**Trend Uncertainty**	**168.34%**

Table B - 1: Details on the Methodology and Assumptions for the Quantification of Sectoral Mitigation Actions

Mitigation Action	Progress Indicators	Methodologies and Assumptions
Energy Sector		
1. Renewable Energy (RE) implementation through Feed-in Tariff (FiT) mechanism **2. Large Scale Solar** **3. Net Energy Metering** **4. Hydropower Generation** **5. Other RE by public and private licensees**	Total electricity generation for each of the programmes (GWh).	Emission avoidances are quantified based on the displacement and/or reduction of the consumption of grid-electricity from RE programs. In regard to electricity consumption from the grid, calculations of GHG emission reduction in 2017, 2018 and 2019 performed throughout this report refer to three grid-electricity emission factors respectively for: • Peninsular Malaysia (0.776 tonnes CO_2/MWh, 0.807 tonnes CO_2/MWh and 0.780 tonnes CO_2/MWh); • Sabah (0.513 tonnes CO_2/MWh, 0.520 tonnes CO_2/MWh, and 0.527 tonnes CO_2/MWh); and • Sarawak (0.213 tonnes CO_2/MWh, 0.193 tonnes CO_2/MWh and 0.222 tonnes CO_2/MWh).
National Energy Efficiency Action Plan (NEEAP)	Total electricity savings for each of the programmes (GWh).	Emission avoidances are quantified based on the displacement and/or reduction of the consumption of grid-electricity which is compiled by the Energy Commission. In this regard, the three grid-electricity emission factors were used for Peninsular Malaysia, Sabah and Sarawak.
Rail-based public transport	Daily ridership volumes on the LRT, Monorail and KLIA ERL	• Annual ridership and average length travelled on the LRT, Monorail, KLIA ERL and MRT networks are compiled. • Modal shift assumptions of 66.5% of the ridership from cars to rail and 33.5% from motorcycles to rail.

Mitigation Action	Progress Indicators	Methodologies and Assumptions
	and MRT networks.	• The number of cars and motorcycles avoided on the road, the corresponding commuting distance and the resulting GHG emission avoidance are computed. The emission factors for passenger vehicle category used are sourced from the publication by the Department for Environment, Food and Rural Affairs (DEFRA), United Kingdom. • Emissions from electricity consumption from the operations of electrified trains are quantified using grid-electricity emission factors for Peninsular Malaysia, which were subtracted from the total emission calculated from the use of rail-based transportation to calculate the net emission reduction achieved.
Use of Energy Efficient Vehicles (EEVs)	Number of EEV vehicles registered under the Road Transport Department Malaysia.	• Information on the number of registered EEV vehicles i.e. hybrid cars and electric cars are obtained from the Road Transport Department. • The difference in emissions of total EEVs on the road and the corresponding categories of conventional vehicles is then computed based on fuel requirement. • Default average km driven per year per passenger vehicle in Malaysia as reported by Malaysian Institute of Road Safety Research (MIROS) is used. • Default vehicle emission factors for hybrid and electric vehicles as reported by Department for Environment, Food and Rural Affairs (DEFRA), United Kingdom for 2017, 2018 and 2019 are used.
Use of palm-based biodiesel in blended petroleum diesel	Nationwide biodiesel consumption	The annual GHG emissions are calculated using the amount of petroleum diesel displaced by biodiesel provided by the

Mitigation Action	Progress Indicators	Methodologies and Assumptions
	data compiled monthly and aggregated to annual amount.	Ministry of Plantation and Industrial Commodities, multiplied by the IPCC default carbon emission factor.
Use of natural gas in vehicles (NGV)	Sale and consumption of NGV in the transport sector.	• Computation of the difference in emissions between the use of natural gas in the transport sector as alternative fuels compared to the use of conventional motor gasoline. • Default emission factors of fuels used are based on the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.
Reduction of venting and flaring	Emissions reduction achievement for Vent-to-flare conversion projects, compressor reliability improvement efforts, and the enhancement of leak detection and repair (LDAR) programmes.	Annual GHG emissions reduction was published by PETRONAS in its PETRONAS Annual Report.

Mitigation Action	Progress Indicators	Methodologies and Assumptions
Waste Sector		
Paper recycling program	Annual amount of wastepaper recycled in tonnes.	Data on the amount of wastepaper recycled each year provided by the Solid Waste Management and Public Cleansing Corporation. The methane emissions avoided are calculated based on the total wastepaper recycled using the methodology described in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories and IPCC default emissions factors. Methane emission is converted to CO_2eq using a Global Warming Potential of 25.
Biogas recovery from palm oil mill effluent (POME)	Number of palm oil mills equipped with on-site biogas capture facilities and the annual amount of biogas captured.	Data on monthly Crude Palm Oil production is reported by MPOB and aggregated to annual production value. Data on the total number of palm oil mills with biogas capture facilities and the method used to recover the biogas is monitored and recorded by MPOB. The total methane emissions captured are computed based on the 2006 IPCC Guidelines for National Greenhouse Gas Inventories and specific parameter values established by MPOB through research. Methane emission is converted to CO_2 equivalent by using the Global Warming Potential of 25.

Mitigation Action	Progress Indicators	Methodologies and Assumptions
IPPU Sector		
Material substitution in cement production	Amount of other cementitious materials.	Data on the annual amount of other cementitious materials to replace clinker in cement production. The quantification of GHG emission reduction follows the 2006 IPCC guideline, where the amount of clinker substituted using other cementitious and alternative materials were multiplied with the emission factor for clinker calculated in the national inventory.
Agriculture Sector		
MyOrganic Certification Program	Area of certified farms under myOrganic program.	The estimation of emission reduction from organic farming is adapted to agriculture GHG inventory, following the 2006 IPCC Guideline to quantify emissions reduction from the displacement of synthetic chemical and urea fertilizer use. Emission reduction is quantified through the reduction of CO_2 emission and the direct N_2O emission in managed soil from no use of synthetic fertilization practice.
LULUCF Sector		
Reducing deforestation, Sustainable management of forest and Conservation of carbon stocks	Net-net approach	A net-net accounting approach is undertaken with 2005 as the base year

Table B - 2: Detailed Description of Mitigation Actions

Name	Description	Objectives	Type of instrument (regulatory, economic instrument or other)	Status (planned, adopted, or implemented)	Sector(s) affected	Gases affec-ted	Start year of implem-entation	Implementing entity or entities
Energy Sector								
1. Renewable Energy (RE) implementa-tion through Feed-in Tariff (FiT) mechanism	Generation of RE power for supply to the grid network from indigenous RE sources, namely biogas (agro-industrial waste and landfill gas), biomass (agro-waste and municipal solid waste), solar photovoltaic and small hydropower which is below 30MW.	To increase renewable energy in the fuel mix for grid electricity so as to enhance national electricity supply security and sustainable socio-economic development.	Regulatory	Implemented	Energy – Power	CO_2	2010	• Ministry of Energy and Natural Resources • Sustainable Energy Development Authority (SEDA)
2. Large Scale Solar	A competitive bidding programme to drive down the Levelized Cost of Energy (LCOE) for the development of large scale solar photovoltaic plant (LSS).	To increase renewable energy in the energy generation mix.	Others: Market-based Instrument	Implemented	Energy – Power	CO_2	2018	• Ministry of Energy and Natural Resources • Energy Commission (EC)
3. Net Energy Metering	This programme aims to lower electricity bills for residential premises	To increase renewable energy in the	Regulatory	Implemented	Energy – Power	CO_2	2016	• Ministry of Energy and

Name	Description	Objectives	Type of instrument (regulatory, economic instrument or other)	Status (planned, adopted, or implemented)	Sector(s) affected	Gases affec-ted	Start year of implem-entation	Implementing entity or entities
	by using solar PV systems. Under this programme, any excess energy generated will be exported to the utility grid and will be paid on a 1:1 offset basis and the credit shall be allowed to roll over for a maximum of 12 months.	energy generation mix.						Natural Resources • Energy Commission (EC) • Sustainable Energy Development Authority (SEDA)
4. Hydropower Generation	To enhance energy security, hydroelectric power stations was incorporated as one of the sources for grid connected electricity generation under the Four-Fuel Diversifica-tion Policy in 1981.	Diversification of sources for generation of grid-connected electricity.	Regulatory	Implemented	Energy – Power	CO_2		• Energy Commission (EC) • Tenaga Nasional Berhad (TNB) • Sabah Electricity Sdn Bhd (SESB) • Sarawak Energy Berhad (SEB)
5. RE by public and private licensees	Power generation from RE resources such as biomass, biogas and solar photovoltaic by the private sector for	To promote the use of RE resources in electricity generation.	Others: Market-based Instrument	Implemented	Energy – Power	CO_2		• Energy Commission (EC)

Name	Description	Objectives	Type of instrument (regulatory, economic instrument or other)	Status (planned, adopted, or implemented)	Sector(s) affected	Gases affec-ted	Start year of implem-entation	Implementing entity or entities
	both on-site and off-site consumption, including supply to the grid not under the existing RE programmes such as FiT scheme and hydropower.							• Tenaga Nasional Berhad (TNB) • Sabah Electricity Sdn Bhd (SESB) • Sarawak Energy Berhad (SEB) • Private sector
6. National Energy Efficiency Action Plan (NEEAP)	Energy efficiency programmes specified in Section 3.2.2.2 and Table B-3.	To increase energy efficiency in residential, commercial and industrial sectors.	Regulatory	Implemented	Energy – Power	CO_2		• Ministry of Energy and Natural Resources • Energy Commission (EC)
7. Rail-based public transport	Public-private sector investment in rail-based urban mass transit infrastructure in the Klang Valley in the form of the Light Rail Transit (LRT), Monorail, Mass Rapid Transit (MRT), KTM Komuter and KLIA Express Rail Link.	To expand and integrate the urban rail public transport system. To promote reduced use of private transport and demand on road infrastructure through increasing	Others: Market-based Instrument	Implemented	Energy - Transport	CO_2		• Ministry of Transport • Land Public Transport Agency (APAD) • Prasarana • Malaysia Bhd • Express Rail Link Sdn Bhd • KTM Bhd

Name	Description	Objectives	Type of instrument (regulatory, economic instrument or other)	Status (planned, adopted, or implemented)	Sector(s) affected	Gases affec-ted	Start year of implem-entation	Implementing entity or entities
		public rail transport modal share.						
8. Use of energy-efficient vehicles	EEVs are defined as vehicles that meet a set of defined specifications in terms of carbon emission level (g CO_2eq/ km) and fuel consumption (L/100 km). EEVs include fuel-efficient internal combustion engine (ICE) vehicles, hybrid and electric vehicles, and alternative-fuelled vehicles.	To increase the number of on-the road EEVs in Malaysia.	Others: Market-based Instrument	Implemented	Energy - Transport	CO_2		• Ministry of International Trade and Industry • Malaysia Automotive, Robotics and IoT Institute (MARii)
9. Use of palm-based biodiesel in blended petroleum diesel	Malaysia introduced blending of 5% palm methyl ester with 95% petroleum diesel under the B5 programme in 2011. The blending was then increased to 7% of palm methyl ester with 93% of petroleum diesel under the B7 programme for	To increase the use of palm oil-based biodiesel as a renewable clean-burning petroleum diesel replace-ment to contribute towards reducing Malaysia's dependen-ce on fossil fuel and	Regulatory	Implemented	Energy - Transport	CO_2		Ministry of Plantation Industries and Commodities

Name	Description	Objectives	Type of instrument (regulatory, economic instrument or other)	Status (planned, adopted, or implemented)	Sector(s) affected	Gases affec-ted	Start year of implem-entation	Implementing entity or entities
	transportation sector in 2015. In 2019, blending for transportation sector was increased to 10% of methyl ester with 90% of petroleum diesel. Also in 2019, blending of 7% of palm methyl ester with 93% of petroleum diesel was introduced for the industrial sector.	enhancing sustainable socio-economic development.						
10. Use of natural gas in vehicles	Recognising the environmental benefits of using natural gas as a fuel source, the Natural Gas for Vehicle (NGV) programme was initiated in 1986 as a pilot program and expanded in 1991 with initial focus in public transportation sector.	To promote the use of compressed natural gas as an alternative fuel in automobiles for enhancing environmental quality and reducing carbon emissions.	Others: Market-based Instrument	Implemented	Energy - Transport	CO_2		Economic Planning Unit, Prime Minister's Department Ministry of Finance
11. Reduction of venting and flaring	Reduction of GHG emissions by reducing hydrocarbon flaring and venting.	To reduce GHG emissions within current operations.	Others: Voluntary Initiative	Implemented	Energy - fugitive emission	CO_2 CH_4		PETRONAS

Name	Description	Objectives	Type of instrument (regulatory, economic instrument or other)	Status (planned, adopted, or implemented)	Sector(s) affected	Gases affec-ted	Start year of implem-entation	Implementing entity or entities
Waste Sector								
12. Paper recycling program	Sustainable waste management through recycling and utilisation of wastepaper for manufacture of paper products.	Methane avoidance through recycling of wastepaper.	Others: Market-based Instrument	Implemented	Waste	CH_4		• National Solid Waste Management Department • Solid Waste Management and Public Cleansing Corporation • Paper products industry
13. Biogas recovery from palm oil mill effluent (POME) treatment	Installation of biogas capture facilities in palm oil mills. Utilisation of methane recovered for energy generation or destruction through flaring. GHG emission reductions are accounted for by methane combustion/ destruction only.	To avoid the release of methane from treatment of POME through biogas capture and utilisation.	Regulatory	Implemented	Waste	CH_4		• Ministry of Plantation Industries and Commodities • Malaysian Palm Oil Board (MPOB)

Name	Description	Objectives	Type of instrument (regulatory, economic instrument or other)	Status (planned, adopted, or implemented)	Sector(s) affected	Gases affec-ted	Start year of implem-entation	Implementing entity or entities
IPPU Sector								
14. Material substitution in cement production	The promotion of the use of low carbon cement with the use of suitable fly ash from coal-fired power plant to produce cement contributes to carbon footprint reduction.	To reduce process emission in cement production from the substitution of clinker with other cementitious materials.	Others: Voluntary Initiative	Implemented	IPPU – Mineral Industry	CO_2		Cement industry
Agriculture Sector								
15. MyOrganic Certification Program	A voluntary certification scheme for commercial farms, comprising of guidelines and criteria to be practiced by farm operators to promote sustainable agriculture and produce better quality organic products.	To recognize farms that practice organic farming based on Malaysian Standard MS 1529:2015 - Plant-based organically produced foods-requirements for production, processing, handling, labelling and marketing. To certify farms in the crop sector that comply with the Good Agricultural	Others: Voluntary Initiative	Implemented	Agricul-ture	CO_2 N_2O	2002	• Ministry of Agriculture and Food Industries • Department of Agriculture

Name	Description	Objectives	Type of instrument (regulatory, economic instrument or other)	Status (planned, adopted, or implemented)	Sector(s) affected	Gases affec-ted	Start year of implem-entation	Implementing entity or entities
		Practices and apply the standard of organic productions. It is an approach to fulfilling the commitment towards a sustainable agriculture in Malaysia. Part of the requirement of this program is the avoidance of synthetic chemicals, fertilizers and pesticides, which contributes to the reduction of GHG emissions in the agriculture practice.						
LULUCF Sector								
16. Reducing deforestation, Sustainable management	Sustainable forest management is practised in Malaysia to ensure that the	To promote sustainable forest management and conservation	Regulatory	Implemented	Forest	CO_2	2006	• Ministry of Energy and Natural Resources

Name	Description	Objectives	Type of instrument (regulatory, economic instrument or other)	Status (planned, adopted, or implemented)	Sector(s) affected	Gases affec-ted	Start year of implem-entation	Implementing entity or entities
of forest and Conservation of carbon stocks	complex ecosystems rich in flora and fauna are conserved, ecosystem services provided by the forest are maintained and at the same time allowing for continuity of forest product harvest.							• Ministry of Plantation Industries and Commodities • State Forestry Departments

Table B - 3: Details of Key Initiatives and Programmes under NEEAP and Breakdown of its GHG Emission Reduction Achievement

Key Initiative	Programme	Description	GHG Emission Reduction Achieved (Gg CO_2e)		
			2017	2018	2019
Initiative 1: **5-star rated appliances**	5-star refrigerator campaign	Promotion of 5-star rating and label for refrigerators to transform the market via more efficient models.	60.67	82.31	91.22
	5-star air conditioner campaign	Promotion of 5-star rating and label for air-conditioners to transform the market via more efficient models.	699.55	893.76	1,049.28
Initiative 2: **Minimum Energy Performance Standards (MEPS)**	EE lighting campaign	Promotion of energy efficient lighting through awareness programmes, enforcement of MEPS and labelling.	43.62	90.00	127.85
	High efficiency motors	Promotion and awareness programme that will lead to mandatory MEPS and labelling for motors by 2020.	2.57	8.23	14.88
Initiative 3: **Energy audits and energy management in buildings and industries**	Large and medium-sized commercial buildings	Matching grants will be provided to large and medium sized industries and commercial buildings where free energy audit is offered and building owners are obliged to invest in energy saving measures equal or more than the amount of grant received. Meanwhile, large Government facilities will be retrofitted through allocation provided or Energy Performance Contract mechanism.	48.30	111.04	165.68
	Large and medium-sized industries		244.10	528.33	771.74
	Large Government facilities		50.34	83.74	106.05
Initiative 4: **Co-generation**	Co-generation in industries and commercial buildings	To promote co-generation in industries and commercial buildings by implementing key strategic measures to reduce barriers.	135.03	346.85	837.98
Initiative 5: **Energy Efficient Building Design**	Energy Efficiency in New Buildings	Incorporating Energy Efficiency in new building designs and constructions.	NA	NA	NA

Note: *NA: Not Applicable

Table B - 4: Distribution of Clean Development Mechanism Project Activities by Project Type

Type	Sub-type	No. of Registered Projects	% of Total Number of Projects	Annual Emission Reduction Potential (t CO_2 eq.)	% of Total Annual Emission Reduction Potential	CERs Issued KP1 (2006 - 2012)	CERs Issued KP2 (2013 - 2021)	Total CERs Issued	Estimated Investment (mil USD)
Biomass energy	Oil palm solid biomass	31	20.81%	2,485,484.00	4.50%	4,053,859.00	943,726.00	4,997,585.00	157.17
	Agricultural residues	6	4.03%	677,780.00	1.23%	1,051,665.19	94,078.80	1,145,744.00	10.07
	Wood waste	4	2.68%	130,537.00	0.24%	-	-	-	22.87
	Gasification	1	0.67%	26,983.00	0.05%	-	-	-	-
Energy efficiency	Electronics	2	1.34%	7,786.00	0.01%	-	-	-	6.00
	Machinery	1	0.67%	173.00	0.00%	-	-	-	0.13
Hydropower	Run of river	3	2.01%	105,083.00	0.19%	42,922.00	-	42,922.00	29.26
	New dam	2	1.34%	260,421.00	0.47%	16,920.00	25,709.00	42,629.00	4.97
Landfill gas	LFG power	6	4.03%	586,488.00	1.06%	740,194.00	3,184,151.00	3,924,345.00	24.25
	LFG flaring	3	2.01%	360,707.00	0.65%	12,623.00	-	12,623.00	1.20
CH_4 avoidance	Palm oil mill effluent	24	16.11%	983,950.00	1.78%	31,244.89	208,421.11	239,666.00	7.05
	Composting	27	18.12%	753,426.00	1.36%	202,534.00	673.00	203,207.00	37.83
	Wastewater	34	22.82%	47,668,628.91	86.33%	1,363,836.00	-	1,363,836.00	47.67
EE supply side	Single to combined cycle	1	0.67%	595,460.00	1.08%	1,326,055.00	-	1,326,055.00	104.79
Fuel switch	New NG plant	1	0.67%	299,832.00	0.54%	8,325.60	468,731.41	477,057.00	-
Geothermal	Geothermal electricity	1	0.67%	269,026.00	0.49%	-	-	-	-
Transport efficient	Efficient vehicle	2	1.34%	3,156.00	0.01%	25.04	1,552.96	1,578.00	-
Total		**149**	**100.00%**	**55,214,920.91**	**100.00%**	**8,850,203.72**	**4,927,043.28**	**13,777,247.00**	**453.26**

Table B - 5: Distribution of Voluntary Carbon Market Project Activities by Project Type

Project Type	No. of Projects	Project Estimate of Annual ERs (t CO2 eq.)	Total VCUs Issued	Total VCUs Retired	Balance Issued VCUs in the VCS Registry
CH_4 avoidance	8	217,714			
Biomass energy	1	21,660			
Hydropower	2	45,219	10,692		
Reforestation	1	138,013	509,540	509,540	-
Total	12	422,606			

UNITS

ºC	degree Celsius
cm	centimetre
CO_2 eq.	carbon dioxide equivalent
g	gram
Gg	Gigagram
GWh	Gigawatt hour
ha	hectare
hr	hour
kg	kilogram
km	kilometre
km^2	square kilometre
kt	kilo tonne
ktoe	kilo tonne of oil equivalent
kWh	kilowatt hour
m	metre
m^3	cubic metre
mm	millimetre
Mt	million tonne
Mtoe	million tonne of oil equivalent
MW	megawatt
MWh	megawatt hour
PJ	Peta Joule
RM	Ringgit Malaysia (Malaysian Ringgit)
t	tonne
TJ	Tera Joule
toe	tonnes of oil equivalent
yr	year

CHEMICAL ELEMENTS

C	Carbon
K	Potassium
N	Nitrogen
P	Phosphorous

GASES

CO	carbon monoxide
CO_2	carbon dioxide
CH_4	methane
HFCs	hydrofluorocarbons
NF_3	nitrogen trifluoride
N_2O	nitrous oxide
NMVOCs	non-methane volatile organic compounds
NOx	nitrogen oxide
PFC	perfluorocarbon
SF_6	sulphur hexafluoride
SO_2	sulphur dioxide

CONVERSION TABLE

1 tonne	= 10^3 kg	= 10^6 g	
1 k tonne	= 10^6 kg	= 10^9 g	= 1 Gg
1 M tonne	= 10^9 kg	= 10^{12} g	= 10^3 Gg
1 km^2	= 100 ha		
1 TJ	= 10^{12} Joules		
1 PJ	= 10^{15} Joules	= 10^3 TJ	

LIST OF ACRONYMS

AFOLU	Agriculture, Forestry and Other Land Use
AMB	Ambitious
APAD	Land Public Transport Agency
AR4	Fourth Assessment Report
ASEAN	Association of Southeast Asian Nations
ASM	Academy of Sciences Malaysia
ATF	Authorised Treatment Facility Framework
BAU	Business as Usual
BHC	British High Commission
BUR	Biennial Update Report
BUR2	Second Biennial Update Report
BUR3	Third Biennial Update Report
BUR4	Fourth Biennial Update Report
B5	A blend of 5% palm-based fatty acid methyl ester and 95% petroleum diesel
B7	A blend of 7% palm-based fatty acid methyl ester and 93% petroleum diesel
CBOs	Community-based Organisations
CDM	Clean Development Mechanism
CER	Certified Emission Reductions
CFS	Central Forest Spine
CGEs	Consultative Group of Experts
CHP	Combined Heat and Power
CIDB	Construction Industry Development Board
CNCA	Cement and Concrete Association
CNG	Compressed natural gas
CPAs	Component Project Activities
CSEF	Country-specific Emission Factor
DEFRA	Department for Environment, Food and Rural Affairs
DID	Department of Irrigation and Drainage
DoA	Department of Agriculture
DoF	Department of Fisheries
DOM	Dead Organic Matter
DOE	Department of Environment
DOSM	Department of Statistics Malaysia
DRR	Disaster Risk Reduction
DVS	Department of Veterinary Services
EACG	Energy Audit Conditional Grant
EAF	Electric Arc Furnace

EBT	Energy Balance Table
EC	Energy Commission
ECBI	European Capacity Building Initiative
EEVs	Energy Efficient Vehicles
EF	Emission Factors
EPC	Energy Performance Contract
EPU	Economic Planning Unit (under the Prime Minister's Department)
ERL	Express Rail Link
ESCO	Energy Service Companies
ETS	Electric Train Service
EV	Electric Vehicle
FAOSTAT	Food and Agriculture Organization Statistics
FiT	Feed-in-Tariff
FRIM	Forest Research Institute of Malaysia
GBI	Green Building Index
GCF	Green Climate Fund
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GGP	Government Green Procurement
GHG	Greenhouse gas
GITA	Green Investment Tax Allowance
GITE	Green Income Tax Exemption
GIZ	German Agency for International Cooperation
GLAD	Global LCA Data Access
GNI	Gross National Income
Green PASS	Green Performance Assessment System
GTFS	Green Technology Financing Scheme
GWP	Global warming potential
HoB	Heart of Borneo
ICE	Internal combustion engine
IFAD	International Fund for Agricultural Development
IKI	International Climate Initiative
IMR	Institute for Medical Research
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
IRDA	Iskandar Regional Development Authority
ISIC	International Standard Industrial Classification of All Economic Activities
IWK	Indah Water Konsortium
JCM	Joint Credit Mechanism
JICA	Japan International Cooperation Agency
JMG	Minerals and Geoscience Department (Jabatan Mineral dan Geosains)
JPP	Sewage Services Department

JPSPN	National Solid Waste Management Department (Jabatan Pengurusan Sisa Pepejal Negera)
KASA	Kementerian Alam Sekitar dan Air (Ministry of Environment and Water)
KeTSA	Kementerian Tenaga dan Sumber Asli (Ministry of Energy and Natural Resources)
KPDNHEP	Kementerian Perdagangan Dalam Negeri dan Hal Ehwal Pengguna Malaysia (Ministry of Domestic Trade and Consumer Affairs)
KTM	Keretapi Tanah Melayu
LCA	Life-cycle Assessment
LCCF	Low Carbon Cities Framework
LCID	Life Cycle Inventory Database
LCOE	Levelized Cost of Energy
LDAR	Leak Detection and Repair
LKIM	Lembaga Kemajuan Ikan Malaysia (Fisheries Development Authority of Malaysia)
LRT	Light Rail Transit
LSS	Large-Scale Solar
LULUCF	Land Use, Land Use Change and Forestry
MAA	Malaysian Automotive Association
MABDR	Malaysia Automotive Bumiputra Development Roadmap
MAFI	Ministry of Agriculture and Food Industries
MAHR	Malaysia Automotive Human Capital Roadmap
MARii	Malaysia Automotive, Robotics and IoT Institute
MARDI	Malaysia Agriculture Research and Development Institute
MARR	Malaysia Automotive Remanufacturing Roadmap
MASCR	Malaysia Automotive Supply Chain Development Roadmap
MATR	Malaysia Automotive Technology Roadmap
MCB	Malayan Cement Berhad
MCB	Malaysian Cocoa Board
MDSES	Malaysia Distributed Solar and Energy Storage
MESTECC	Ministry of Energy, Science, Technology, Environment and Climate Change
MetMalaysia	Malaysian Meteorological Department
MEPS	Minimum Energy Performance Standards
MGTC	Malaysian Green Technology Corporation
MHLG	Ministry of Housing and Local Government
MIGHT	Malaysian Industry-Government Group for High Technology
MIROS	Malaysian Institute of Road Safety Research
MISIF	Malaysian Iron and Steel Industry Federation
MITI	Ministry of International Trade and Industry
MOH	Ministry of Health
MOSTI	Ministry of Science, Technology & Innovation
MOT	Ministry of Transport

MMU	Minimum Mapping Unit
MNRE	Ministry of Natural Resources and Environment
MNHP	Malaysia National Health Policy
MPIC	Ministry of Plantation Industries and Commodities
MPOB	Malaysian Palm Oil Board
MRB	Malaysian Rubber Board
MRT	Mass Rapid Transit
MRV	Measurement, Reporting and Verification
MSA	Malaysia Steel Association
MSIG	Malaysian Sewarage Industry Guidelines
MWIG	Malaysia Water Industry Guide
MWA	Malaysian Water Associations
MyCAC	Malaysia Climate Change Action Council
MyCREST	Malaysian Carbon Reduction and Environmental Sustainability Tool
MyHIJAU	Malaysia Green Technologies Tax Incentives Scheme
MyOrganic	Malaysia Organic Certification Scheme
NADMA	National Disaster Management Agency
NAHRIM	National Hydraulic Research Institute of Malaysia
NAP	National Automotive Policy
NC	National Communication
NC2	Second National Communication
NC3	Third National Communication
NDC	Nationally Determined Contribution
NEB	National Energy Balance
NEEAP	National Energy Efficiency Action Plan
NEM	Net-energy Metering
NEP	Net Energy Policy
NKTB	National Kenaf and Tobacco Board
NPP-3	National Physical Plan-3
NGOs	Non-governmental Organisations
NGV	Natural Gas Vehicle
NIES	National Institute for Environmental Studies (Japan)
NMVOCs	Non-methane volatile organic compounds
NRPP 2030	National Rural Physical Plan 2030
NSCCC	National Steering Committee on Climate Change
NSCREDD	National Steering Committee on REDD plus
NUP-2	Second National Urbanisation Policy
PA	Protected Area
PETRONAS	Petroleum Nasional Bhd (National Petroleum Limited)
PFCs	Perfluorocarbons
PoAs	Programme of Activities
POME	Palm Oil Mill Effluent
PRFs	Permanent Reserved Forests

PV	Photovoltaic
QA	Quality Assurance
QC	Quality Control
R&D	Research and Development
RE	Renewable Energy
REDD plus	Reducing Emissions from Deforestation and Forest Degradation, and the Role of Conservation, Sustainable Management of Forests and Enhancement of Forest Carbon Stocks in Developing Countries
SBST	Stage Bus Service Transformation
SDC	Sabah Development Corridor
SEB	Sarawak Energy Berhad
SEADPRI	Southeast Asia Disaster Prevention Research Initiative
SEDA	Sustainable Energy Development Authority
SEDIA	Sabah Economic Development and Investment Authority
SESB	Sabah Electricity Sdn Bhd
SIRIM	Standard and Industrial Research Institute of Malaysia
SLF	State Land Forests
SMEs	Small and Medium Enterprises
SME Corp	Small and Medium Enterprise Corporation
SPAN	National Water Services Commission
SSD	Sewerage Services Department
STI	Science, Technology and Innovation
SW Corp	Solid Waste and Public Cleansing Management Corporation
SWG/SWGs	Sub-Working Group/ Sub-Working Groups
TCCC	Technical Committee on Climate Change
TDM	Malaysian Army (Tentera Darat Malaysia)
TNB	Tenaga Nasional Berhad
TOR	Terms of Reference
TPA	Totally Protected Area
TUDM	Royal Malaysian Air Force (Tentera Udara Diraja Malaysia)
TWG/TWGs	Technical Working Group/Technical Working Groups
UKM	Universiti Kebangsaan Malaysia (National University of Malaysia)
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organisation
UNITEN	Universiti Tenaga Nasional
USEPA	United States Environmental Protection Agency
V&A	Vulnerability and Adaptation
VCS	Verified Carbon Standard
VCUs	Verified Carbon Units
WGIA	Workshops on GHG Inventories in Asia

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GHG INVENTORY

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Department of Marine

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KL Airport Services Sdn. Bhd.
Land and Survey Department, Sarawak
Linde (M) Sdn Bhd
Lotte Titan Chemicals Sdn. Bhd.
Machinery and Equipment Manufacturers Association
Malaysia Airlines, Firefly, Mas Wings, Mas Kargo
Malaysia Airports (Sepang) Sdn. Bhd.
Malaysia Airports Holdings Berhad
Malaysia Automotive Institute
Malaysia Palm Oil Board
Malaysia Sheet Glass (M) Sdn. Bhd.
Malaysia Steel Association
Malaysia Steel Works
Malaysian Agricultural Research and Development Institute
Malaysian Automotive Association
Malaysian Cement and Concrete Association
Malaysian Chambers of Mines
Malaysian Cocoa Board
Malaysian Cocoa Board
Malaysian Industrial Development Authority
Malaysian Institute of Road Safety Research
Malaysian Iron and Steel Federation
Malaysian Newsprint Industries

Malaysian Palm Oil Board
Malaysian Pineapple Industry Board
Malaysian Rubber Board
Malaysian Space Agency
Malaysian Textile Manufacturers Association
MCB Industries Sdn. Bhd.
Ministry of Agriculture and Food Industries
Ministry of Domestic Trade and Consumer Affairs
Ministry of Energy and Natural Resources
Ministry of Housing and Local Government
Ministry of Local Government and Housing Sabah
Ministry of Natural Resources and Urban Development Sarawak
Ministry of Plantation Industries and Commodities
Ministry of Public Health, Housing and Local Government Sarawak
Ministry of Transport
Monument Mining Limited
Muda Agricultural Development Authority
National Water Services Commission
Natural Resources and Environment Board, Sarawak
Newton Leather Industries Sdn. Bhd.
Om Material Sdn Bhd
P.T Sampoerna JL Sdn. Bhd
Pertama Ferroalloy Sdn. Bhd.
PETRONAS
Philip Morris Malaysia Sdn. Bhd.
Ramsmark Tobacco Company Sdn. Bhd.
Rbm Building Machinery Trading Sdn. Bhd.
Sabah Electricity Sdn. Bhd.
Sabah Forestry Department
Sabah Parks
Sabah State Railways
Sakura Ferralloy Sdn. Bhd.
Sarawak Economic Planning Unit
Sarawak Energy Berhad
Sarawak Forestry Department
SC Wooden Products Manufacturing Sdn. Bhd.
Sewerage Services Department
Sewerage Services Department Sabah
Sewerage Services Department Sarawak
SGS (Malaysia) Sdn. Bhd.

Shell
Solutionpack Machinery (Malaysia) Sdn. Bhd.
Southern Steel
Subang Sky Park. Sdn. Bhd.
Tenaga Nasional Berhad
Tobacco Imports and Manufacturer Sdn. Bhd.
Universiti Putra Malaysia
Woodlandor Wood Products Sdn. Bhd.

MITIGATION

Lead Ministry

Ministry of Environment and Water

Sector Lead Agencies and Members

Centre for Environment, Technology and Development, Malaysia
Department of Environment
Department of Town and Country Planning
Economic Planning Unit, Prime Minister's Department (Energy Division, Macroeconomics Division, and Environmental and Natural Resources Division)
Energy Commission
Institute of Energy Policy and Research, Universiti Tenaga Nasional
Iskandar Regional Development Authority
Malaysian Agriculture Research and Development Institute
Malaysian Green Technology and Climate Change Corporation
Malaysian Meteorological Department
Melaka Green Technology Corporation
Ministry of Agriculture and Food Industries
Ministry of Energy and Natural Resources
Ministry of Housing and Local Government
Ministry of International Trade and Industry
Ministry of Plantation Industries and Commodities
Ministry of Transport
National Solid Waste Management Department
Sabah State Economic Planning Unit
Sarawak Economic Planning Unit
SIRIM Berhad
Sustainable Energy Development Authority Malaysia

Contributors

Civil Aviation Authority of Malaysia
Department of Agriculture (Peninsular Malaysia, Sabah and Sarawak)
Department of Environment
Department of Survey and Mapping
Department of Town and Country Planning
Department of Veterinary Services
Department of Wildlife and National Parks
Economic Planning Unit, Prime Minister's Department
Energy Commission
Environment Protection Department Sabah
Forest Department Peninsular Malaysia
Green Building Index Sdn Bhd
Indah Water Konsortium Sdn Bhd
Land Public Transport Commission
Malaysia Automotive Institute
Malaysia Investment Development Authority
Malaysian Cocoa Board
Malaysian Institute of Road Safety Research
Malaysian Palm Oil Board
Malaysian Timber Industry Board
Marine Department Malaysia
Melaka Green Technology Corporation
Ministry of Domestic Trade and Consumer Affairs
Ministry of Energy and Environmental Sustainability Sarawak
Ministry of Finance
Ministry of Local Government and Housing Sabah
Ministry of Public Health, Housing and Local Government Sarawak
Ministry of Utilities Sarawak
National Landscape Department
National Solid Waste Management Department
Natural Resources and Environmental Board Sarawak
PETRONAS
Sabah Electricity Sdn Bhd
Sabah Forest Department
Sabah Parks
Sabah Wildlife Department
Sarawak Energy Berhad
Sarawak Forest Department
Sarawak Forestry Corporation

Sewerage Service Department
Single Buyer
SME Corporation Malaysia
Solid Waste and Public Cleansing Management Corporation
State Governments
TNB Research Sdn. Bhd.
Universiti Kebangsaan Malaysia

TRANSPARENCY RELATED ACTIVITIES

Lead Ministry

Ministry of Environment and Water

Members (Energy)

Ministry of Energy and Natural Resources
Ministry of Transport
Economic Planning Unit, Prime Minister's Department
Ministry of Plantation Industries and Commodities
Energy Commission
Sabah State Economic Planning Unit
Ministry of Energy and Environmental Sustainability Sarawak
Sabah Electricity Sdn Bhd
Sarawak Energy Berhad
Single Buyer

Technical Committee on Climate Change (TCCC)

Deputy Secretary-General (Environment), Ministry of Environment and Water (Chair)
Climate Change Division, Ministry of Environment and Water (Secretariat)
Economic Planning Unit, Prime Minister's Department
Forest Research Institute Malaysia
Ministry of Energy and Natural Resources
Ministry of Finance
Malaysia Meteorological Department
National Water Research Institute of Malaysia

National Steering Committee on Climate Change (NSCCC)

Secretary General Ministry of Environment and Water (Chair)
Climate Change Division, Ministry of Environment and Water (Secretariat)
Ministry of Finance
Ministry of Foreign Affairs
Ministry of Energy and Natural Resources

Ministry of Transport
Ministry of Housing and Local Government
Ministry of International Trade and Industry
Ministry of Agriculture and Food Industries
Ministry of Science, Technology and Innovation
Ministry of Plantation Industries and Commodities
Ministry of Women, Family and Community Development
Ministry of Works
Economic Planning Unit, Prime Minister's Department
Attorney General Chambers
Department of Environment
National Hydraulic Research Institute of Malaysia
Malaysian Meteorological Department
Forest Research Institute Malaysia
National Disaster Management Agency
Department of Town and Country Planning
Malaysian Green Technology and Climate Change Corporation
Southeast Asia Disaster Prevention Research Institute
Centre for Environment, Technology and Development, Malaysia
Malaysia Nature Society
Environmental Protection Society Malaysia
WWF Malaysia