MALAYSIA

THIRD BIENNIAL UPDATE REPORT TO THE UNFCCC

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TO THE UNFCCC

This is Malaysia's Third Biennial Update Report submitted to the United Nations Framework Convention on Climate Change in December 2020.

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Unit

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

Chemical Elements

C	Carbon
K	Potassium
N	Nitrogen
P	Phosphorous

Gases

CO	carbon monoxide
CO_2	carbon dioxide
CO_2 eq	carbon dioxide equivalent
CH_4	methane
HFCs	hydrofluorocarbons
NF_3	nitrogen trifluoride
N_2O	nitrous oxide
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
ATF	Authorised Treatment Facility Framework
BAU	Business as Usual
BUR	Biennial Update Report
BUR2	Second 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
CNG	Compressed natural gas
CIDB	Construction Industry Development Board
CPAs	Component Project Activities
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
DVS	Department of Veterinary Services
EACG	Energy Audit Conditional Grant
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)
ESCO	Energy Service Companies
FAOSTAT	Food and Agriculture Organisation 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
IKI	International Climate Initiative
IMR	Institute of Medical Research
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
IWK	Indah Water Konsortium
JICA	Japan International Cooperation Agency
KASA	Kementerian Alam Sekitar dan Air (Ministry of Environment and Water)
KeTSA	Kementerian Tenaga dan Sumber Asli (Ministry of Energy and Natural Resources)
KTM	Keretapi Tanah Melayu
LCA	Life-cycle Assessment
LCCF	Low Carbon Cities Framework
LCID	Life Cycle Inventory Database
LKIM	Lembaga Kemajuan Ikan Malaysia (Fisheries Development Authority of Malaysia)
LRT	Light Rail Transit
LULUCF	Land Use, Land Use Change and Forestry
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	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
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
MMU	Minimum Mapping Unit
MNRE	Ministry of Natural Resources and Environment
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
MyCREST	Malaysian Carbon Reduction and Environmental Sustainability Tool
MyHIJAU	Malaysia Green Technologies Tax Incentives Scheme
MyOrganic	Malaysia Organic Certification Scheme
NAHRIM	National Hydraulic Research Institute of Malaysia
NC	National Communication
NDC	Nationally Determined Contribution
NEEAP	National Energy Efficiency Action Plan
NGOs	Non-governmental Organisations
NGV	Natural Gas Vehicle
NIES	National Institute for Environmental Studies (Japan)
NMVOCs	Non-methane volatile organic compounds
NSC	National Steering Committee
NSCCC	National Steering Committee on Climate Change
NSCREDD	National Steering Committee on REDD plus
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
QA	Quality Assurance
QC	Quality Control
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
SEB	Sarawak Energy Berhad
SEDA	Sustainable Energy Development Authority
SESB	Sabah Electricity Sdn Bhd

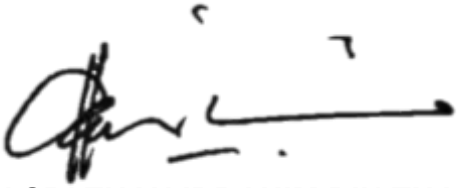
SIRIM	Standard and Industrial Research Institute of Malaysia
SLF	State Land Forests
SMEs	Small and Medium Enterprises
SME Corp	Small and Medium Enterprise Corporation
SSD	Sewerage Services Department
SW Corp	Solid Waste and Public Cleansing Management Corporation
SWG/SWGs	Sub-Working Group/ Sub-Working Groups
TNB	Tenaga Nasional Berhad
TPA	Totally Protected Area
TWG/TWGs	Technical Working Group/Technical Working Groups
UKM	Universiti Kebangsaan Malaysia (National University of Malaysia)
UNDP	United Nations Development 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
VCS	Verified Carbon Standard
VCUs	Verified Carbon Units
WGIA	Workshops on GHG Inventories in Asia

Foreword

It gives me great pleasure to present to you Malaysia's Third Biennial Update Report (BUR3) to the United Nations Framework Convention on Climate Change (UNFCCC). The BUR3 highlights estimations of anthropogenic emissions and removals in four sectors, namely energy; industrial processes and product used (IPPU); agriculture, forestry and other land use (AFOLU), and waste sectors with time series estimates from 1990 to 2016. The mitigation actions and their effects in 2016 were also reported. The estimation of GHG emissions avoidance from these actions were identified from three sectors, namely the energy, waste and forestry sectors. The chapter also contains information on future mitigation action targets and the implementation key enablers at national and sub-national level.

As this report was being prepared, the world was in the struggle of the COVID-19 pandemic. It became apparent that the challenges from the pandemic would be profound and has put a constraint towards implementing climate change actions. This is as financial resources are being diverted for urgent action to combat the disease. Nevertheless, Malaysia remains committed to fulfilling our Nationally Determined Contribution. In this regard, Malaysia will continue to play constructive role to strengthen our responses in accordance with our commitments under the UNFCCC and Paris Agreement. In this report, we have also highlighted the constraints, gaps and needs to build up Malaysia's capacity to address climate change effectively.

Due to the challenges of the pandemic, the preparation for the BUR3 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 express my sincere gratitude to them and the National Steering Committee, Technical Working Groups 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.



DATO' SRI TUAN IBRAHIM BIN TUAN MAN
Minister of Environment and Water

Executive Summary

Introduction

The Third Biennial Update Report (BUR3) was prepared according to Decision 2/CP.17 of the United Nations Framework Convention on Climate Change (UNFCCC). The submission of BUR3 in 2020 is to meet Malaysia's obligations as a Party to the UNFCCC. The report is also an output of the United Nations Development Programme-Global Environment Facility (UNDP-GEF) Project. The BUR3 contains the following chapters:

Chapter 1: National Circumstances;

Chapter 2: National Greenhouse Gas Inventory;

Chapter 3: Mitigation Actions and Their Effects; and

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

1. National Circumstances

Information is provided on national circumstances up to the year 2016 for the sectors where published statistics are available. For comparison purposes, the summary of key statistics for 2005 and 2016 is provided in Table 1.15.

Over the past four decades, increasing temperature trends of 0.13^{o}C to 0.24^{o}C per decade have been observed. However the long term trends in rainfall is less pronounced. A slight decreasing trend is observed for the rainfall in Peninsular Malaysia and Sabah, whereas a slight increasing trend in rainfall is observed in Sarawak. Forest is an important heritage and eco-system of the country. In 2016 approximately 55.2% of the land remained forested. Terrestrial biodiversity is concentrated within these forests and the country is considered as one of the world's mega-diverse countries.

The total population of Malaysia in 2016 were 31.6 million. Population increased by approximately 21.5% over the period 2005-2016. Approximately 94% of the population is below 65 years old and the average life expectancy is 74.6 years.

To catalyse investment and economic growth, Malaysia launched an Economic Transformation Programme (ETP) covering the period 2010-2020 in 2010. Gross Domestic Product (GDP) (at 2010 constant prices) grew from RM659.6 billion in 2005 to RM1,108.9 billion in 2016 respectively. The main contributions to the GDP were from services (55.0%), manufacturing (23.3%), mining and quarrying (8.9%), agriculture, livestock, forestry and fishing (8.2%), and construction (4.6%).

Malaysia's primary energy supply in 2016 was recorded at 93,396 ktoe, while the final energy consumption was recorded at 57,216 ktoe (with breakdown in the transport sector (42.0%), industrial sector (28.0%), residential and commercial sector (14.1%), agriculture sector (0.7%) and non-energy use (15.3%)).

Development planning and implementation including for climate change are coordinated by the Economic Planning Unit under the Prime Minister's Department in consultation with the Ministries. These are carried out through the five-year development plans.

Since the Second Biennial Update Report submission to the UNFCCC in 2018, there was a change in the national focal point to the UNFCCC, under which the national focal point currently resides under the Ministry of Environment and Water. Operational matters on climate change are guided and endorsed by a National Steering Committee on Climate Change (NSCCC). Technical Working Groups were established under the National Communication and Biennial Update Report National Steering Committee to prepare national communications and biennial update reports to the UNFCCC. In addition, a National Steering Committee on REDD plus (NSCREDD) was established in 2011 to guide the development of a national REDD plus strategy for implementation.

2. National Greenhouse Gas Inventory

The greenhouse gas (GHG) inventory details the anthropogenic emissions and removals for the year 2016 for four sectors: energy; industrial processes and product use (IPPU); agriculture, forestry and other land use (AFOLU); and waste. The inventory also contains time series estimates from 1990 to 2016 for all the sectors that were recalculated to reflect updated activity data and emission factors. These GHG inventory estimates were obtained following the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

The total GHG emissions for 2016 were 316,833 Gg CO_2 eq for emissions without LULUCF and 75,488 Gg CO_2 eq with LULUCF as presented in the table below:

Sector	Emissions/ Removals (Gg CO_2 eq.)
Energy	251,695.02
Industrial Processes and Product Use	27,348.83
AFOLU – Agriculture	10,627.72
AFOLU – LULUCF (Emissions)	17,801.27
AFOLU – LULUCF (Removals)	-259,146.03
AFOLU – LULUCF (Sub-total)	-241,344.75
Waste	27,161.66
Total Emissions (without LULUCF)	316,833.23
Total Emissions (with LULUCF emissions part only)	334,634.51
Total Emissions (with LULUCF)	75,488.48

In 2016, in terms of GHG emissions, the energy sector remained as the largest contributor of emissions where it accounted for 79.4% of the total emissions. This is followed by the IPPU and the waste sectors, both contributed to about 8.6% of the total emissions respectively. Meanwhile, the agriculture sector contributed the lowest emissions at 3.4% while LULUCF is a net sink. In terms of gaseous, CO_2 emissions amounted to 80% of the total GHG emissions

in 2016. CH_4 emissions were 17% of the total emissions, while both N_2O and F-Gases emissions were at 2% respectively.

3. Mitigation Actions and their effects

Malaysia's key strategy to mitigate greenhouse gas emissions is in the energy, waste, and forestry sector. Mitigations in the other sectors, IPPU and Agriculture sectors have yet to be quantified. The summary to the mitigations and their effects in 2016 is shown in the table below:

Sector	Sub-sector	Mitigation Actions	Emissions avoidance achieved in 2016 (Gg CO_2 eq.)
Energy	Renewable Energy (Power)	Feed-in-Tariff (FiT)	460.52
		Hydropower	6,570.15
		Other RE by public and private licensees	231.92
	Energy Efficiency	National Energy Efficiency Action Plan (NEEAP)	458.02
	Transportation	Rail based public transport	212.93
		Use of energy-efficient vehicles	90.65
		Use of palm-based biodiesel in blended petroleum diesel	1,127.34
		Use of natural gas in vehicles	114.77
Waste	Paper recycling		3,937.76
	Biogas recovery from palm oil mill effluent		2,377.84
Forestry	Reducing deforestation, Sustainable management of forest and Conservation of carbon stocks		20,307.50

Future mitigation action targets and the implementation key enablers at national and sub-national levels were also described in sub-section 3.4 of the report.

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

In the Eleventh Malaysia Plans, substantial national resources have been allocated 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 including documenting and disclosing the level of support received.

The Global Environment Facility (GEF) was the main source of funding for climate change activities. The support received was channelled mainly towards developing Malaysia's institutional and technical capacity on reporting obligations to the UNFCCC and implementing mitigation actions. The mitigation projects supported had focused on energy efficiency in buildings, manufacturing, industrial and transport sectors. Clean and green technologies were another focus area, with projects targeting small and medium industries and low-carbon cities development.

In this current report, funding received by NGOs is also reported to the extent possible. In addition, Malaysia also received capacity building through participation in regional workshops.

Like in previous BURs, Malaysia also reported its constraints, gaps and needs for fulfilling its reporting obligation and implementation. For greenhouse gas inventory, challenges remains in the completeness and moving to higher tiers of estimates. For mitigation, technical capacity and access to clean technologies remains a major constraint. The assessment tools, use of big data and analytics are the needs identified in developing a resilient Malaysia.

1. NATIONAL CIRCUMSTANCES

1.1 Introduction

This chapter updates information on Malaysia's national circumstances up to 2016 for sectors where published statistics are available. Besides describing sectors that are relevant to climate change, the chapter also outlines the physical geography, climatic trends and climate governance arrangements.

1.2 Geography: Location and Topography

Malaysia is located in the Southeast Asia region. Its coordinates lie between 0º 51' N and 7º 33' N, and 98º 01' E and 119º 30' E. Malaysia has an area of 330,345 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, as seen on the left of Figure 1.1. These states are separated from the states of Sabah and Sarawak by the South China Sea shown on the right of Figure 1.1. The Federal Territory of Labuan is located off the coast of western Sabah.

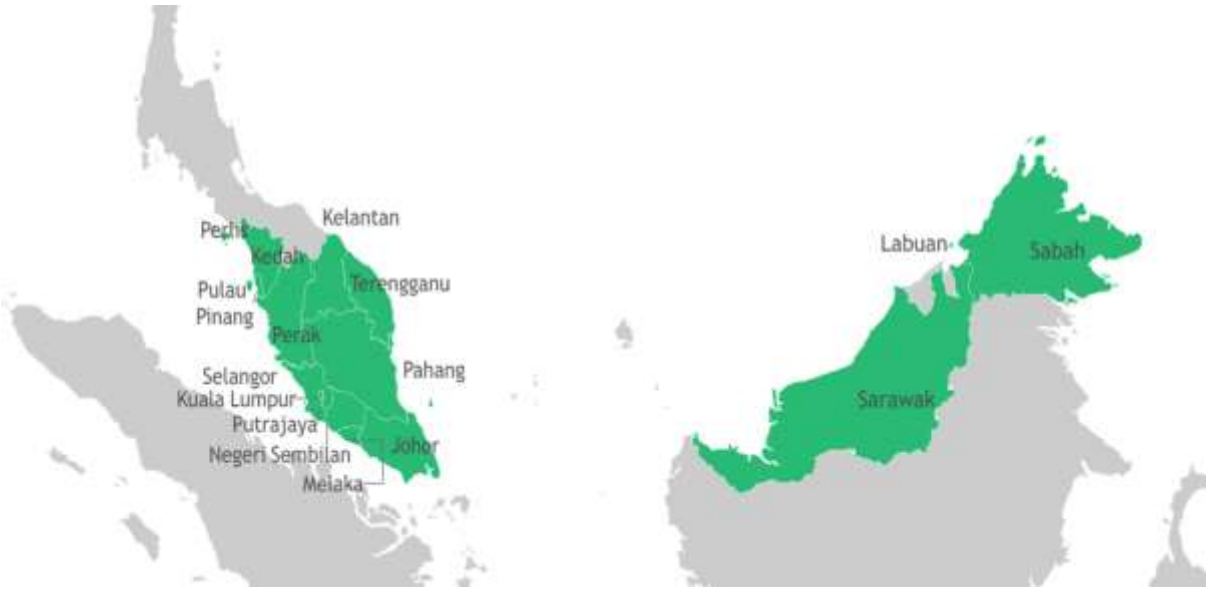


Figure 1.1: Map of Malaysia

The topography of Peninsular Malaysia ranges from coastal plains to mountainous terrains. It has a land area of approximately 131,898 km^2 and a coast length of about 1,938 km. Its north-south extent is about 746 km and its maximum east-west width is about 315 km. The central mountainous spine is known as the Titiwangsa Range and it extends from north to south for about 617 km in length and reaches 2,183 m above sea level. It divides the peninsula between its east and west coasts. 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 73,904 km^2. Its coastline runs the length of approximately 2,155 km. Sabah's topography is mountainous, primarily in the west coast, with undulating lowland basins in the eastern part. The Crocker Range divides the western coastal plains from the rest 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 124,451 km^2 and lies on the north central and western part of Borneo Island. Sarawak's coastline is about 1,109 km. Its topography features coastal plains followed by a narrow belt of hills before sharply rising into a mountainous region towards the Kalimantan border. Mount Murud at 2,422 m is the highest mountain in Sarawak. The Rajang River at 780 km is the longest river in Sarawak as well as in Malaysia.

1.3 Climate Governance

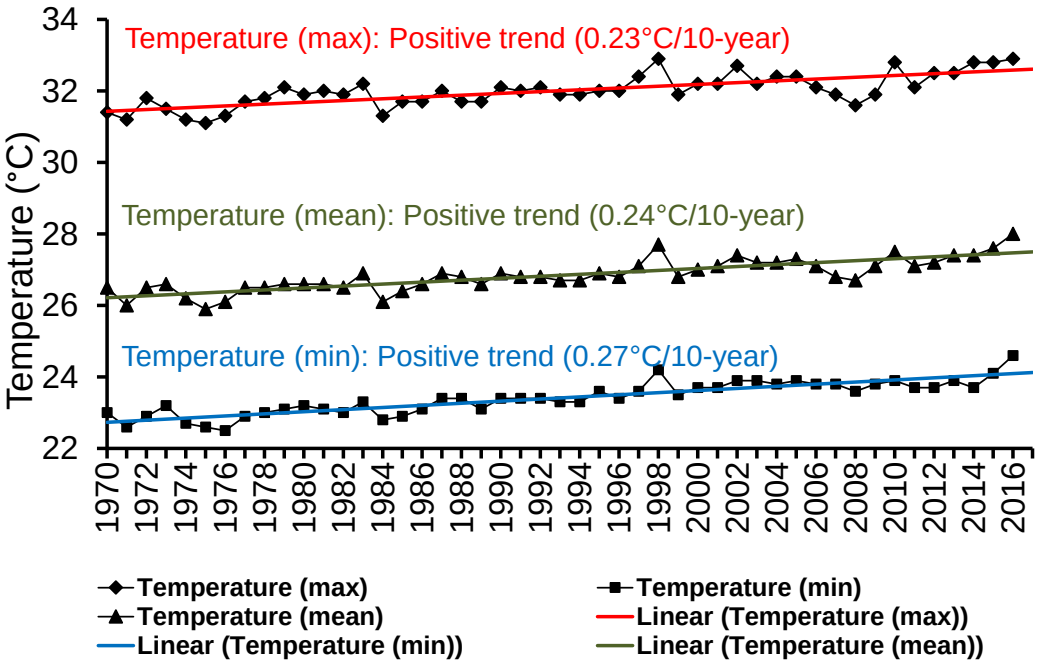
Malaysia is a constitutional elective monarchy based on the Westminster system. Its legislative power is divided between its federal and state legislatures. However, the federal legislature and the executive arm of the government has responsibility for developing and implementing policies and drafting national laws to enable the country to fulfil its international obligations in addressing climate change (for institutional arrangement of development planning and implementation, please refer to Table 1.16 under sub-section 1.12.3).

1.4 Climate

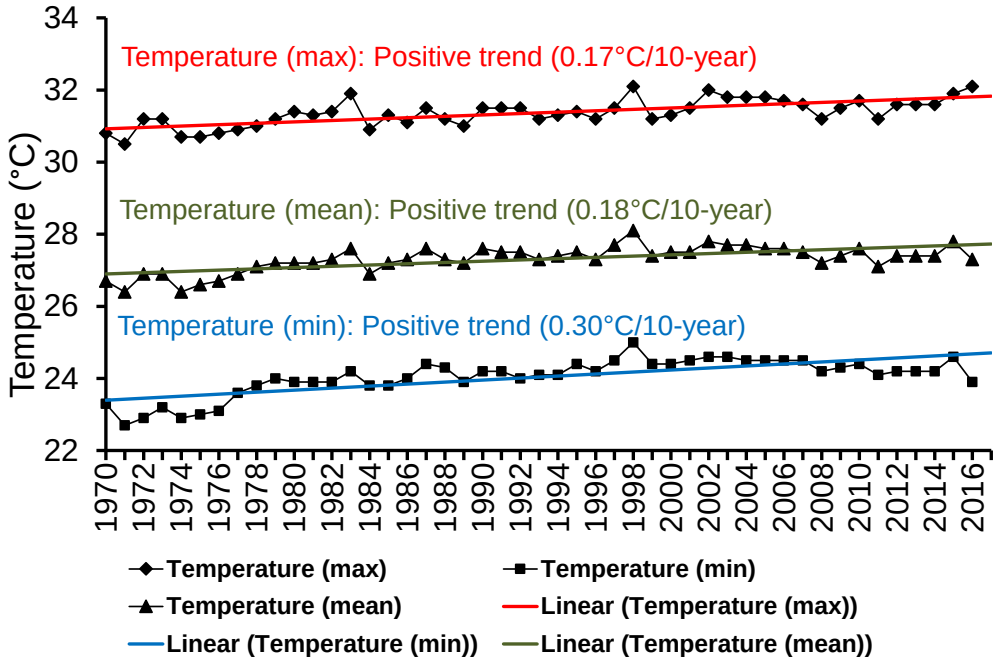
1.4.1 Annual Temperature Trends for Malaysia

Malaysia has an equatorial climate that generally has uniform daily variation of temperatures throughout the year. The daily mean temperature lies between 26 ºC and 28 ºC.

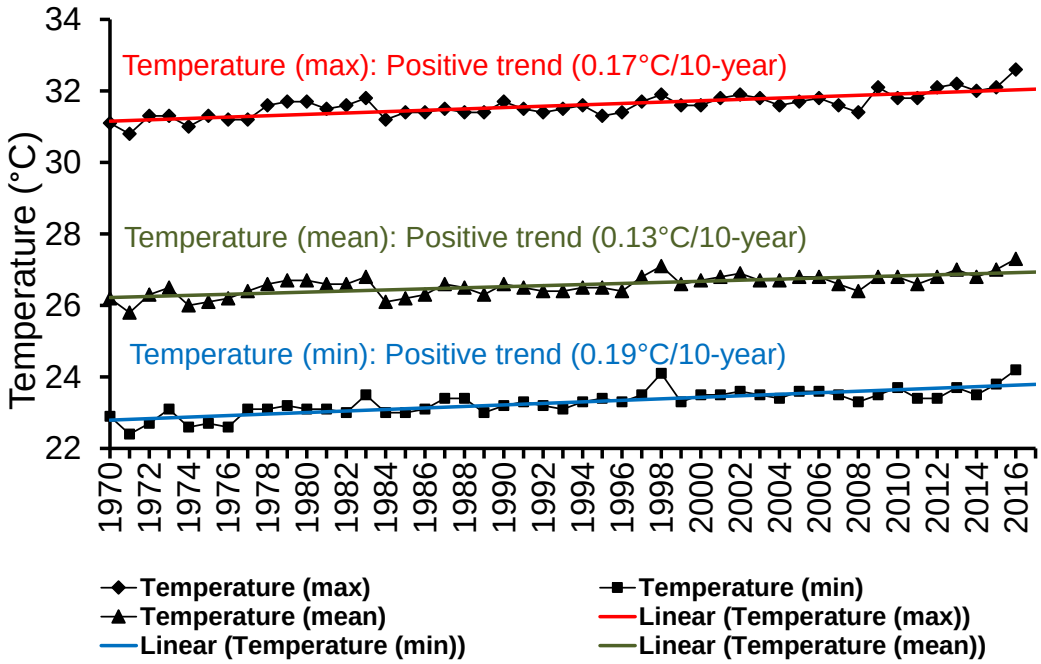
In the past 46 years, there has been a positive trend in temperature increase. Figure1.2 shows the annual trends of temperature for Peninsular Malaysia, Sarawak and Sabah from 1969 to 2016 respectively. The surface mean temperature increased by 0.13 ºC to 0.24 ºC per decade. The surface maximum temperature 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.



(a) Peninsular Malaysia



(b) Sabah



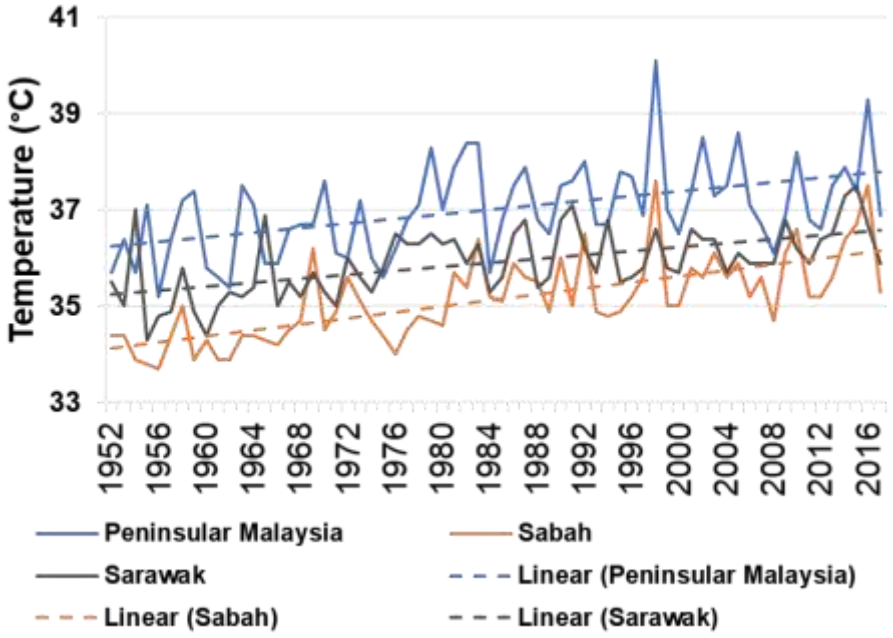
(c) Sarawak

Source: Malaysian Meteorological Department

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

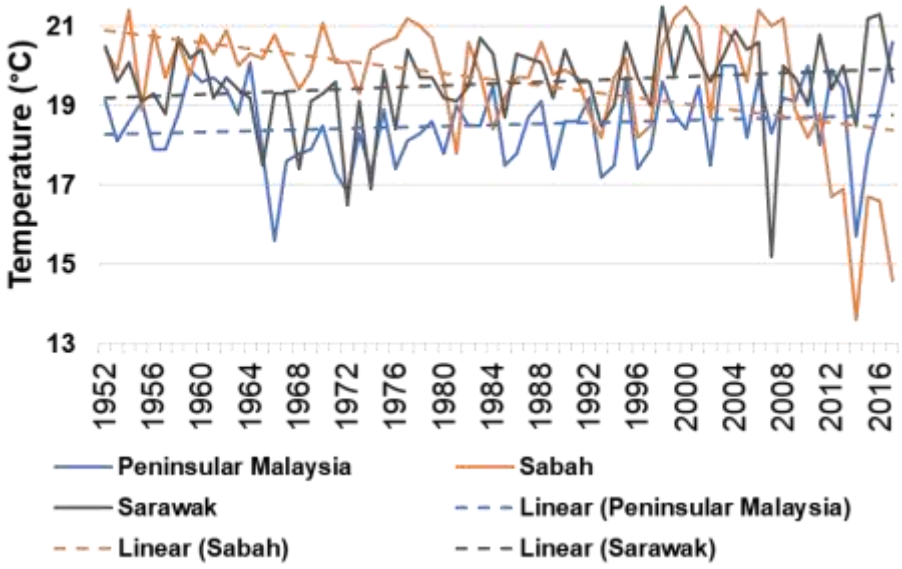
Malaysia's climate can be characterised by two monsoons which are separated by two shorter inter-monsoon periods. North-eastern winds are strong during the boreal winter monsoon which usually occurs from November to March. The boreal summer monsoon occurs between May to September with southwestern winds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

The highest daily maximum and lowest daily minimum temperatures for each year from 1952 to 2016 from the various meteorological stations across Malaysia are shown below in Figures 1.3 and 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



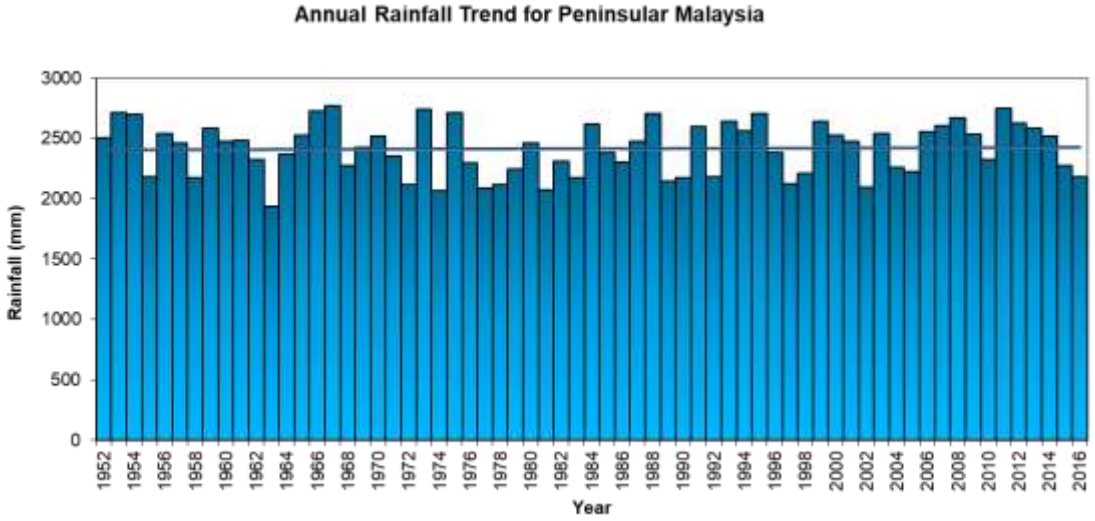
Source: Malaysian Meteorological Department

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

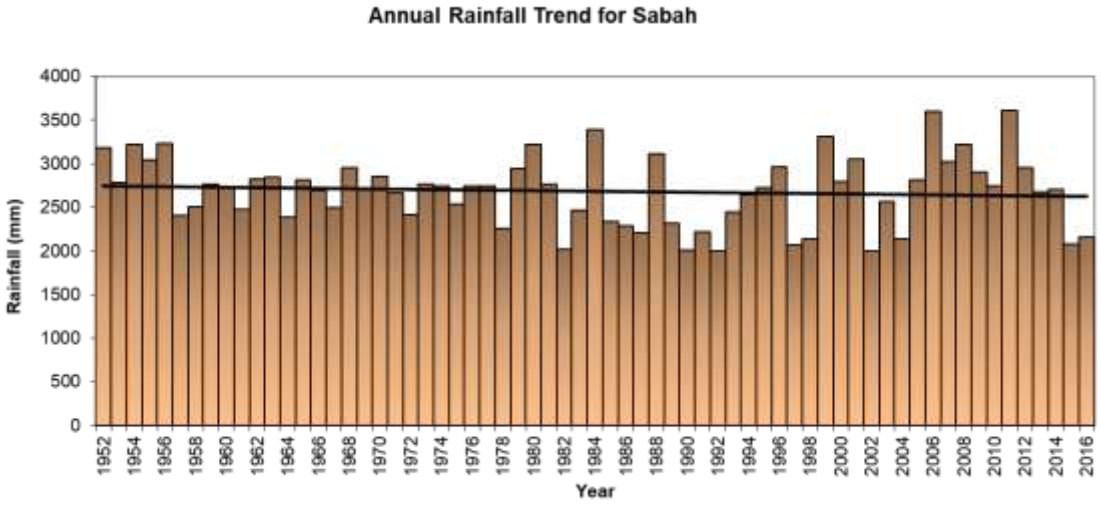
1.4.2 Annual Rainfall Distribution

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 lead to severe floods. In comparison, the southwest monsoon brings about lower rainfall. During the inter-monsoon periods, heavy rain from convective showers and thunderstorms occur in the late afternoons and evenings.

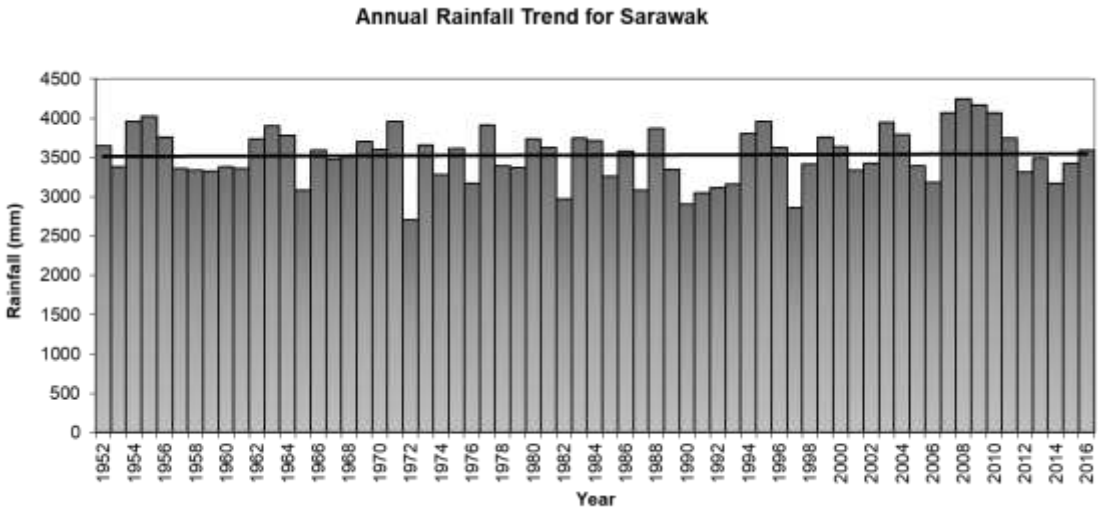
Figure 1.5 shows the annual rainfall for Peninsular Malaysia, Sabah and Sarawak from 1952 to 2016. During these years, there is a slight downward trend in rainfall for Peninsular Malaysia and Sabah while in Sarawak, there is a slight increasing trend. For a shorter timeframe from 1990 onwards, increasing trends in rainfall are observed throughout the country.



(a) Peninsular Malaysia



(b) Sabah



(c) Sarawak

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 is home to a wide range of species. Malaysia has consistently maintained more than 50% of its landmass as forest. This includes permanent reserved forests (PRFs), state land forests (SLF) and totally protected areas (TPA/PA). In 2016, 18.24 million ha, or approximately 55.2% of the total land area of Malaysia, was under forest cover. The remaining land area comprises 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 (million ha)

Year	Peninsular Malaysia	Sabah	Sarawak	Total
1990	6.27	4.44	8.07	18.78
1995	5.86	4.42	7.68	17.96
2000	5.92	4.42	7.86	18.20
2005	5.83	4.36	7.62	17.82
2010	5.86	4.44	7.63	17.93
2011	5.81	4.44	7.69	17.93
2012	5.79	4.42	7.80	18.01
2013	5.83	4.43	7.80	18.06
2014	5.80	4.44	8.03	18.28
2015	5.79	4.56	8.05	18.39
2016	5.77	4.56	7.91	18.24

Source: Ministry of Energy and Natural Resources

1.5.2 Biodiversity

Malaysia is rich in biodiversity in terms of estimated species in the respective 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 Coral	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, which includes lakes and rivers. Marine biodiversity is primarily located among islands and coastal ecosystems, especially in 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 & vegetable farms - Livestock rearing and aquaculture farms

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

The 11th Malaysia Plan (2015-2020) emphasised the need for conserving natural resources for present and future generations and had two strategies to enhance the conservation of biodiversity, namely ensuring natural resources security and enhancing alternative livelihood for indigenous and local communities. Malaysia reviewed its National Biodiversity Policy in 2016, reemphasising protection of the country's biodiversity over its 10-year implementation period.

1.6 Water Resources

Malaysia relies on its annual rainfall as its main water source. 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.

Annual rainfall in Malaysia is unevenly distributed with some states having more rain than others. High intensity and prolonged periods of rainfall will result in flooding in low-lying and coastal areas where rivers are short and catchment areas are small. Areas with smaller water catchments are also more susceptible to water stress and droughts in the future.

The National Water Resources Policy launched in 2012 outlined clear directions and strategies for water resources management, including collaborative governance to ensure water security and sustainability in accordance to the 10th Malaysia Plan. The 11th Malaysia Plan continued the policy direction and emphasised that stronger protection and conservation of water resources needs to be carried out.

1.7 Economy

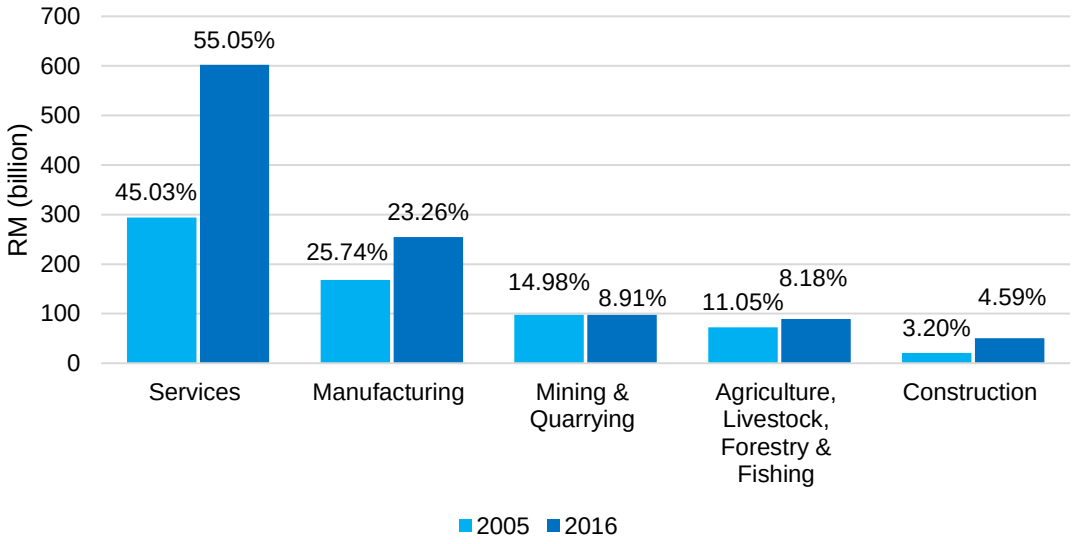
1.7.1 Gross Domestic Product and Gross National Income

Table 1.4 below shows a summary of the GDP and GNI of Malaysia while Figure 1.6 shows the sectoral contributions to GDP in 2005 and 2016.

Table 1.4: GDP and GNI at Current and Constant Prices (2010 = 100)

Year	Gross Domestic Product (GDP)		Gross National Income (GNI)		GDP per capita	GNI per capita
	RM Billion				RM	
	Current Prices	Constant Prices (2010 = 100)	Current Prices	Constant Prices (2010 = 100)	Constant Prices (2010 = 100)	Constant Prices (2010 = 100)
1990	119.1	262.6	114.0	258.5	14,509	13,937
1995	222.4	412.9	212.1	402.0	19,966	19,257
2000	356.4	521.8	519.6	503.3	22,209	21,423
2005	543.6	659.6	536.8	644.3	25,326	24,739
2010	821.4	821.4	795.3	795.3	28,733	27,819
2011	911.7	864.9	890.1	839.1	29,761	28,871
2012	971.3	912.3	935.4	871.8	30,914	29,543
2013	1,018.6	955.1	984.6	916.7	31,611	30,341
2014	1,106.4	1,012.4	1,069.8	972.5	32,968	31,670
2015	1,176.9	1,064.0	1,144.8	1,039.6	34,118	33,336
2016	1,249.7	1,108.9	1,215.1	1,085.6	35,055	34,320

Source: Economics Planning Unit, Prime Minister's Department



Note:
Contribution before adding import duties; GDP is at Constant Prices 2010
Source: Economics Planning Unit, Prime Minister's Department

Figure 1.6: Sectoral contributions to GDP for 2005 and 2016 (RM billion and %)

1.7.2 International Trade

Trade is an essential part of the Malaysian economy with Malaysia practising an open trade regime. In 2016, the Malaysian economy had a net balance of trade of RM88.1 billion, with exports accounting for almost RM787 billion and imports at nearly RM699 billion. Table 1.5 shows Malaysia's annual trade for the selected years.

Table 1.5: Summary of Malaysia's Annual Trade

Year	Gross Exports	Gross Imports	Total Trade	Balance of Trade
		(RM Million)		
2000	373,270	311,459	684,729	61,811
2005	536,234	432,871	969,104	103,363
2010	638,822	528,828	1,167,651	109,994
2015	777,355	685,778	1,463,134	91,577
2016	786,964	698,819	1,485,783	88,145

Source: Economic Planning Unit, Prime Minister's Department

In 2016, manufactured products were the bulk of total exports at 82.1%, while oil and gas products took 6.9% of the share. Agricultural products made up 7.3% of exports. The top exports were electrical and electronic products, chemical and chemical products, petroleum products, palm oil and palm-based agriculture products and machinery equipment and parts. Imports were led by intermediate goods at 57.1% while capital goods made up 14.3% of imports and consumption goods at 9.6% in 2016.

1.8 Energy Sector

1.8.1 Energy Policy

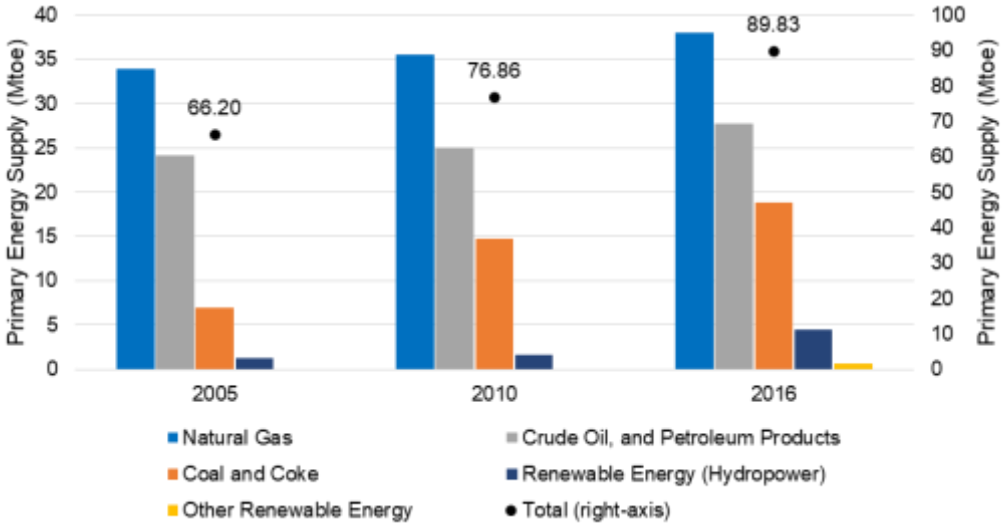
Malaysia's energy policy is guided by three principal objectives stated in the National Energy Policy (1979):

- Supply Objective - ensures adequate, secure and cost-effective energy supply through developing and utilising alternative sources of energy, both non-renewable and renewable, from within and outside the country;
- Utilisation Objective - promotes efficient utilisation of energy and discourage wasteful and non-productive patterns of energy consumption;
- Environmental Objective - minimises the negative environmental impacts of the energy supply chain i.e. energy production, conservation, transportation and utilisation.

Building on the National Depletion Policy (1980), Four Fuel Diversification Policy (1981), Five Fuel Policy (2001) and National Biofuel Policy (2006) that were formulated to ensure energy security and sustainability, the 11th Malaysia Plan further strengthened the sustainability agenda with the National Renewable Energy Policy and Action Plan introduced in 2010. The promotion of energy efficiency action plans is coordinated under the National Energy Efficiency Action Plan (NEEAP) and implemented between 2016 and 2025.

1.8.2 Energy Balance

Figure 1.7 shows a summary of Malaysia's primary energy supply in 2005, 2010 and 2016 and its breakdown by fuel type while Table 1.6 shows the breakdown in selected years from 1990 to 2016.



Source: Malaysia Energy Statistics Handbook 2018

Figure 1.7: Primary Energy Supply Breakdown for 2005, 2010 and 2016 (in Mtoe)

Table 1.6: Primary Energy Supply Breakdown in selected years (in ktoe)

Year	Natural Gas	Crude Oil and Petroleum Products	Coal and Coke	Renewable Energy	Total
1990	6,801	12,434	1,326	915	20,970
1995	13,960	16,769	1,612	1,540	33,879
2000	26,370	20,242	2,486	1,560	50,710
2005	33,913	24,264	6,889	1,313	66,211
2010	36,936	25,008	14,777	1,577	76,809
2011	35,740	26,903	14,772	1,874	79,289
2012	38,648	29,502	15,882	2,463	86,495
2013	39,973	32,474	15,067	3,217	90,731
2014	40,113	33,422	15,357	3,594	92,486
2015	39,365	29,164	17,406	4,253	90,188
2016	37,980	31,327	18,886	5,203	93,396

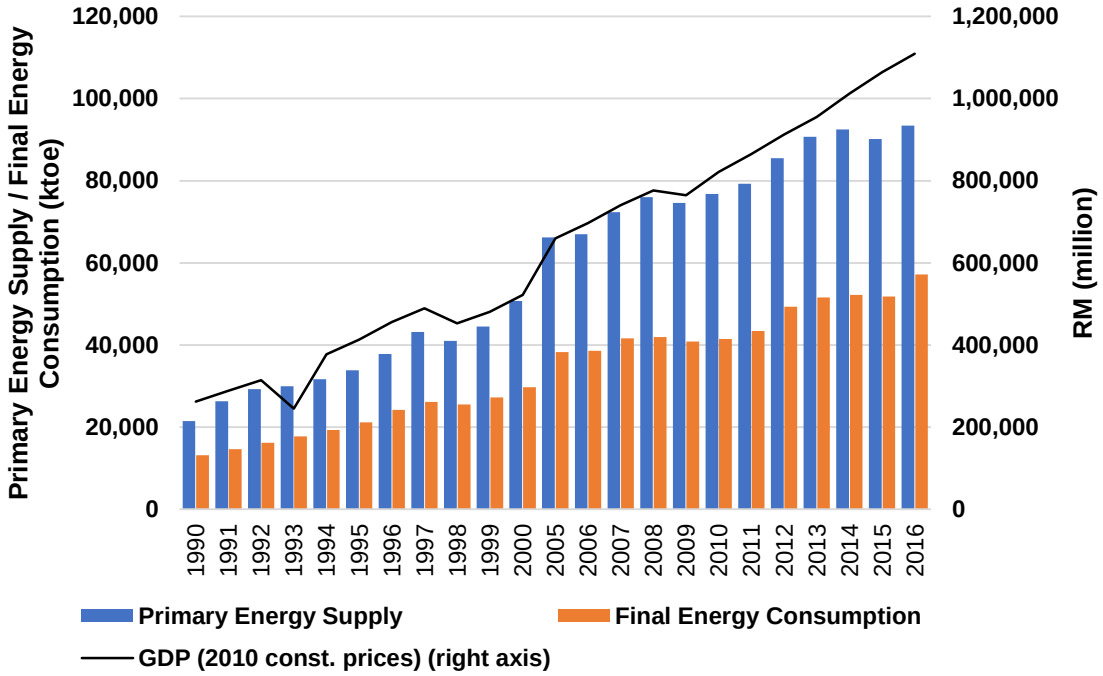
Source: Malaysia Energy Statistics Handbook 2018

Malaysia's final energy consumption according to its sectoral breakdown is shown in Table 1.7 while the trends in GDP, primary energy supply and final energy consumption is shown in Figure 1.8.

Table 1.7: Final energy consumption by sector (in ktoe)

Year	Transport	Industry	Residential and Commercial	Non-energy use	Agriculture	Total
1990	5,386	5,276	1,622	838	-	13,122
1995	7,827	8,060	2,556	2,994	446	21,883
2000	12,071	11,406	3.868	2,250	104	29,699
2005	15,384	15,492	5,134	2,173	101	38,284
2010	16,828	12,928	6,951	3,696	1,074	41,477
2011	17,070	12,100	6,993	6,377	916	43,456
2012	19,757	13,919	7,065	7,497	1,053	49,291
2013	22,357	13,496	7,403	7,277	1,051	51,584
2014	24,327	13,162	7,458	6,217	1,045	52,209
2015	23,435	13,989	7,559	5,928	895	51,806
2016	24,004	16,019	8,049	8,729	415	57,216

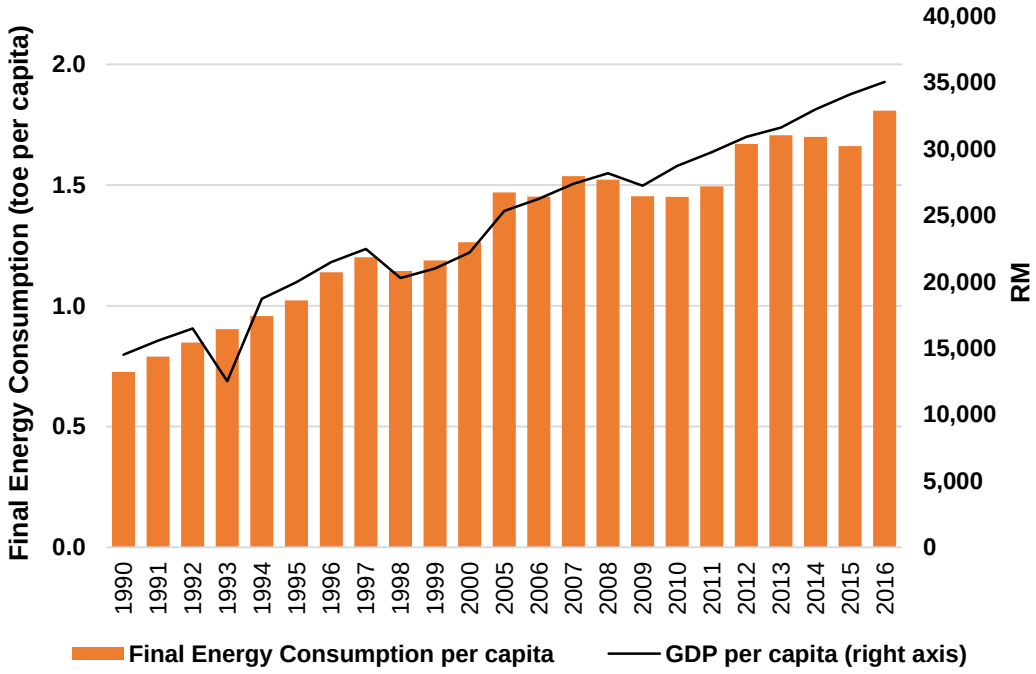
Note: Final energy use of transport sector includes fuel consumption in the international civil aviation
Source: Malaysia Energy Statistics Handbook 2018



Source: National Energy Balance 2016 and Malaysia Energy Statistics Handbook 2018

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

In terms of GDP per capita and final energy consumption per capita, the trends are shown in Figure1.9.



Source: National Energy Balance 2016 and Malaysia Energy Statistics Handbook 2018

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

1.8.3 Renewable Energy

The National Renewable Energy Policy and Action Plan (2010) sets out the vision of "enhancing the utilisation of indigenous renewable energy resources to contribute towards national electricity supply security and sustainable socio-economic development". The adoption of RE technology is also supported by the National Green Technology Policy (2009) and the National Green Technology Masterplan that aims to facilitate the development of green technology as a key economic driver.

The Renewable Energy Act 2011 established the Feed-in Tariff (FiT) scheme to catalyse the generation of electricity from RE sources. It offers long-term agreements (up to 21 years) to RE producers to sell electricity to the grid at premium prices. Besides that, firms that generate energy from renewable sources could apply incentives or investment tax allowance on qualifying capital expenditure incurred.

The Sustainable Energy Development Authority (SEDA) of Malaysia was formed under the Sustainable Energy Development Authority Act 2011 and has been granted statutory powers to administer and manage the implementation of the FiT mechanism. Table 1.8 and 1.9 highlight the implementation of the FiT mechanism. In 2016, two new mechanisms, the Large Scale Solar and Net Energy Metering were introduced to increase the deployment of solar technologies to complement the FiT effort.

Table 1.8: Cumulative Installed Capacities (MW) of Grid-connected FiT Renewable Energy Projects

Year	Biogas	Biomass	Small Hydro	Solar PV	Total
2012	5.2	36.9	11.7	31.6	85.3
2013	11.7	36.9	11.7	138.6	198.9
2014	12.8	49.4	11.7	203.7	277.6
2015	20.2	68.4	18.3	230.5	337.4
2016	30.9	75.4	30.3	284.3	450.9

Source: National Energy Balance 2016, Malaysia Energy Statistics Handbook 2018, SEDA

Table 1.9: Annual Power Generation (MWh) of Commissioned FiT Renewable Energy Installations

Year	Biogas	Biomass	Small Hydro	Solar PV	Total
2012	7,564	104,544	25,630	5,319	143,057
2013	22,767	220,552	79,082	50,757	373,158
2014	51,617	230,544	67,568	184,284	534,013
2015	58,111	210,462	55,406	263,875	587,854
2016	87,629	188,137	47,798	316,965	640,529

Source: SEDA

1.9 Agriculture

In 2011, policies on food production and agro-commodities were separated and developed under two distinct policy documents, namely the National Agro-food 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.

1.9.1 Agricultural Crops

The agriculture area consists of primarily commodity crops such as rubber, oil palm and cocoa. Paddy is also an important agricultural crop and it is reported as the planted area including double cropping. Table 1.10 reflects the planted areas of major agricultural crops in selected years between 1990 and 2016.

Table 1.10: Planted Areas of Major Agricultural Crops ('000 ha)

Year	Crops				
	Rubber	Oil Palm	Coconut	Cocoa	Paddy
1990	1,836.6	2,029.5	171.5	393.5	680.6
1995	1,679.0	2,540.1	141.7	190.1	672.8
2000	1,430.7	3,376.7	158.6	75.8	698.7
2005	1,271.3	4,051.4	121.0	34.0	666.8
2010	1,020.4	4,853.8	105.7	20.1	677.9
2011	1,027.1	5,000.1	106.3	20.9	687.9
2012	1,041.2	5,076.9	101.0	11.8	684.5
2013	1,058.8	5,229.7	88.0	13.8	671.7
2014	1,068.7	5,392.2	88.1	16.1	679.2
2015	1,074.5	5,642.9	82.0	18.1	681.6
2016	1,078.0	5,738.0	84.6	17.4	688.8

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

1.9.2 Livestock

Total population of livestock has increased exponentially from 2005 to 2016 from 186.1 million to 302.4 million (Table 1.11). This is primarily due to the growth of poultry population from 174.7 million in 2005 to 289.7 million in 2016.

Table 1.11: Selected livestock populations

Year	Livestock								
	Buffalo-es	Cattle	Goats	Sheep	Swine	Horses	Chickens	Ducks	Total
1990	205,163	667,632	331,278	205,409	2,678,083	374	43,802,273	1,834,141	49,728,479
1995	165,061	715,279	282,109	221,588	3,150,226	2,621	97,670,921	4,602,104	106,811,688
2000	142,042	733,892	237,634	145,257	1,894,438	3,051	123,169,625	5,338,556	131,665,444
2005	133,232	781,316	287,670	115,922	2,035,647	2,367	174,694,165	8,052,997	186,107,949
2010	129,878	790,065	498,385	123,475	1,931,207	3,706	217,227,467	8,490,975	229,195,158
2011	128,205	768,710	479,444	126,412	1,816,557	3,903	229,142,007	9,219,884	241,685,122
2012	124,985	744,377	462,510	131,923	1,851,842	4,101	251,157,340	9,351,106	263,828,184
2013	123,646	751,497	434,202	141,918	1,842,953	3,684	272,451,321	9,691,491	285,441,190
2014	121,259	746,783	429,398	142,435	1,844,103	3,687	288,304,256	9,501,672	301,093,645
2015	118,569	742,38	431,651	147,033	1,886,823	3,663	286,620,834	9,897,115	299,105,609
2016	119,133	737,827	416,529	138,479	1,654,381	4,228	289,666,002	9,633,185	302,369,681

Sources: Agrofood Statistics 2015, Ministry of Agriculture and Food Industries; DVS Livestock Statistics, Department of Veterinary Services, FAOSTAT

1.10 Solid Waste

Waste generation increases in tandem with population growth. Table 1.12 provides a breakdown of average daily waste generation by region while Table 1.13 presents the number of both sanitary and non-sanitary landfills according to states in 2016.

Table 1.12: 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 1.13: Number of Landfills in Malaysia in 2016

State	Landfills in operation		Total
	Sanitary	Non-Sanitary	
Johor	2	12	14
Kedah	0	7	7
Kelantan	0	11	11
Melaka	1	0	1
Negeri Sembilan	1	5	6
Pahang	5	12	17
Perak	1	16	17
Perlis	0	1	1
Pulau Pinang	0	2	2
Sabah	0	19	19
Sarawak	3	46	49
Selangor	3	6	9
Terengganu	0	9	9
WP Labuan	0	1	1
WP KL/ Putrajaya	0	0	0
Total	16	147	163

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 1.14.

Table 1.14: 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

1.11 Summary of Key Statistics

Table 1.15 provides a summary of key statistics for 2005 and 2016.

Table 1.15: Key Statistics for 2005 and 2016

Year	2005	2016
Latitude	0º 51' N - 7º 33' N	
Longitude	98º 01' E – 1 9º 30' E	
Area	330,345 km^2	
Coastline	8,840 km	
Mean daily temperature	26 – 28 ºC	
Average annual rainfall	2,000 – 4,000 mm	
Average daily direct sunlight	6 hours	
Forest Cover as % of total land area	53.9% (estimate)	55.5% (estimate)
Population	26.0 million	31.6 million
Population density	79 per km^2	96 per km^2
Female life expectancy	76.0 years	77.0 years
Male life expectancy	71.4 years	72.1 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 – 24.5% 15 to 64 years old – 69.5% Above 65 years old – 6.0%
Urbanisation Rate	66.5%	74.8%
GDP (at 2010 constant prices)	RM 659,639 million	RM 1,108,900 million
GNI/capita (at 2010 constant prices)	RM 24,739	RM 37,822
Primary Energy Supply	66,211 ktoe	93,396 ktoe
Final Energy Demand	38,284 ktoe	57,218 ktoe
Total Electricity Consumption	73,987 GWh	116,529 GWh
Length of roads (Federal and State)	88,528 km	236,802 km
Motor vehicle registration	14,816,407	27,613,259
Annual Ridership on urban rail network in Greater Kuala Lumpur/ Klang Valley (passenger journeys)	157,475,402	210,498,247
Public transport modal share in Greater Kuala Lumpur/ Klang Valley	-	20%
Annual ridership on Stages Buses (11 towns and cities) (passenger journeys)	-	46,915
Solid Waste	-	33,130 tonnes/day (2012)

1.12 Institutional Arrangements

Institutions in Malaysia support three key areas of climate change action: policy making, development planning and implementation, and guidance and reporting.

1.12.1 Restructuring of ministries between 2018 and 2020

Following the results of the 14th General Election in May 2018, the two key ministries for climate change had undergone restructuring. The Ministry of Natural Resources and Environment (MNRE) and the Ministry of Energy, Green Technology and Water were restructured as the Ministry of Energy, Science, Technology, Environment and Climate Change (MESTECC) and the Ministry of Water, Lands and Natural Resources. Therefore, the focal point to the UNFCCC was moved from MNRE to MESTECC. In March 2020, restructuring exercise occurred the second time following to another change of government. The two key ministries were then reconfigured as the Ministry of Environment and Water (KASA) and Ministry of Energy and Natural Resources (KeTSA). The national focal point to the UNFCCC thus resides under KASA.

1.12.2 Policy-making

The National Green Technology and Climate Change Council was established in September 2009 to set the policy direction on addressing climate change (it has since been renamed as the Malaysia Climate Change Action Council in December 2020). It is chaired by the Prime Minister and has several key Cabinet Ministers as members.

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

1.12.3 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 1.16 shows the coordinating Ministries and their respective implementing agencies for key sectors.

Table 1.16: Coordinating Ministries and their respective agencies responsible for climate actions

Area	Sector/Area	Coordinating Ministries	Associated Implementing 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 (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 Sector and Industrial Processes and Product Use Sector)
Mitigation	Energy	Ministry of Energy and Natural Resources	Energy Commission Sustainable Energy Development Authority
	Transport	Ministry of Transport	Land Public Transport Agency Marine Department Malaysia Civil Aviation Authority of Malaysia
	Industries	Ministry of International Trade and Industry	Malaysia Investment Development Authority SME Corporation Malaysia Malaysia Automotive Institute
	Agriculture	Ministry of Agriculture and Food Industries Ministry of Plantation Industries and Commodities	Department of Agriculture Department of Veterinary Services Malaysian Agriculture Research and Development Institute Malaysian Palm Oil Board

Area	Sector/Area	Coordinating Ministries	Associated Implementing Ministries/Agencies
	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
Adaptation	Water Resources	Ministry of Water and Environment Ministry of Energy and Natural Resources	Department of Irrigation and Drainage National Water Services Commission National Hydraulic Research Institute of Malaysia
	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 Department of Veterinary Services Department of Fisheries 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 Sabah Forestry Department

Area	Sector/Area	Coordinating Ministries	Associated Implementing Ministries/Agencies
			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
	Energy	Ministry of Energy and Natural Resources	Energy Commission Sustainable Energy Development Authority
	Health	Ministry of Health	Institute of Medical Research Disease Control Division

1.12.4 Guidance and Reporting

1.12.4.1 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 National Steering Committee on National Communication and Biennial Update Report (NSC NC/BUR) which reports to the NSCCC.

The secretariat to these Steering 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 NSC NC/BUR. Figure 1.10 shows the institutional arrangement and thematic groupings to address climate change and NC/BUR reporting.

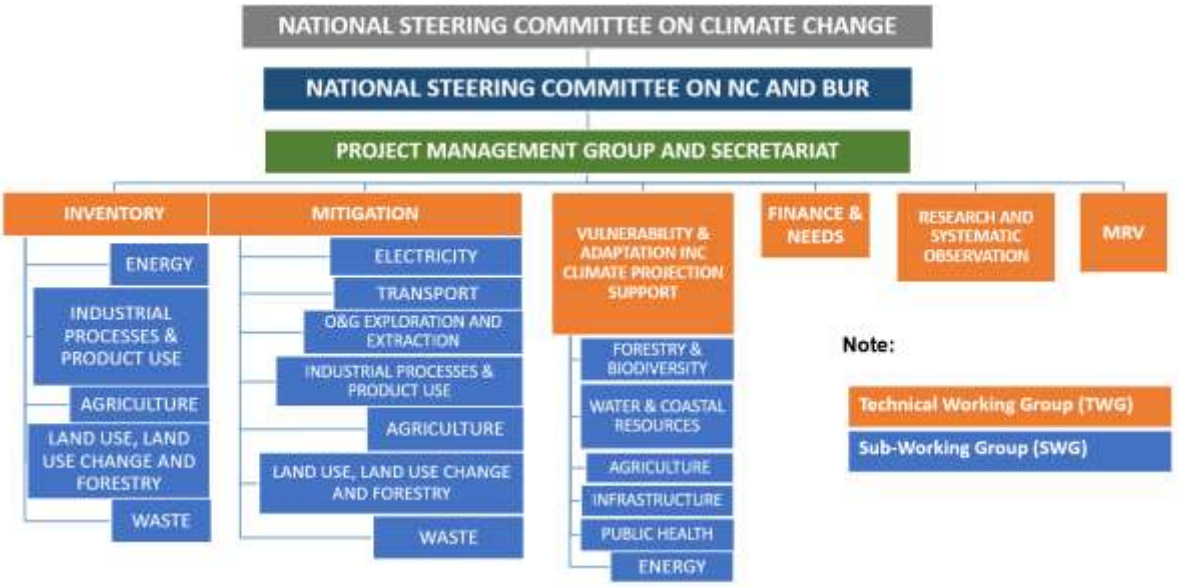


Figure 1.10: Institutional Arrangement and Thematic Working Groups for Climate Change

1.12.4.2 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, chaired by the Deputy Secretary General of the Ministry of Energy and Natural Resources. The roles of this Technical Working Committee include providing methodological guidance on REDD plus implementation and formulating national action plans.

1.12.4.3 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.

2. GHG INVENTORY

2.1 Introduction

This chapter describes the national greenhouse gas (GHG) inventory for the year 2016. 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. The inventory also contains time series estimates from 1990 to 2016 for each of these sectors.

2.2 Methodologies and Coverage

The 2006 IPCC Guidelines for National Greenhouse Gas Inventories was used to estimate the GHG emissions and removals. The *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* was applied to improve the transparency, accuracy, consistency, comparability and completeness of the inventory. Time series were recalculated to reflect the updated methodologies, activity data as well as additional sub sectors in accordance with these guidelines.

The 2006 IPCC Guidelines for National Greenhouse Gas Inventory Software was used to generate the estimates. External spreadsheets as provided in the 2006 IPCC Guidelines were also created as a check on the calculations from the software.

Emission estimates were based on both reference and sectoral approach for the energy sector. Estimates were made using the default conversion and emission factors provided in the *2006 IPCC Guidelines* for the energy sector, selected AFOLU categories and most of the waste sub-sectors. For the LULUCF and industrial processes sectors, country-specific emission factors were applied in some subsectors.

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 are associated with activities occurring in Malaysia were covered in the inventory.

The estimation of the emissions and removals used a combination of country-specific data and emission factors (EFs). Generally, tier 1 IPCC methodology with IPCC default emission factors was applied. Tier 2 methodology was used for sub-sectors where country specific emission factors were available.

The land use category definition for the AFOLU sector is shown in Table 2.1 below.

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%; ● Minimum height at maturity is 5 m.
Cropland	Include perennials like rubber, oil palm, cocoa, kenaf, as commodities and fruit trees and annual crops like vegetables, spices and herbs. It also includes abandoned agricultural area that is now considered as unmanaged.
Grassland	Grazing 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 includes reservoirs, natural rivers and lakes as unmanaged sub-divisions.
Settlement	These include all developed land, including transport infrastructure and human settlements of any size, graveyards, mining and golf courses. It also includes 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 industrial processes and product use sector. The global warming potential values from the IPCC Fourth Assessment Report 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
Hydroflurocarbons	HFCs	1,430 – 14,800*
Perfluorocarbons	PFC	7,390 – 12,200*
Sulphur hexafluoride	SF_6	22,800
Nitrogen trifluoride	NF_3	17,200

* 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 2016 inventory for activities where the emission factors are available.

2.3 Sources of Activity Data and Emission Factors

The mapping of methods and emission factors used, summary of emission factors and activity data/information are shown in Table A1, A2 and A3 respectively.

Most of the activity data for the calculations of the GHG inventory were derived from annual scheduled national publications. Where required, additional activity data were collected from the same source of data. 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. Additional information for the energy data is obtained from the Energy Commission (the custodian of the National Energy Balance). Additional activity data from other government agencies and the private sector were obtained through official requests by the Ministry of Environment and Water to those entities.

For the Industrial Processes and Product Use (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 the Ministry of Environment and Water to those entities. For this sector, 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 1990-1999, SF_6 use in electrical equipment from 1990-2000, N_2O emissions from medical equipment from 1990-2010 and emissions from the electronic industry from 2000-2011 were not available. Hence information for those activities in those years was obtained through extrapolation.

For the Agriculture sector, activity data was obtained from the Livestock Statistics published annually by the Department of Veterinary Services, Agrofood Statistics produced by the Ministry of Agriculture and Food Industries, the Paddy Statistics of Malaysia produced by the Department of Agriculture, Malaysia 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, 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 Activity data were 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, annual publications from MPOB, Malaysian Rubber Board (MRB) and the National Energy Balance. Additional information was sourced from the relevant government agencies and industries.

2.4 Quality Assurance and Quality Control Arrangements

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.

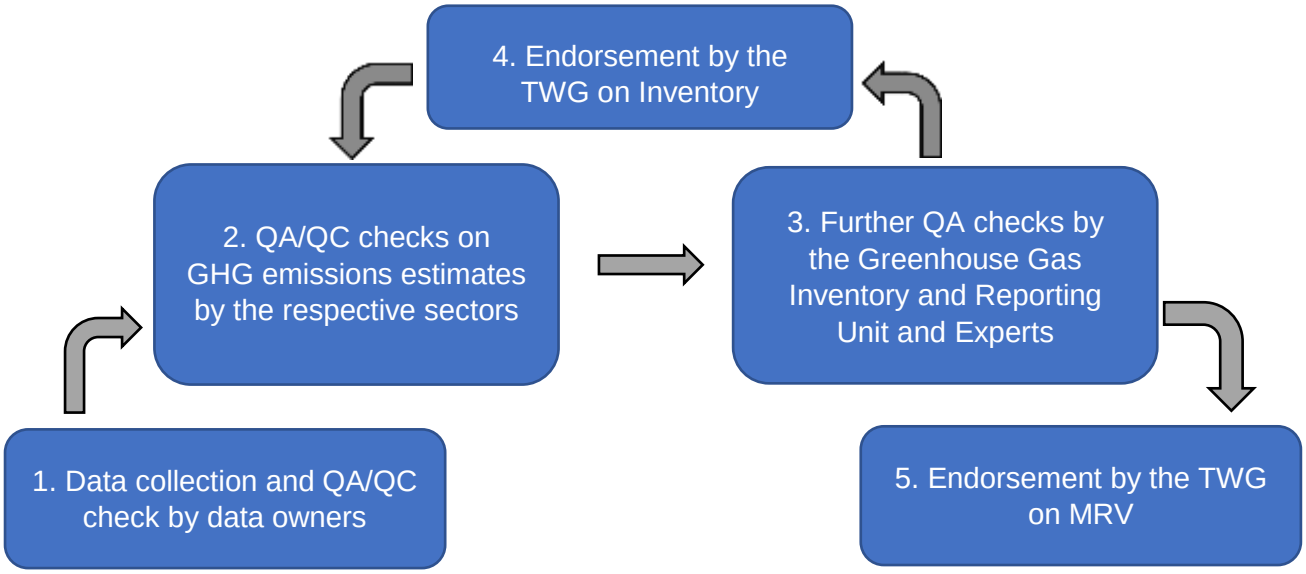


Figure 2.1: Schematic Diagram showing Quality Assurance and Quality Control Arrangement for Greenhouse Gas Inventory

Malaysia applied a Tier 1 QC approach as shown in the 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 calculation tables in the Non-Annex 1 National Communications Reporting Guidelines.	
	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

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 MRV TWG for endorsement that the MRV process for the GHG inventory estimation is complete, accurate to the extent possible and transparent.

2.5 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 2006 IPCC Guidelines software, external 2006 IPCC Guidelines spreadsheets and a sectoral report. Documentation of the procedures for the calculations and of the GHG Inventory team for each sector uses the United States Environmental Protection Agency (USEPA) templates.

For the archiving of the GHG Inventory, the 2006 IPCC 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. The analysis files contain the 2006 IPCC Guidelines Software database and the 2006 IPCC Guidelines spreadsheets for each of the sectors.

The data files, 2006 IPCC Guidelines software database, analysis spreadsheets, reports and sectoral USEPA documentation templates are deposited with the GHG Inventory and Reporting Unit of the Ministry of Environment and Water. The agency heading each sectoral GHG inventory group also keeps a copy of their sectoral data files, analysis spreadsheets, reports and USEPA documentation templates as a second level backup.

2.6 Summary of Greenhouse Gas Emissions and Removals for 2016

This section provides a summary of the greenhouse gas emissions and removals for 2016.

2.6.1 Reference and Sectoral Approaches for Energy Sector

Comparison between the CO_2 emissions based on the Reference and Sectoral Approaches for the energy sector was undertaken. For 2016, the *Reference Approach* resulted in emissions of 235,881.97 Gg of CO_2 whereas the *Sectoral Approach* resulted in an emission of 222,510.48 Gg of CO_2 (Table 2.4). The percentage of difference in CO_2 emissions between the sectoral approach and reference approach was about 5.7%.

2.6.2 Major Sources of Greenhouse Gas Emissions and Removals

Table 2.4 represents the greenhouse gas emissions and removals according to the respective sectors in 2016.

Table 2.4: Emissions and Removals of Greenhouse Gas for each Sector in 2016

Sector		Emissions/ Removals (Gg CO_2 eq.)	GWPs	CO_2 eq (Gg CO_2 eq.)
Energy (Reference Approach)	CO_2	235,881.971	1	235,881.97
Energy (Sectoral Approach)	CO_2 (from Fuel Combustion)	222,510.481	1	222,510.48
	CO_2 (from Fugitive Emissions)	1,942.147	1	1,942.15
	CH_4	1,037.704	25	25,942.60
	N_2O	4.362	298	1,299.79
Sub-total				**251,695.02**
Industrial Processes and Product Use	CO_2	20,807.763	1	20,807.76
	CH_4	13.523	25	338.08
	N_2O	0.237	298	70.70
	HFC-134a	0.4987728	1,430	713.25
	HFC-23 (CHF_3)	0.0029560	14,800	43.75
	PFC-14 (CF_4)	0.4889423	7,390	3,613.28
	PFC-116 (C_2F_6)	0.1090460	12,200	1,330.36
	PFC-218 (C_3F_8)	0.0036950	8,830	32.63
	SF_6	0.0152705	22,800	348.17
	NF_3	0.0029564	17,200	50.85
Sub-total				**27,348.83**
AFOLU –Agriculture	CO_2	531.828	1	531.83
	CH_4	165.957	25	4,148.93
	N_2O	19.956	298	5,946.96
Sub-total				**10,627.72**
AFOLU – LULUCF (Emissions)	CO_2	17,753.214	1	17,753.21
	CH_4	1.157	25	28.93
	N_2O	0.064	298	19.13
AFOLU – LULUCF (Removals)	CO_2	-259,146.025	1	-259,146.03
Sub-total				**-241,344.75**
Waste	CO_2	31.060	1	31.06
	CH_4	1,070.098	25	26,752.45
	N_2O	1.269	298	378.15
Sub-total				**27,161.66**
Total Emissions (Without LULUCF)				**316,833.23**
Total Emissions (With LULUCF emissions part only)				**334,634.51**
Total Emissions (With LULUCF)				**75,488.48**

In 2016, in terms of GHG emissions, the energy sector remained as the largest contributor of emissions where it accounted for 79.4% of the total emissions. This is followed by the IPPU and the waste sectors, both contributed to about 8.6% of the total emissions respectively. Meanwhile, the agriculture sector contributed the lowest emissions at 3.4% while LULUCF is a net sink.

2.6.3 Major Sources of Carbon Dioxide Emissions

In 2016, CO_2 emissions accounted for a total of 263,577 Gg CO_2 eq. CO_2 emission from electricity and heat production was the highest contributor at 103,047 Gg CO_2 (39%), followed by emissions from road transportation at 55,188 Gg CO_2 (21%). Manufacturing industries and construction was the third largest contributor of CO_2 emissions at 23,856 Gg CO_2 (9%) (Figure 2.2).

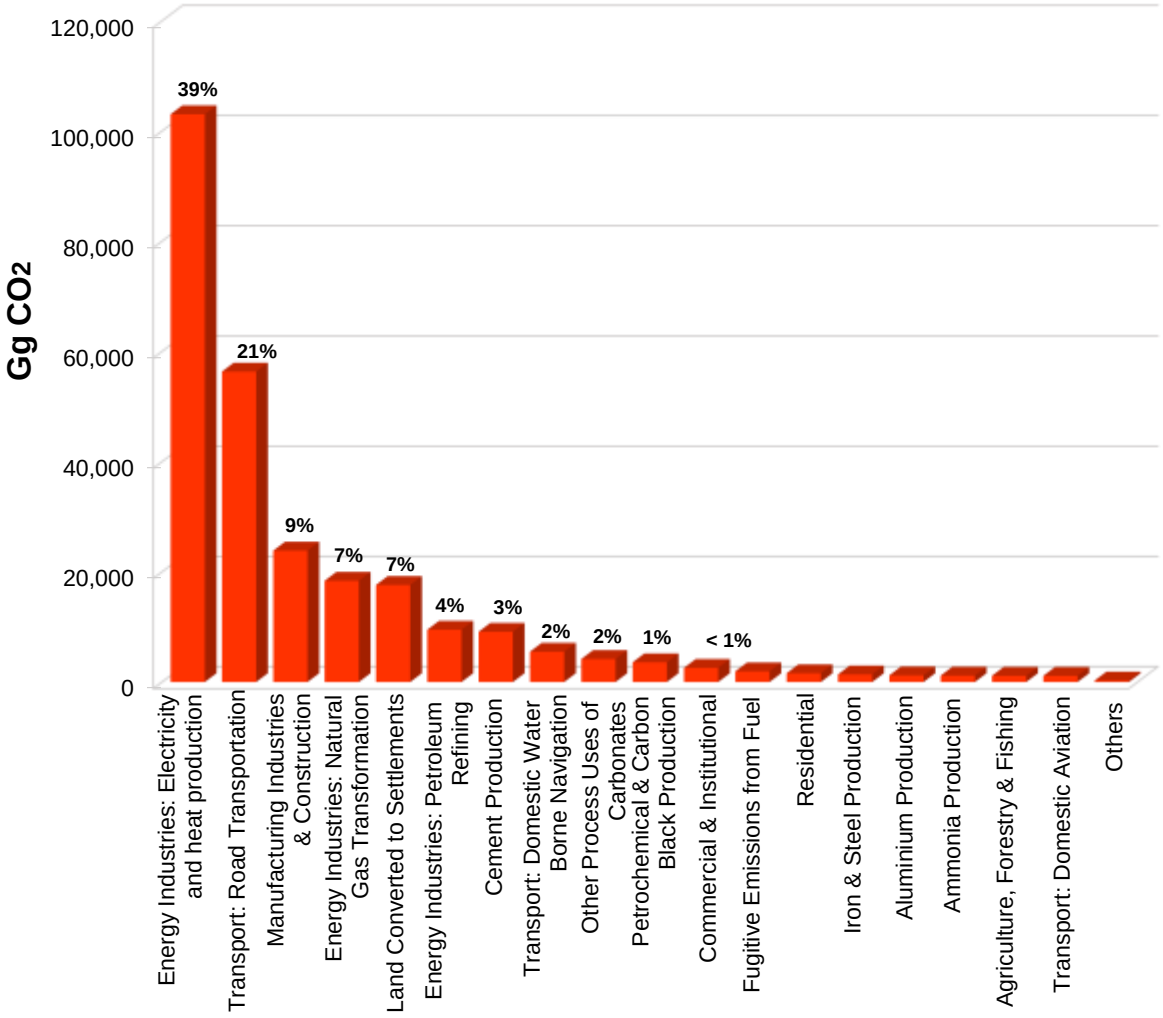


Figure 2.2: Major sources of carbon dioxide in 2016

2.6.4 Major Sources of Methane Emissions

A total of 57,211 Gg CO_2 eq of CH_4 were emitted in 2016 (Figure 2.3). The highest emission was from fugitive emissions from the oil and gas industries which accounted for 25,308 Gg CO_2 eq (44%) of the CH_4 emissions, followed by emissions from industrial waste water treatment and discharge amounting to 13,928 Gg CO_2 eq (24%) and solid waste disposal sites at 11,214 Gg CO_2 eq (20%). About 99% of the emissions from industrial waste water treatment and discharge were from palm oil mill effluent (POME).

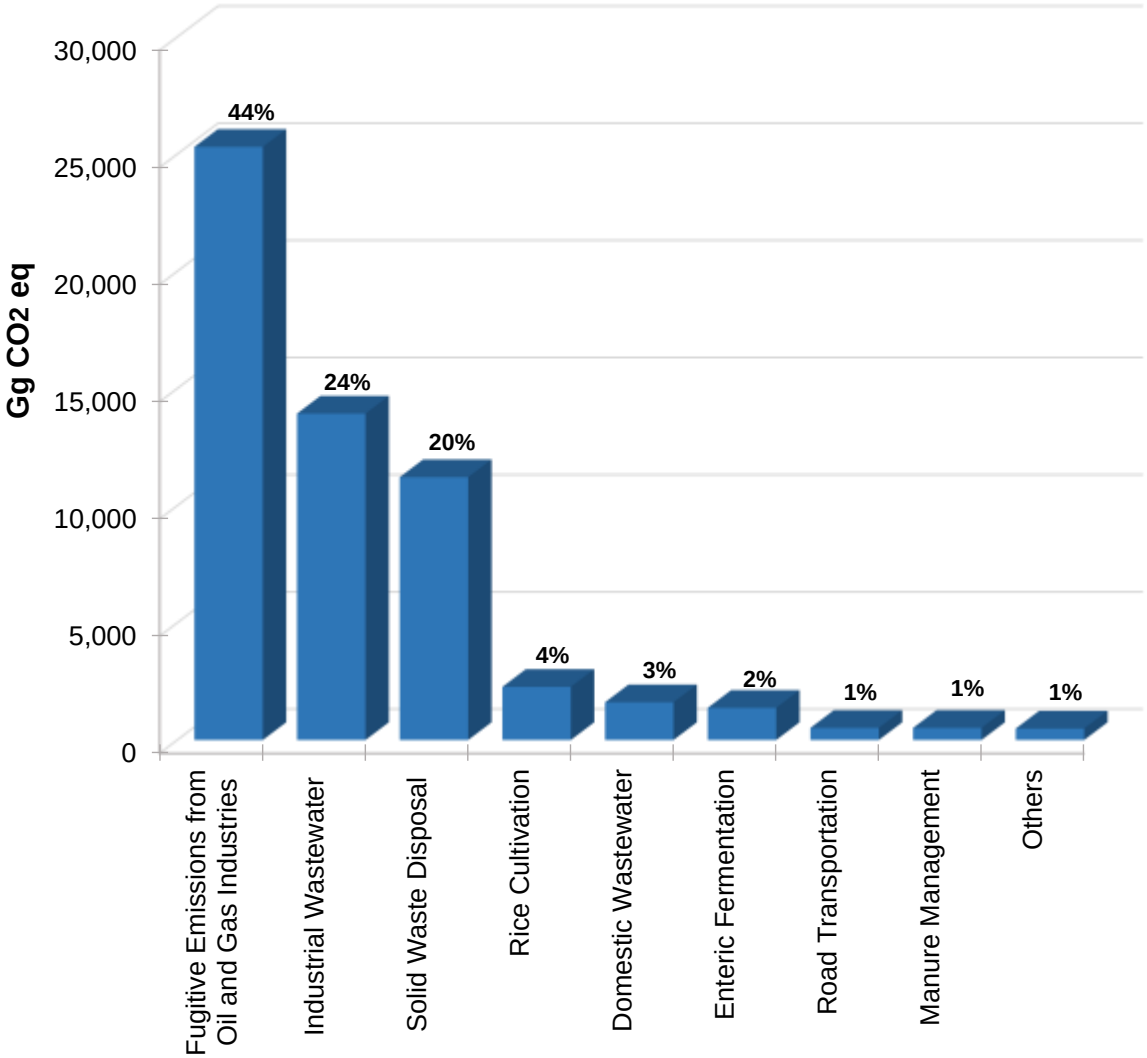
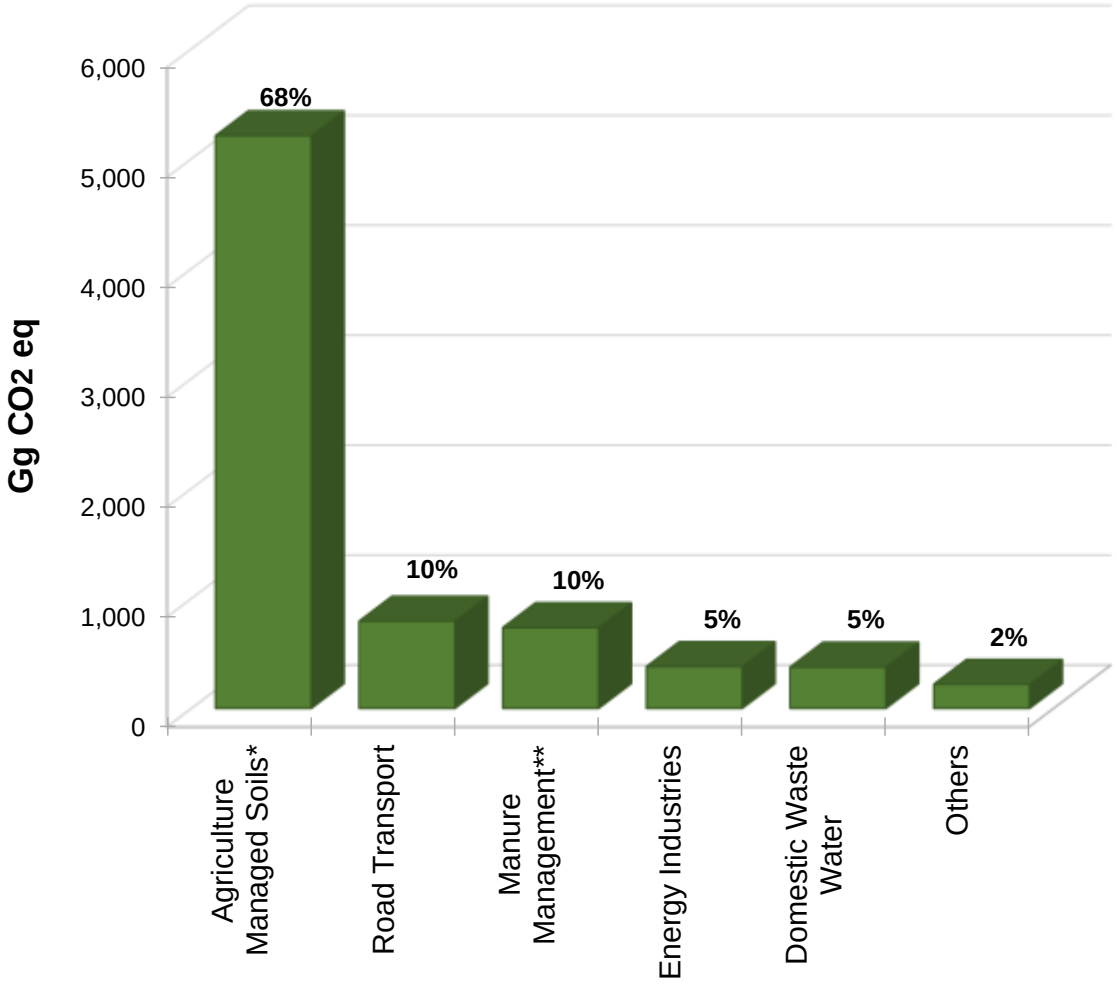


Figure 2.3: Major sources of methane emissions in 2016

2.6.5 Major Sources of Nitrous Oxide Emissions

In 2016, a total of 7,715 Gg CO_2 eq of N_2O were emitted. This estimate excluded the cross-sectoral indirect N_2O emissions from the atmospheric deposition of nitrogen in NOx and NH_3 which were not estimated. The emissions were primarily from the agriculture sector and energy sector (road transport and energy industries) as shown in Figure 2.4. The agriculture

sector (emissions from direct and indirect N_2O from managed soil) contributed about 5,209 Gg CO_2 eq or 68% of the total N_2O emissions. This is followed by road transport in the energy sector which contributed 794 Gg CO_2 eq (10% of the total N_2O emissions), and emissions from direct and indirect N_2O from manure management in the agriculture sector contributed 735 Gg CO_2 eq (10% of the total N_2O emissions).



Note:
* Included direct and indirect N_2O emissions from agriculture managed soils
** Included direct and indirect N_2O emissions from manure management

Figure 2.4: Major sources of nitrous oxide emissions in 2016

2.7 Key Categories of Emissions and Uncertainty Assessment

2.7.1 Key Category Analysis

The key sources of GHG emissions for 2016 without LULUCF and with LULUCF are shown in Tables 2.5 and 2.6 respectively. Overall, the key categories did not change much between those reported in NC2, BUR1, NC3 and BUR2 and the 2016 inventory reported in this report. However, the inventory in 2016 has further disaggregated the sources of GHG emissions and hence provides more specific sources of emission of GHGs. Without LULUCF, the main bulk

of the emissions under the key categories were from the energy sector (77.97%), followed by waste sector (8.44%), IPPU sector (6.48%) and agriculture sector (2.43%). The energy industries (gaseous, liquid and solid fuels) accounted for 41.32% of the key category emissions followed by road transportation at 17.42%, fugitive emissions from fuels (natural gas and oil) at 8.3% and waste water treatment and discharge (industrial and domestic) at 4.9%. Meanwhile, with LULUCF, the main bulk of the emissions under the key categories were from the AFOLU sector (47.32%), followed by the energy sector (41.29%), waste sector (4.23%) and IPPU sector (2.24%).

Table 2.5: Approach 1 Key Category Analysis of Greenhouse Gas Emissions for 2016, without Land Use, Land-Use Change and Forestry Emission

Sector	IPCC Category Code	IPCC Category Name	Gas	2016 estimate (Gg CO_2 eq)	Level Assessment (%)	Cumulative (%)
Energy	1.A.1	Energy Industries - Solid Fuels	CO_2	68,189.15	21.52%	21.52%
Energy	1.A.3.b	Road Transportation	CO_2	55,188.34	17.42%	38.94%
Energy	1.A.1	Energy Industries - Gaseous Fuels	CO_2	52,070.82	16.43%	55.38%
Energy	1.B.2.b	Fugitive Emissions from Fuels - Natural Gas	CH_4	24,446.89	7.72%	63.09%
Waste	4.D.2	Industrial Wastewater Treatment and Discharge	CH_4	13,927.93	4.40%	67.49%
Waste	4.A	Solid Waste Disposal	CH_4	11,214.23	3.54%	71.03%
Energy	1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	CO_2	10,896.28	3.44%	74.47%
Energy	1.A.1	Energy Industries - Liquid Fuels	CO_2	10,663.81	3.37%	77.83%
IPPU	2.A.1	Cement Production	CO_2	9,125.90	2.88%	80.71%
Energy	1.A.2	Manufacturing Industries and Construction - Solid Fuels	CO_2	6,795.19	2.14%	82.86%
Energy	1.A.2	Manufacturing Industries and Construction - Liquid Fuels	CO_2	6,164.27	1.95%	84.80%
Energy	1.A.3.d	Transport - Water-borne Navigation - Liquid Fuels	CO_2	5,505.04	1.74%	86.54%
Energy	1.A.4	Other Sectors - Liquid Fuels	CO_2	5,260.26	1.66%	88.20%
IPPU	2.A.4	Other Process Uses of Carbonates -	CO_2	4,184.05	1.32%	89.52%

Sector	IPCC Category Code	IPCC Category Name	Gas	2016 estimate (Gg CO_2 eq)	Level Assessment (%)	Cumulative (%)
		Limestone and Dolomite				
AFOLU-Agriculture	3.C.4	Direct N_2O Emissions from Managed Soils	N_2O	4,052.61	1.28%	90.80%
IPPU	2.B.8	Petrochemical and Carbon Black Production	CO_2	3,583.40	1.13%	91.93%
AFOLU-Agriculture	3.C.7	Rice Cultivations	CH_4	2,265.20	0.71%	92.65%
IPPU	2.C.3	Aluminium Production	PFC-14	2,246.56	0.71%	93.36%
Energy	1.B.2.a	Fugitive Emissions from Fuel - Oil	CO_2	1,846.14	0.58%	93.94%
Waste	4.D.1	Domestic Wastewater Treatment and Discharge	CH_4	1,608.12	0.51%	94.45%
IPPU	2.C.1	Iron and Steel Production	CO_2	1,384.51	0.44%	94.88%
AFOLU-Agriculture	3.A.1	Enteric Fermentation	CH_4	1,370.44	0.43%	95.31%

Table 2.6: Approach 1 Key Category Analysis of Greenhouse Gas Emissions for 2016, with Land Use, Land-Use Change and Forestry Emission

Sector	IPCC Category Code	IPCC Category Name	Gas	2016 estimate (Gg CO_2 eq)	Level Assessment (%)	Cumulative (%)
AFOLU	3.B.1.a	Forest Land Remaining Forest Land	CO_2	-243,831.71	41.06%	41.06%
Energy	1.A.1	Energy Industries - Solid Fuels	CO_2	68,189.15	11.48%	52.55%
Energy	1.A.3.b	Road Transportation	CO_2	55,188.34	9.29%	61.84%
Energy	1.A.1	Energy Industries - Gaseous Fuels	CO_2	52,070.82	8.77%	70.61%
Energy	1.B.2.b	Fugitive Emissions from Fuels - Natural Gas	CH_4	24,446.89	4.12%	74.73%
AFOLU	3.B.5.b	Land Converted to Settlements	CO_2	17,753.21	2.99%	77.72%
AFOLU	3.B.2.a	Crop Land Remaining Cropland	CO_2	-15,314.31	2.58%	80.30%
Waste	4.D.2	Industrial Wastewater Treatment and Discharge	CH_4	13,927.93	2.35%	82.64%

Sector	IPCC Category Code	IPCC Category Name	Gas	2016 estimate (Gg CO_2 eq)	Level Assessment (%)	Cumulative (%)
Waste	4.A	Solid Waste Disposal	CH_4	11,214.23	1.89%	84.53%
Energy	1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	CO_2	10,896.28	1.84%	86.37%
Energy	1.A.1	Energy Industries - Liquid Fuels	CO_2	10,663.81	1.80%	88.16%
IPPU	2.A.1	Cement Production	CO_2	9,125.90	1.54%	89.70%
Energy	1.A.2	Manufacturing Industries and Construction - Solid Fuels	CO_2	6,795.19	1.14%	90.84%
Energy	1.A.2	Manufacturing Industries and Construction - Liquid Fuels	CO_2	6,164.27	1.04%	91.88%
Energy	1.A.3.d	Transport - Water-borne Navigation - Liquid Fuels	CO_2	5,505.04	0.93%	92.81%
Energy	1.A.4	Other Sectors - Liquid Fuels	CO_2	5,260.26	0.89%	93.70%
IPPU	2.A.4	Other Process Uses of Carbonates - Limestone and Dolomite	CO_2	4,184.05	0.70%	94.40%
AFOLU	3.C.4	Direct N_2O Emissions from Managed Soils	N_2O	4,052.61	0.68%	95.08%

Approach 1 trend assessment was also carried out for the inventory without LULUCF and with LULUCF, and these are presented in Tables 2.7 and 2.8 respectively. Without LULUCF, the highest trends were observed for increase emissions of CO_2 from energy industries usage of solid fuels (31.11%), decrease of CO_2 emission from gaseous fuels in the energy industries (17.59%), decrease of CO_2 emission from liquid fuel usage in the manufacturing industries and construction (12.71%) and increase in CO_2 emissions in road transportation (7.47%). With LULUCF, the highest trends occurred for increase in removals of CO_2 by Forest Land Remaining Forest Land (42.53%). This is followed by decrease of CO_2 emissions from land converted to settlements (10.85%), decrease of energy industries' usage of gaseous fuels (10.84%) and increase of energy industries' usage of solid fuels (9.2%).

Table 2.7: Approach 1 Trend Assessment for Greenhouse Gas Inventory for 2016, without Land Use, Land-Use Change and Forestry Emission

IPCC Category Code	IPCC Category Name	Gas	Base Year (2005) estimate (Gg CO_2 eq)	2016 estimate (Gg CO_2 eq)	Trend Assess-ment	Percen-tage contribu-tion to trend (%)	Cumula-tive (%)
1.A.1	Energy Industries - Solid Fuels	CO_2	22,279.39	68,189.15	0.16	31.11%	31.11%
1.A.1	Energy Industries - Gaseous Fuels	CO_2	57,713.54	52,070.82	0.09	17.59%	48.70%
1.A.2	Manufacturing Industries and Construction - Liquid Fuels	CO_2	17,297.09	6,164.27	0.07	12.71%	61.41%
1.A.3.b	Road Transportation	CO_2	35,458.78	55,188.34	0.04	7.47%	68.89%
1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	CO_2	12,480.19	10,896.28	0.02	4.09%	72.98%
1.A.1	Energy Industries - Liquid Fuels	CO_2	11,757.33	10,663.81	0.02	3.54%	76.52%
2.A.4	Other Process Uses of Carbonates - Limestone and Dolomite	CO_2	178.68	4,184.05	0.02	3.12%	79.63%
4.D.2	Industrial Wastewater Treatment and Discharge	CH_4	13,833.55	13,927.93	0.02	3.08%	82.71%
4.A	Solid Waste Disposal	CH_4	6,072.29	11,214.23	0.01	2.67%	85.38%
1.B.2.b	Fugitive Emissions from Fuels - Natural Gas	CH_4	21,581.36	24,446.89	0.01	2.66%	88.04%
2.C.3	Aluminium Production	PFC-14	-	2,246.56	0.01	1.77%	89.81%
2.C.3	Aluminium Production	CO_2	-	1,216.00	0.00	0.96%	90.77%
3.C.4	Direct N_2O Emissions from Managed Soils	N_2O	3,852.49	4,052.61	0.00	0.72%	91.49%
2.E.3	Photovoltaics	PFC-14	-	875.16	0.00	0.69%	92.18%

IPCC Category Code	IPCC Category Name	Gas	Base Year (2005) estimate (Gg CO_2 eq)	2016 estimate (Gg CO_2 eq)	Trend Assess-ment	Percen-tage contribu-tion to trend (%)	Cumula-tive (%)
1.B.2.a	Fugitive Emissions from Fuel - Oil	CO_2	2,006.83	1,846.14	0.00	0.58%	92.76%
2.A.1	Cement Production	CO_2	7,615.98	9,125.90	0.00	0.54%	93.30%
1.A.4	Other Sectors - Liquid Fuels	CO_2	4,555.67	5,260.26	0.00	0.48%	93.79%
4.D.1	Domestic Wastewater Treatment and Discharge	CH_4	1,694.11	1,608.12	0.00	0.45%	94.24%
3.A.1	Enteric Fermentation	CH_4	1,452.12	1,370.44	0.00	0.40%	94.63%
2.E.1	Integrated Circuit or Semiconductor	PFC-14	-	491.57	0.00	0.39%	95.02%

Table 2.8: Approach 1 Trend Assessment for Greenhouse Gas Inventory for 2016, with Land Use, Land-Use Change and Forestry Emission

IPCC Category Code	IPCC Category Name	Gas	Base Year (2005) estimate (Gg CO_2 eq)	2016 estimate (Gg CO_2 eq)	Trend Assess-ment	Percen-tage contribu-tion to trend (%)	Cumula-tive (%)
3.B.1.a	Forest Land Remaining Forest Land	CO_2	-215305.31	-243,831.71	0.30	42.53%	42.53%
3.B.5.b	Land Converted to Settlements	CO_2	35,969.41	17,753.21	0.08	10.85%	53.38%
1.A.1	Energy Industries - Gaseous Fuels	CO_2	57,713.54	52,070.82	0.08	10.84%	64.22%
1.A.1	Energy Industries - Solid Fuels	CO_2	22,279.39	68,189.15	0.06	9.20%	73.42%
1.A.2	Manufacturing Industries and Construction - Liquid Fuels	CO_2	17,297.09	6,164.27	0.04	5.88%	79.29%
1.B.2.b	Fugitive Emissions from Fuels - Natural Gas	CH_4	21,581.36	24,446.89	0.02	2.67%	81.96%

IPCC Category Code	IPCC Category Name	Gas	Base Year (2005) estimate (Gg CO_2 eq)	2016 estimate (Gg CO_2 eq)	Trend Assess-ment	Percen-tage contribu-tion to trend (%)	Cumula-tive (%)
1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	CO_2	12,480.19	10,896.28	0.02	2.45%	84.41%
4.D.2	Industrial Wastewater Treatment and Discharge	CH_4	13,833.55	13,927.93	0.02	2.20%	86.61%
1.A.1	Energy Industries - Liquid Fuels	CO_2	11,757.33	10,663.81	0.02	2.19%	88.80%
3.B.2.a	Crop Land Remaining Cropland	CO_2	-18612.73	-15314.31	0.01	2.07%	90.87%
2.A.4	Other Process Uses of Carbonates - Limestone and Dolomite	CO_2	178.68	4,184.05	0.01	1.09%	91.96%
2.A.1	Cement Production	CO_2	7,615.98	9,125.90	0.01	0.80%	92.76%
2.C.3	Aluminium Production	PFC-14	-	2,246.56	0.00	0.63%	93.39%
3.C.4	Direct N_2O Emissions from Managed Soils	N_2O	3,852.49	4,052.61	0.00	0.56%	93.95%
1.A.4	Other Sectors - Liquid Fuels	CO_2	4,555.67	5,260.26	0.00	0.54%	94.48%
1.A.2	Manufacturing Industries and Construction - Solid Fuels	CO_2	5,420.07	6,795.19	0.00	0.49%	94.97%
4.A	Solid Waste Disposal	CH_4	6,072.29	11,214.23	0.00	0.46%	95.43%

2.7.2 Uncertainty Analysis

In this report, Approach 1 for uncertainty analysis (following the methodology described in the 2006 IPCC Guidelines) is adopted for both uncertainty of annual estimate and uncertainty in the trend. The approach which is based upon error propagation was used for Malaysia's inventory, both with and without LULUCF sector (Table B21a and B21b of the Technical Annex). The uncertainty in the total inventory and trend is summarised in Table 2.9. The 2016 uncertainty of the total inventory without AFOLU-LULUCF (including both sources and sinks of greenhouse gases) was ±7%. In case of trend from 2005 to 2016, the uncertainty was ±8%.

Meanwhile, the uncertainty in total inventory with the AFOLU-LULUCF sector was ±66% and uncertainty in trend was ±120%. The uncertainty range was assumed to be under a Gaussian distribution. For published data, the uncertainty indicated in those reports were assumed to be accurate. For emission factors, maximum range of uncertainty was assumed for all sectors.

Table 2.9: Estimated Uncertainty of Greenhouse Gas Inventory for 2016

Sector	Uncertainty in total Inventory (%)	Uncertainty in Trend (%)
Total Inventory without AFOLU - LULUCF	7.26	7.64
Total Inventory with AFOLU - LULUCF	66.2	119.71

2.8 Sectoral Time Series of Greenhouse Gas Emissions

The annual total GHG emissions from 1990-2016 is shown in Figure 2.5.

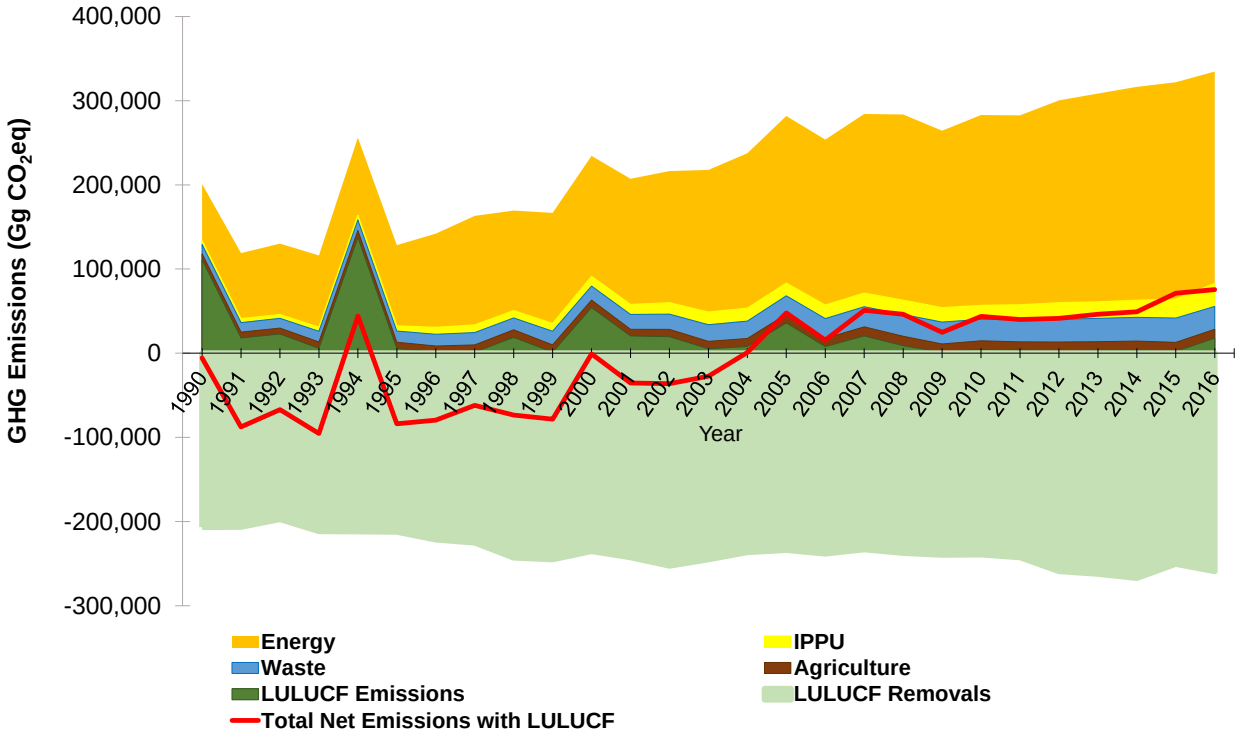


Figure 2.5: Emissions Time Series from 1990 to 2016

2.8.1 Emissions from Energy Sector

The GHG emissions for the energy sector increased at an average rate of 5.4% per year from 1990-2016 (Figure 2.6). The highest emissions were from the energy industries with average annual growth rate of 6.4%. Within the energy industries, electricity generation contributed

over 65% of the sector's emissions and its average annual growth rate of emissions from 1990 to 2016 was 7.5%. The second highest emissions were from the transport sector with an average annual growth rate of 5.9% from 1990 to 2016. These growth rates however had slowed down over the past few years. The decrease in emissions from the manufacturing industry and construction from 2008 onwards is due to the sector's shift from coal fuel consumption to electricity consumption and increase in energy efficiency adoption of the sector. Fugitive emissions from the oil and gas industries also grew at an average rate of 5.1% per year from 1990 to 2016, however the emissions growth rate had also slowed down over the past few years.

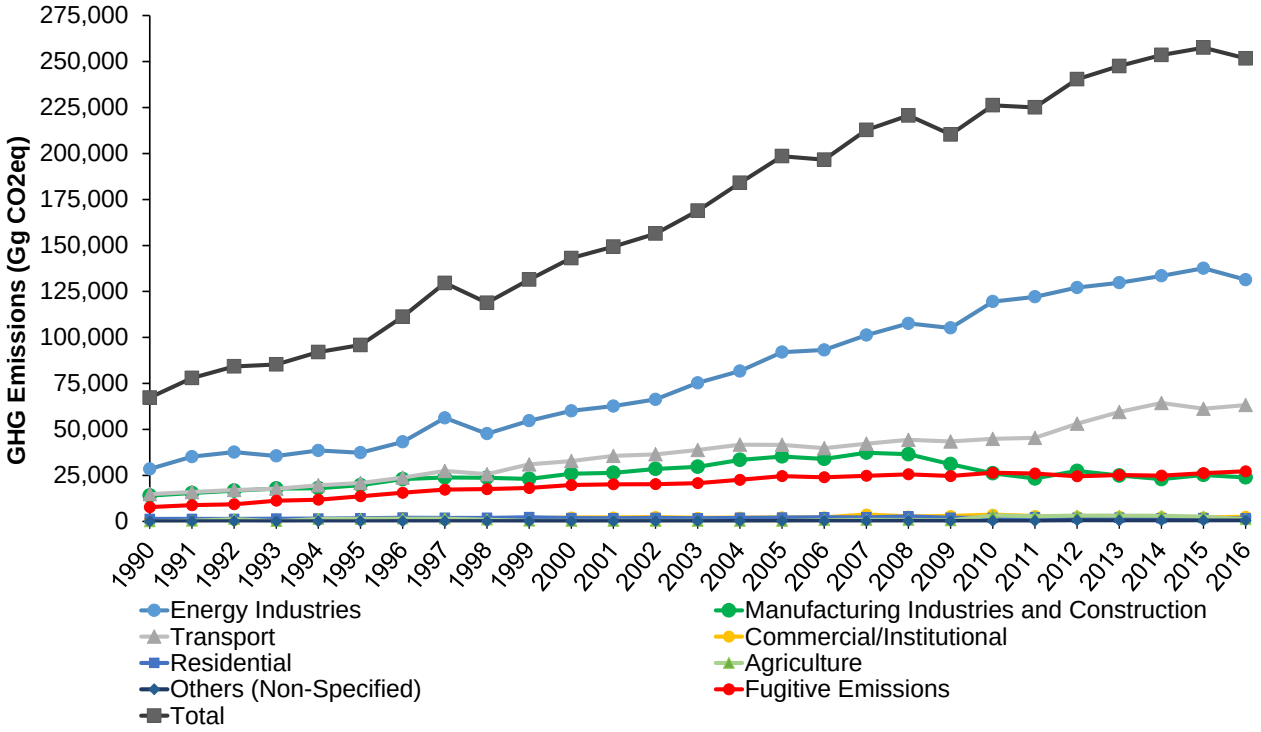


Figure 2.6: Emissions Time Series from 1990 to 2016 for Energy Sector

2.8.2 Emissions from Industrial Processes and Product Use Sector

The GHG emissions from the IPPU sector grew at an average rate of 7.6% per year from 1990 to 2016 (Figure 2.7). Throughout the time-series, the mineral industry contributed the highest emissions followed by the chemical industry, metal industry and electronics industry. These grew at an average rate of 5.9%, 15.8%, 11.4% and 11.0% per year respectively. The main contribution of GHG emissions by the mineral industry was from cement production. However, the trend of emission by the mineral industry fluctuates widely from year to year depending on the demand for cement in the construction industry. Emissions from the chemical industry grew gradually from 1990 to 2010 and stabilised from 2010 till 2016. The emissions from the metal industry were mainly from the iron and steel industry and the emissions showed gradual growth.

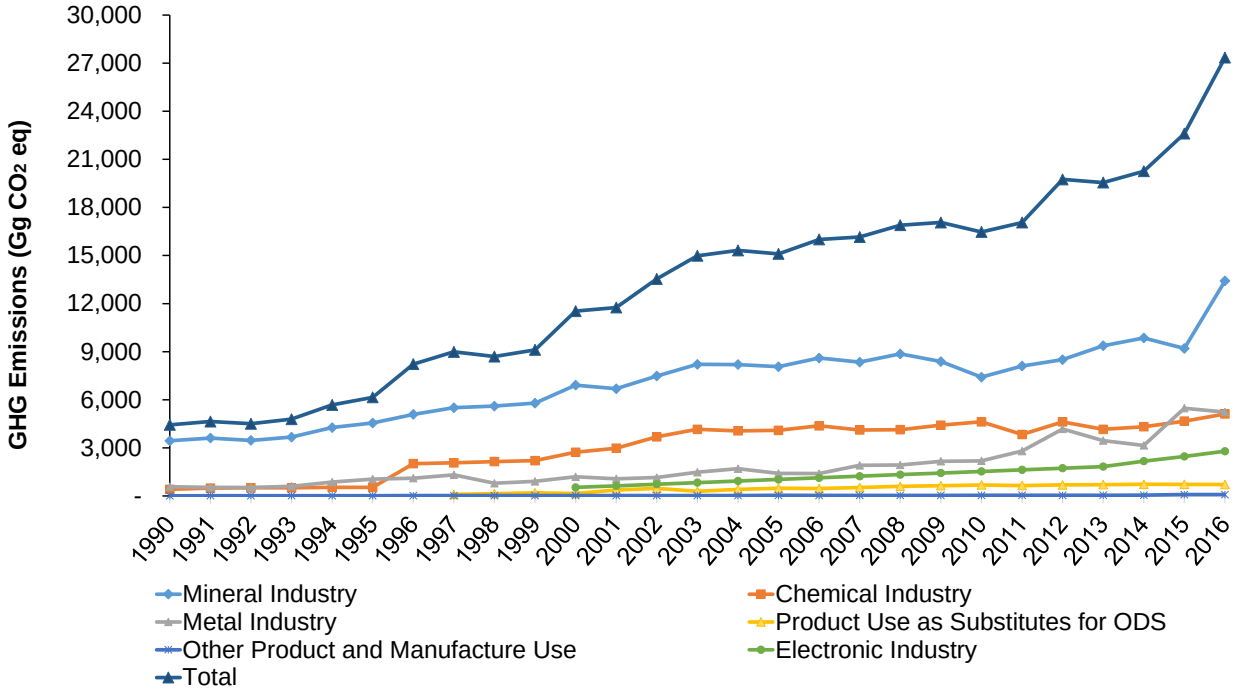


Figure 2.7: Emissions Time Series from 1990 to 2016 for Industrial Processes and Product Use Sector

2.8.3 Emissions from Land Use, Land-Use Change and Forestry Sector

Removals and emissions from the LULUCF (Figure 2.8) sector have become more stable from 1995. Additionally, the removals have increased since 2011. The largest removal was from Forest Land Remaining Forest Land and the emissions were from Forest Land Converted to Settlement and Cropland Converted to Settlement.

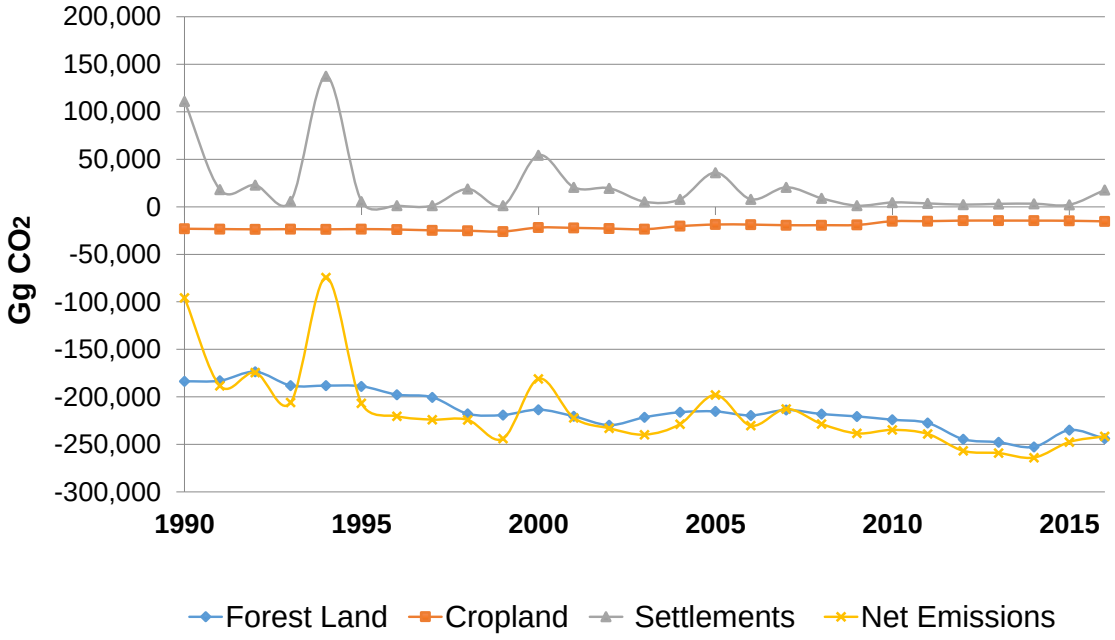


Figure 2.8: Emissions Time Series from 1990 to 2016 for AFOLU (LULUCF Sector)

2.8.4 Emissions from Agriculture Sector

GHG emissions from the agriculture sector grew at an average rate of 1.8% per year from 1990 to 2016 (Figure 2.9). The GHG emissions growth rate however fluctuated from year to year in tandem with the usage of fertilisers by the sector, particularly by the oil palm plantations. Nitrous oxide emissions from managed agricultural soils were the largest source throughout the whole time series period, contributing an average of 43.8% of the emissions from 1990 to 2016. Of these, 33.4% were from direct N_2O emissions from managed agriculture soils and the remaining 10.4% 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 4.1% and 3.5% respectively. The second largest source was CH_4 emission from rice cultivation and this source contributed an annual average of 23.9% of the total agriculture sector GHG emissions over the time series period. Its average growth rate per year is relatively low at 0.35%. Methane emission from enteric fermentation was the third largest source and this contributed an average of 15.9% of the emissions.

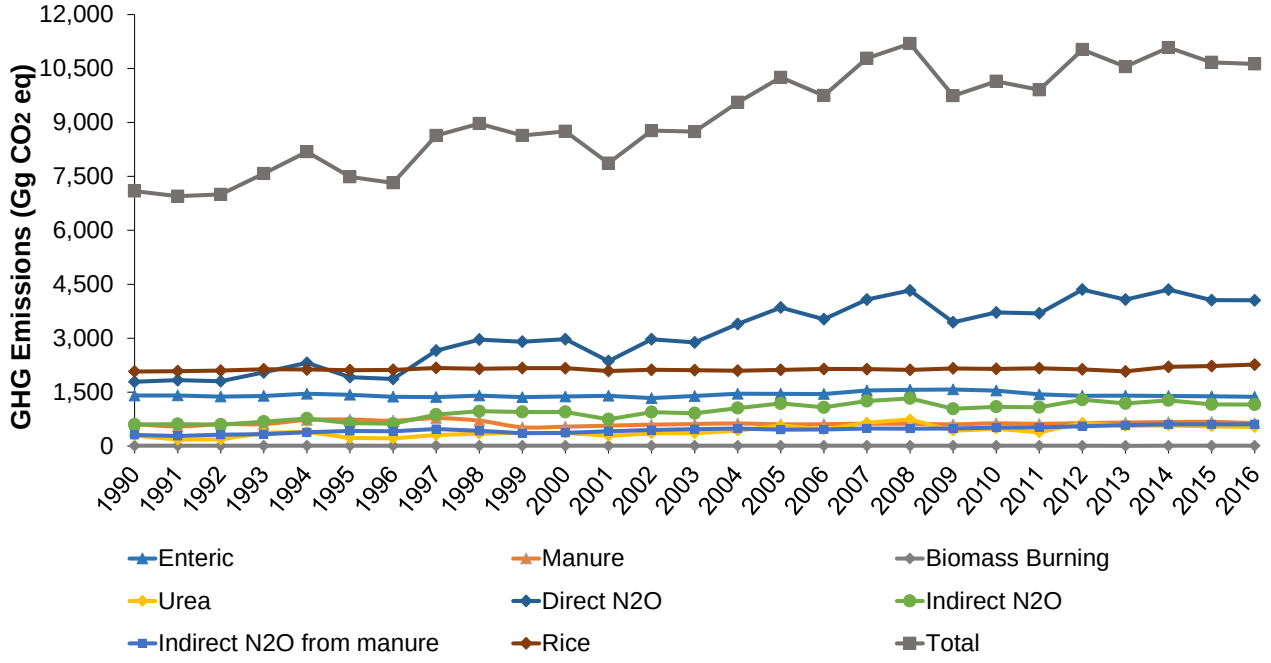


Figure 2.9: Emissions Time Series from 1990 to 2016 for AFOLU-Agriculture Sector

2.8.5 Emissions from Waste Sector

GHG emissions from the waste sector grew at an average rate of 3.6% per year over the period 1990 to 2016 (Figure 2.10). Methane emissions from wastewater treatment and discharge was the largest source of emissions throughout the time series period and this contributed an average of 68.7% of the total emissions. Of these, emissions from industrial wastewater contributed 57.8% of the emissions and emissions from domestic wastewater contributed 10.9% of the total emissions. The average growth rate of emissions from industrial wastewater and domestic wastewater were 3.7% and 0.3% respectively. 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 31.2% of the emissions throughout the time series period. The average growth rate of emissions from solid waste disposal sites was at 4.6%.

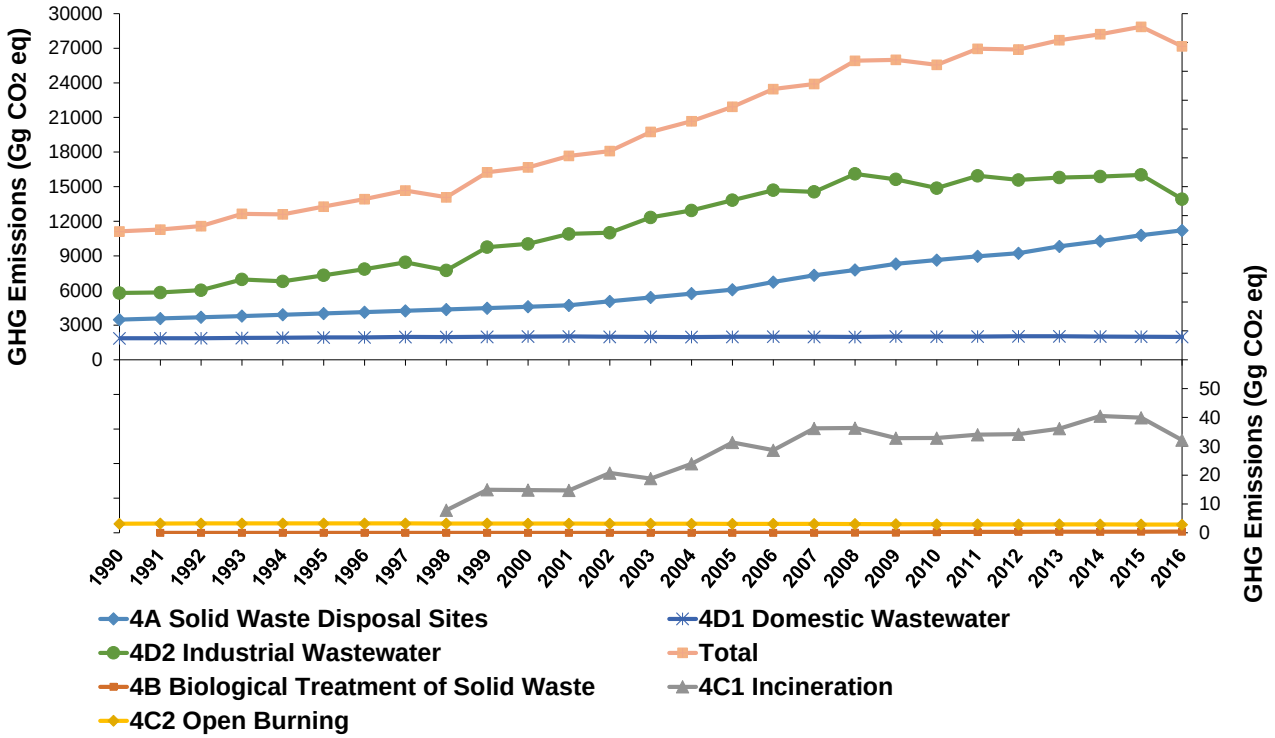


Figure 2.10: Emissions Time Series from 1990 to 2016 for Waste Sector

2.9 Greenhouse Gas Emissions for the Years 1994, 2000, 2005, 2011, 2014 and 2016

Recalculated GHG emissions for 1994, 2000, 2005, 2011, 2014 and 2016 are shown in Table 2.10. The increase of emissions over the time period is due to the significant increase in GHG emissions from the energy sector, while LULUCF's sink capacity has stabilised. The rate of forest conversion is on a decreasing trend as indicated by Table 2.10. In 2016, the increase of emissions from LULUCF is due to development purposes i.e. construction of highways and new airports.

Table 2.10: Greenhouse Gas Emissions for the Years 1994, 2000, 2005, 2011, 2014 and 2016

Sector	Emissions/ Removals (Gg CO_2 eq)					
	1994	2000	2005	2011	2014	2016
Energy	92,049.66	143,141.29	198,514.01	225,060.62	253,517.24	251,695.02
Industrial Processes and Product Use	5,678.85	11,531.89	15,101.60	17,058.02	20,257.83	27,348.83
Agriculture	8,183.89	8,752.54	10,253.15	9,906.22	11,081.37	10,627.72
LULUCF (Emissions)	137,523.00	54,298.83	35,985.19	3,560.43	3,317.15	17,801.28
LULUCF (Removals)	-211,843.11	-235,244.29	-233,918.04	-242,586.19	-267,147.77	-259,146.03
Waste	12,605.09	16,670.76	21,928.28	26,957.38	28,216.36	27,161.66
Total Emissions (without LULUCF)	118,517.49	180,096.48	245,797.04	278,982.24	313,072.80	316,833.23
Total Emissions (including LULUCF emissions part only)	256,040.49	234,395.31	281,782.23	282,542.66	316,389.95	334,634.51
Net total (After Subtracting Sink)	44,197.38	-848.98	47,864.19	39,956.47	49,242.18	75,488.48

2.10 Greenhouse Gas Emission Intensity Indices

Three approaches are presented in this section (Table 2.11). The first approach considered emissions from four sectors (Energy, IPPU, Agriculture and Waste). The second approach included emissions from the LULUCF sector and the third approach included both emissions and removals from the LULUCF sector in deriving the GHG emission intensity indices.

In the first approach, when LULUCF is excluded, the indices reflect only a modest gain. This is due to the cost differential between carbon-intensive and low-carbon technologies to achieve further emission reductions. In the second approach, the significant effects of emission reductions from the LULUCF sector are apparent. The third approach emphasises the impact of forest management and associated GHG removals on the indices.

Table 2.11: Greenhouse Gas Emission Indices for Malaysia

	Unit	2005	2011	2014	2016	Difference in percentage in 2016 against 2005 (%)
Population	million	26.045	29.062	30.708	31.633	21.5
GDP at constant 2010 prices	million RM	659,639	864,920	1,012,449	1,108,935	68.1
Approach 1: Without LULUCF						
CO_2eq emissions	mil tonne	245.797	278.982	313.073	316.833	28.9
CO_2eq emissions per capita	tonne/capita	9.437	9.600	10.195	10.016	6.1
CO_2eq emissions per GDP	kg/RM	0.373	0.323	0.309	0.286	-23.3
Approach 2: With LULUCF (Deforestation Emissions Only)						
CO_2eq emissions	mil tonne	281.766	282.543	316.373	334.586	18.7
CO_2eq emissions per capita	tonne/capita	10.818	9.722	10.303	10.577	-2.2
CO_2eq emissions per GDP	kg/RM	0.427	0.327	0.313	0.302	-29.4
Approach 3: With LULUCF (Emissions and Removals)						
CO_2eq emissions	mil tonne	47.864	39.956	49.242	75.488	57.7
CO_2eq emissions per capita	tonne/capita	1.838	1.375	1.604	2.386	29.9
CO_2eq emissions per GDP	kg/RM	0.073	0.046	0.049	0.068	-6.2

2.11 GHG Inventory 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.

For the energy sector, efforts would be carried out to improve the emission factors and collection and disaggregation of activity data to enable higher tier calculations for the energy industries, road transport and domestic water-borne transport sub categories. Efforts would

also be carried out to improve the completeness of activity data and emission factors for fugitive emissions from the oil and gas sector.

The activity data for the IPPU sector 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.

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

For the LULUCF sector, development of an updated soil carbon map for the whole country is needed. This development requires international resources.

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.

3. MITIGATION ACTIONS AND THEIR EFFECTS

3.1 Introduction

This chapter describes the mitigation actions and their effects for the year 2016. The estimation of GHG emissions avoidance from these actions are from three key sectors, namely energy, waste and forestry. The chapter also contains information on future mitigation action targets and the implementation key enablers at national and sub-national level.

3.2 Summary of Emissions Avoidance Achieved

Table 3.1 shows the summary of emissions avoidance achieved in 2016. It comprises mitigation actions across the areas of renewable energy, energy efficiency, building, transportation, waste, and forestry. The GHG emissions avoidance from the industrial processes and product use and the agriculture sectors are not quantified as there are still gaps in collecting data for the quantification of their GHG emissions impact. Nevertheless, several initiatives that have been implemented in mitigating GHG emissions from these two industries are briefly described.

Table 3.1: Summary of Emissions Avoidance Achieved in 2016

Sector	Sub-sector	Mitigation Actions	Emissions avoidance achieved in 2016 (Gg CO_2 eq.)
Energy	Renewable Energy (Power)[a]	Feed-in-Tariff (FiT)	460.52
		Hydropower	6,570.15
		Other RE by public and private licensees	231.92
	Energy Efficiency[a]	National Energy Efficiency Action Plan (NEEAP)	458.02
	Transportation	Rail based public transport	212.93
		Use of energy-efficient vehicles	90.65
		Use of palm-based biodiesel in blended petroleum diesel	1,127.34
		Use of natural gas in vehicles	114.77
Waste	Paper recycling		3,937.76
	Biogas recovery from palm oil mill effluent		2,377.84

Sector	Sub-sector	Mitigation Actions	Emissions avoidance achieved in 2016 (Gg CO_2 eq.)
Forestry	Reducing deforestation, Sustainable management of forest and Conservation of carbon stocks		20,307.50

Note:
[a]As general rule, the emissions avoidance 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 grid-electricity emission factors were used for Peninsular Malaysia, Sabah and Sarawak which were 0.639 tonnes CO_2/MWh, 0.512 tonnes CO_2/MWh and 0.249 tonnes CO_2/MWh respectively.

3.3 Details of Mitigation Actions

The following section describes the details of each mitigation actions.

3.3.1 Energy Sector

The following sub-sections describes the details of each mitigation actions in the energy sector.

3.3.1.1 Renewable Energy (RE)

The deployment of RE has gained momentum since the launch of the National Renewable Energy Policy and Action Plan in 2010, the Renewable Energy Act 2011 and the Sustainable Energy Development Authority (SEDA) Act 2011. The latter enabled SEDA to administer the Feed-in-Tariff mechanism as well as established the Renewable Energy Fund to supplement the FiT scheme. Through the FiT programmes, emission avoidance of 460.52 Gg CO_2 eq were achieved in 2016 (details in Table 3.4).

Hydropower, which consists as the largest RE portion of the electricity generation mix has also grown from a share of 5.35% (6,361 GWh) of the electricity generation mix in 2010 to 12.83% (20,357 GWh) in 2016. This has resulted in a total of 6,535.99 Gg CO_2 eq avoidance excluding hydro projects listed under the FiT mechanism (Table 3.5).

Renewable electricity generation by public and private licensees beyond the FiT scheme has also resulted in the avoidance of 231.92 Gg CO_2eq during the same year (Table 3.6). In summary, the overall renewable energy generation has contributed to GHG emissions avoidance of 7,262.59 Gg CO_2 eq in 2016.

3.3.1.2 National Energy Efficiency Action Plan (NEEAP)

In enhancing energy efficiency implementation, a National Energy Efficiency Action Plan (NEEAP) was introduced in 2016 targeting the residential, commercial and industrial sectors.

The NEEAP sets a target to save 52,233 GWh of electricity over a 10-year period from 2016 to 2025, corresponding to an electricity demand growth reduction at the end of the plan of about 8.0%. This would be implemented through five initiatives as described in Table 3.2.

Table 3.2: Key Initiatives and Programmes under NEEAP

Key Initiative	Programme	Description
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
	5-star air conditioner campaign	Promotion of 5-star rating and label for air-conditioners to transform the market via more efficient models
Minimum Energy Performance Standards (MEPS)	EE lighting campaign	Promotion of energy efficient lighting through awareness programmes, enforcement of MEPS and labelling
	High efficiency motors	Promotion and awareness programme that will lead to mandatory MEPS and labelling for motors by 2020
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.
	Large and medium-sized industries	
	Large Government facilities	
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
Energy Efficient Building Design	Energy Efficiency in New Buildings	Incorporating Energy Efficiency in new building designs and constructions

In 2016, the promotion of 5-star rated electrical appliances under the NEEAP programme has resulted in the avoidance of 31.04 Gg CO_2 eq and 330.51 Gg CO_2 eq from refrigerator and air conditioner respectively. The avoidance of 0.53 Gg CO_2 eq. from the use of energy-efficient lighting and 0.38 Gg CO_2 eq. from the promotion of high efficient electric motors were also achieved under the Minimum Energy Performance Standards (MEPS) Programme.

Under the Energy Audit Conditional Grant (EACG), the energy audits and energy management in commercial buildings and industries were the highest contribution in terms of energy savings (80.76 Gg CO_2 avoidance), followed by energy efficiency measures in large government facilities (14.82 Gg CO_2 avoidance). During the 11th Malaysia Plan, 109 commercial buildings and 108 industries participated under the EACG programme (2016 –

2018) where audits and subsequent energy efficiency improvement efforts were carried out in stages for a period of 3 years from the date of energy audit completion. Meanwhile, Energy Efficiency in Government Buildings programme was introduced in 2013 to promote energy efficiency in government operations through energy audits and good practices. Annual monitoring of electricity usage of all the buildings in 25 Federal Ministries at Putrajaya and Kuala Lumpur was carried out.

Overall, the electricity savings from NEEAP has led to GHG emissions avoidance of 458.02 Gg CO_2 eq in 2016 as outlined in Table 3.7.

3.3.1.3 Green Building Rating Scheme

The objective of the implementation of a green building rating scheme is to promote the efficient use of resources, particularly of energy and water leading to GHG emission reductions. The Eleventh Malaysia Plan foresees that new government buildings will adopt green features and designs and will use green building materials in accordance with existing standards such as the Malaysia Public Works Department Green Rating Scheme known as the Malaysian Carbon Reduction and Environmental Sustainability Tool (MyCREST) and Green (Performance Assessment System) PASS green ratings by the Construction Industry Development Board (CIDB). Existing government buildings will be gradually retrofitted while industry players will be encouraged to obtain green certification such as the Green Building Index (GBI), or Green RE for private buildings. Based on GBI ratings, an estimated total of 143.47 Gg CO_2 eq of emissions reduction were achieved under the implementation of green buildings in 2016 (Table 3.8). This estimate however is not reported in Table 3.1 to avoid double counting between this programme and other programmes (such as NEEAP).

3.3.1.4 Urban Rail-based Public Transport

The implementation of public transport initiatives is important to reduce the use of private vehicles on roads. The Land Public Transport Agency through its National Land Public Transport Master Plan has emphasised on an integrated planning of public transportation and management of the growth of private vehicles. The Master Plan sets a target of a 40% modal share of public transport in urban areas by 2030.

The Tenth and Eleventh Malaysia Plan (2010-2015 and 2016-2020 respectively) has placed emphasis on expanding the urban rail transport system in the Greater Kuala Lumpur/Klang Valley as envisaged in the Greater Kuala Lumpur/Klang Valley Public Land Transport Master Plan. The major effort encompasses the extension of the Kelana Jaya and Ampang Light Rail Transit (LRT) lines which were completed in 2016 and the implementation of the Mass Rapid Transit (MRT) system as major investment priorities. The MRT Line 1 which traverses 51 km through 31 stations, serving about 1.2 million people with a daily expected ridership of about 400,000 passengers was completed in 2017. Construction of the 52 km MRT Line 2 started in 2016 and is scheduled to become operational by 2022. Additionally, construction on Light Rail Transit (LRT) Line 3 running over 37 km and serving 25 stations has been delayed and is expected to be completed in 2024 instead of 2020. In 2016, the use of rail-public transport has resulted in 212.93 Gg CO_2 eq emission reduction in 2016 (Table 3.9).

3.3.1.5 Energy Efficient Vehicles (EEVs)

The National Automotive Policy 2014 set the vision of Malaysia becoming a regional hub for energy efficient vehicles (EEVs) by 2020 through strategic investments and adoption of high technology. The EEVs include fuel-efficient internal combustion engines (ICE) vehicles, hybrid vehicles, electric vehicles, hybrid and alternative-fuelled vehicles that meet a set of specifications in terms of fuel consumption and emissions. It was reported in 2017 that 52% of total industry volume in Malaysia were EEVs, which mainly consists of fuel-efficient ICE vehicles. However, quantification of its impact in terms of GHG emissions could not be carried out due to insufficient activity data. Therefore, in this report, the quantification of GHG emission reduction by EEVs is only based on hybrid and electric vehicles.

The growth of sales for hybrid and electric vehicles were influenced by the various tax incentives introduced in 2009. Until December 2013, exemptions were given on import and excise duties for these vehicles. In 2016, the use of hybrid and electric vehicles has resulted in a total of 90.65 Gg CO_2 eq emissions avoidance in 2016 (Table 3.10).

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

In 2006, the National Biofuel Policy was introduced under the Ministry of Plantation Industries and Commodities. This was 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 programme known as the B5 programme (a blend of 5% palm-based biodiesel and 95% petroleum diesel) was implemented since 2011. The implementation of B5 programme throughout the country was successfully achieved in 2014. Subsequently, the B7 programme was introduced in December 2014 followed by the B10 programme in 2018. The Government remains committed to its plan to pursue the implementation of higher blends of biodiesel for use in all sectors by 2020 under the Eleventh Malaysia Plan. In 2016, the use of palm-based biodiesel contributed to a reduction of 1,127.34 Gg CO_2 eq (Table 3.11).

3.3.1.7 Natural Gas Vehicles (NGVs)

The Natural Gas for Vehicles (NGVs) programme was initiated in the late 1990s with the focus of promoting natural gas-vehicles in the public transport sector, in particular for taxis and buses. Through this initiative, 103 PETRONAS service stations are equipped to retail in NGV. In addition, the Government has provided several incentives to encourage the switching from gasoline to natural gas as transport fuel. These include setting the retail price of natural gas for vehicles at half the retail price of petrol, exemption of import duty and sales tax on equipment for natural gas vehicles conversion tool kits, and a 50% reduction on road tax for 100% natural gas-powered vehicles, as well as 25% reduction on road tax for dual fuel vehicles. Through this programme, a reduction of 114.77 Gg CO_2 eq was achieved in 2016 (Table 3.12).

3.3.1.8 Oil and Gas Operations

PETRONAS, as the national oil and gas company of Malaysia is committed towards a lower carbon footprint. The emissions reduction in oil and gas operations would be achieved through among others, zero continuous flaring and venting in all operations for fugitive emissions, continuous improvement in operations and plant efficiency in natural gas transformation by optimising fuel consumption; and enhance improvement in plant efficiency of oil refining industries by optimising fuel consumption. The emissions reduction in oil and gas operations however are not quantified in this report due to limitation of data.

3.3.2 Waste Sector

The following sub-sections describes the details of each mitigation actions in the waste sector.

3.3.2.1 Waste Paper Recycling

The National Solid Waste Management Policy 2006 and the Eleventh Malaysia Plan has set a target of 22% recycling in 2020. The revised National Solid Waste Management Policy 2016 targets a redirection of 40% of the waste, away from waste disposal sites, out of which 22% is carried out through recycling and 18% through waste treatment. A survey conducted by the Solid Waste and Public Cleansing Management Corporation (SWCorp) shows that there is an increase of recycling rate materials from 17% in 2015 to 21% in 2017. Through these efforts, the paper recycling activities resulted in an emissions reduction of 3,937.76 Gg CO_2 eq in 2016 (Table 3.13).

3.3.2.2 Biogas Recovery from Palm Oil Mill Effluent

Realising the economic value of biogas from palm oil mill effluents (POME), the Government in 2010 had developed an Entry Point Project on *Developing Biogas Facilities at Palm Oil Mills* under its Economic Transformation Programme. The objective of the programme was to ensure that palm oil mills were equipped with biogas entrapment facilities. The biogas can be used to generate electricity for supply to the grid or for self-consumption. As initially envisaged, this EPP would be wholly funded by independent millers and plantation companies with a total estimated investment of RM2.8 billion, for the construction and operation of biogas plants; building gas flaring facilities; and investing in connection of mills to the national grid as well as in gas burners. To accelerate the implementation, the Government mandated that from 1st January 2014, all new mills and all existing mills applying for expansion to install biogas trapping or methane avoidance facilities. As of 2017, out of 454 palm oil mills, 104 of them were fully equipped with biogas capture facilities. Through this initiative, an emissions reduction of 2,377.84 Gg CO_2 eq was achieved in 2016 (Table 3.14).

3.3.3 Industrial Processes and Product Use

In addressing climate change, the cement and iron and steel industries has undertaken a string of initiatives as part of its responsibility to support the global and national concerns in climate change. For cement and iron and steel industries, material substitution with alternative raw materials have been implemented in improving the sustainability and reducing

the emissions. For cement industries, one of the measures implemented was by reducing clinker ratio to cement by using a substitution material such as fly ash and granulated blast furnace slag. By using alternative raw materials, it can help in reducing the emissions in the cement production process. Whilst for iron and steel industries, the measures that have been implemented in reducing the emissions is by utilising recycled material such as scrap as one of the key raw materials. By using the recycled materials, it can help to reduce the raw material consumption by reducing the extraction and utilisation of iron ore. The GHG emissions impact from these two industries however, are not quantified in this report due to limitation of data.

3.3.4 Agriculture

Synthetic chemicals used as fertiliser, pest and disease control, post-treatment, and soil structure improvement are among the contributors to GHG emissions. The Malaysian Organic Scheme (SOM) currently known as Malaysia Organic (MyOrganic) is a certification that recognises farms that practice good agricultural practices and organic farming based on Malaysian Standard MS 1529:2015 Plant-based organically produced foods-requirements for production, processing, handling, labelling and marketing (First Revision) and ASEAN Standard for Organic Agriculture (ASOA). To date, 253 farms have been certified with MyOrganic certification with an area of 2,045.60 ha. The GHG emissions impact from this program however, are not quantified due to limitation of data.

3.3.5 Forestry

Forestry plays an important role in Malaysia's action to address climate change. This sector remains a net sink while contributing to the nation's GDP. It is therefore necessary to continue to strengthen the sustainable forest management implementation and conservation efforts of the country and enhance the forest sinks. Over the years, Malaysia has put in place measures to maintain at least 50% of its land mass as forest. Both sustainable management of Permanent Reserved Forest (PRF) and conservation are being strengthened.

For sustainable harvesting of timber, a forest certification scheme began in 2001 with the adoption of the Malaysian Criteria and Indicators for forest management certification. The annual allowable cut in the PRF is capped at 85 m^3/ha for each of the Malaysia Plan period and the overall national harvest level has been on the decline since 2001, as shown in Table 3.3.

Table 3.3: Annual Allowable Cut in the Permanent Reserved Forest (ha) during the 10th and 11th Malaysia Plan Period

Malaysia Plan	Peninsular Malaysia	Sabah	Sarawak	Total
10th MP (2011-2015)	40,334	60,000	155,000	255,334
11th MP (2016-2020)	41,888	50,000	155,000	246,888

Source: Ministry of Energy and Natural Resources

Malaysia's Protected Area (PA) network, which forms the backbone for the maintenance of biodiversity and of ecosystem services, is an impressive result of decades of work. Hence, a target is set to increase the Protected Area to at least 20% by 2025. Between 2014 and 2016, the Protected Area increased from 2.757 to 3.171 million ha.

On-going forest enrichment programmes not only aims to improve degraded forests sequestration capacity but also to enhance connectivity between forests through two distinct initiatives, the Central Forest Spine (CFS) programme in Peninsular Malaysia and the Heart of Borneo (HoB) programme in Sabah and Sarawak.

Through these efforts, a total of 20,307.50 Gg CO_2 eq emissions reduction was achieved in 2016 (Table 3.15).

3.4 Mitigation Actions and Implementation Key Enablers at National and Sub-National Levels

Various initiatives were also introduced by the government to create a conducive and enabling environment to encourage more mitigation efforts. The following sub-sections detailed out the key enablers and its respective achievements.

3.4.1 Power Sector Development Plan

The Ministry of Energy and Natural Resources has set a long-term power sector development plan (2020 – 2038) for Peninsular Malaysia. In 2020, the development plan has also set new targets on renewable energy capacity at 31% of the total installed capacity by 2025 and at 40% by 2035. This involves the installation of 1,178 MW of renewable energy by 2025 and 2,414 MW by 2035. Within the plan period, there will also be no new capacity expansion of coal-fired power plant. However, an exception is considered when an existing coal-fired power plant is decommissioned during this period with a capacity capped at a maximum level of the installed capacity of the decommissioned power plant. As a result of the capping, the coal power plant capacity in 2039 will be reduced by 35% compared to its capacity in 2020.

3.4.2 Green Technology Financing Scheme (GTFS)

GTFS is a financing scheme to facilitate the financing of green technology projects, providing easier access to private funds. The scheme, which targets both producers and users of green technology, offers a government guarantee of 60% of the financed amount and a 2% per annum rebate on the interest/profit rate charged by financial institutions. Projects from energy, building, transport, waste and water sectors are eligible to apply for GTFS. The first phase of the Scheme was introduced in 2010 and extended until 2017. As of 31 December 2017, 319 projects were approved with secured financing total up to RM3.64 billion, where most of them are renewable energy projects. An extension of the Scheme was announced for GTFS 2.0 with a RM2.0 billion allocation in March 2019, together with additional eligibility for energy service companies (ESCOs) and manufacturing sector to apply. GHG emissions reduction from majority of the projects under this Scheme had already been accounted for in other mitigation actions, in particular under the FiT category.

3.4.3 Green Investment Tax Allowances (GITA) and Green Income Tax Exemption (GITE)

In 2014, the Government have introduced the Green Technology Tax Incentives with the objective to strengthen the development of green technology in Malaysia, namely the Green Investment Tax Allowances (GITA) for qualifying green assets and projects as well as Green Income Tax Exemption (GITE) for qualifying green service providers. Companies that acquire green technology assets, undertake green technology projects and green technology service providers are eligible to apply for the incentives.

A green recognition scheme known as MyHIJAU provides a list of certified products and services that meet local and international environmental standards. Local companies that are acquiring green technology assets and listed under the MyHIJAU Directory as well as companies who undertake qualifying green technology projects for business or own consumption are eligible to apply for GITA; whereas GITE are applicable for qualifying green technology service provider companies that are listed under the MyHIJAU Directory. Several GHG mitigation related projects and services have been approved under both GITA and GITE, where most of them are renewable energy and energy efficiency projects.

3.4.4 Low Carbon Cities Framework (LCCF)

Introduced in 2011, the Low Carbon Cities Framework (LCCF) is a national framework to guide Local Governments in transforming their cities into Low Carbon Cities. It provides the necessary tools including guidelines for cities' design, measurement and reporting methodologies, assessments and recognitions to enable cities to implement low carbon strategies that are both systematic and impactful. The framework covers urban environment, urban transportation, urban infrastructure as well as buildings. As of 2019, a total of 53 Local Governments have been introduced to and trained on the LCCF and 22 of these Local Governments have implemented low carbon solutions in their cities that have resulted in GHG emissions reduction from the respective cities’ baselines. The Low Carbon Cities program is also gaining traction with the private sector who are collaborating and working together with the Local Governments both as solution providers as well as partners in helping achieve the common goal of a low carbon city.

3.4.5 Government Green Procurement

Government Green Procurement (GGP) is defined as procurement of products, services and works that take into account environmental criteria and standards for protecting the environment and natural resources and minimize or mitigate the negative effects of human activities. Malaysia’s GGP was piloted in 2013, spearheaded by the Ministry of Finance. The 11th Malaysian Plan has set a target of 20% GGP to be achieved by 2020. As of 2017, 30 product groups were recognised under GGP. At that point of time, 25 ministries and government agencies took part in GGP, which resulted in RM286.3 million of green procurement value.

Table 3.4: Renewable Energy through Feed-in-Tariff Mechanism

Mitigation Action	Objectives	Description	Key Implementing Agency	Progress of Implementation/ Steps taken or Envisaged to achieve action	Progress Indicators	Methodologies and Assumptions	Gas Coverage	Results Achieved
Renewable Energy (RE) implementation through Feed-in Tariff (FiT) mechanism.	To increase proportion of renewable energy in the fuel mix for grid electricity so as to enhance national electricity supply security and sustainable socio-economic developme nt.	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.	Sustainable Energy Development Authority (SEDA)	Adoption of National Renewable Energy Policy and Action Plan 2010. Establishment of Renewable Energy Act 2011 and Sustainable Energy Development Authority Act 2011. Establishment of the Renewable Energy Fund to finance the scheme. Provision of financing support to capital investment by qualified Feed-in Tariff project developers through the Green Technology Financing Scheme.	Total approved Feed-in Tariff capacities and RE generated by operational projects.	RE generation is based on statements of claims on sales of by all approved holders submitted by distribution licensees for recovery from the Renewable Energy Fund. Emissions avoidance are quantified based on the displacement and/or reduction of the consumption of grid-electricity. In this regard, three grid-electricity emission factors were used for Peninsular Malaysia, Sabah and Sarawak which were 0.639 tonnes CO_2/MWh, 0.512 tonnes CO_2/MWh and 0.249 tonnes CO_2/MWh respectively. Emission leakage is not considered.	CO_2	FiT RE electricity generated (GWh): 2016: 765.24 Emissions avoidance (Gg CO_2 eq): 2016: 460.52

Table 3.5: Renewable Energy: Hydropower

Mitigation Action	Objectives	Description	Key Implementing Agencies	Progress of Implementation /Steps taken or Envisaged to achieve action	Progress Indicators	Methodologies and Assumptions	Gas Coverage	Results Achieved
Generation of electricity by hydropower stations.	Diversification of sources for generation of grid connected electricity.	To enhance energy security, hydroelectric power stations was incorporated as one of the sources for grid connected electricity generation under the Four-Fuel Diversification Policy in 1981.	Energy Commission (EC) Tenaga Nasional Berhad (TNB) Sabah Electricity Sdn Bhd (SESB) Sarawak Energy Berhad (SEB)	Two hydroelectric power stations namely Tembat (15MW) and Ulu Jelai (372MW) were commissioned at the end of 2015 and 2016 respectively.	Total installed capacity and electricity generated by hydroelectric power stations.	The capacity and electric generated by each hydroelectric power stations is reported by the Energy Commission and Sarawak Energy Berhad in the annual Energy Balance and SEB Annual Report Electricity generated under the FiT, are excluded. Emissions avoidance are quantified based on the displacement and/or reduction of the consumption of grid-electricity. In this regard, three grid-electricity emission factors were used for Peninsular Malaysia, Sabah and Sarawak which were 0.639 tonnes CO_2/MWh, 0.512 tonnes CO_2/MWh and 0.249 tonnes CO_2/MWh respectively.	CO_2	Electricity generated by hydroelectric power stations (GWh): 2016: 20,132.47 Emissions avoidance (Gg CO_2 eq): 2016: 6,570.15

Table 3.6: Renewable Energy: Public and Private Licensees

Mitigation Action	Objectives	Description	Key Implementing Agencies	Progress of Implementation/ Steps taken or Envisaged to achieve action	Progress Indicators	Methodologies and Assumptions	Gas Coverage	Results Achieved
RE by public and private licensees.	To promote the use of RE resources in electricity generation.	Power generation from RE resources such as biomass, biogas and solar photovoltaic by the private sector for both on-site and off-site consumption, including supply to the grid not under the existing RE programmes including FiT scheme and hydropower.	Energy Commission (EC) Tenaga Nasional Berhad (TNB) Sabah Electricity Sdn Bhd (SESB) Sarawak Energy Berhad (SEB) Private sector	Provision of fiscal incentives to commercial and industrial business entities which undertake generation of energy using RE resources either for their own consumption or supply to the national electricity grid system.	Total approved licensed installed capacities of RE and total units of RE electricity generated by regulated private and public licensees.	Total units of RE generated are captured by annual reports made by public and private licensees to Energy Commission and Sarawak Energy Berhad published in the respective annual National Energy Balance and SESB Annual Report. Emissions avoidance are quantified based on the displacement and/or reduction of the consumption of grid-electricity. In this regard, three grid-electricity emission factors were used for Peninsular Malaysia, Sabah and Sarawak which were 0.639 tonnes CO_2/MWh, 0.512 tonnes CO_2/MWh and 0.249 tonnes CO_2/MWh respectively.	CO_2	RE electricity generated by public and private licensees (GWh): 2016: 481.11 Emissions avoidance (Gg CO_2 eq): 2016: 231.92

Table 3.7: National Energy Efficiency Action Plan (NEEAP)

Mitigation Action	Objectives	Description	Key Implementing Agencies	Progress of implementation/ Steps taken or Envisaged to achieve action	Progress Indicators	Methodologies and Assumptions	Gas Coverage	Results Achieved
Implementation of energy efficiency programmes identified in the National Energy Efficiency Action Plan (NEEAP)	To increase energy efficiency in residential, commercial and industrial sectors	Energy efficiency programmes specified in sub-section 3.3.1.2.	Ministry of Energy and Natural Resources Energy Commission	Funds have been allocated under the Eleventh Malaysia Plan for initial implementation of the programmes under NEEAP. Implementation would be through phases. The Energy Commission has started the implementation of energy audits for industrial and commercial sectors in 2016.	Total electricity savings for each of the programmes (GWh)	Annual electricity savings under NEEAP programmes is compiled by the Energy Commission. Emissions avoidance are quantified based on the displacement and/or reduction of the consumption of grid-electricity. In this regard, three grid-electricity emission factors were used for Peninsular Malaysia, Sabah and Sarawak which were 0.639 tonnes CO_2/MWh, 0.512 tonnes CO_2/MWh and 0.249 tonnes CO_2/MWh respectively.	CO_2	Electricity savings (GWh): 2016: 716.78 Emissions avoidance (Gg CO_2 eq): 2016: 458.02

Table 3.8: Green Building Rating Scheme

Mitigation Action	Objectives	Description	Key Implementing Agency	Progress of implementation / Steps taken or Envisaged to achieve action	Progress Indicators	Methodologies and Assumptions	Gas Cover-age	Results Achieved
Implemen-tation of green building rating scheme	• To promote sustainability in the built environment through the application of green rating tools for buildings and townships by stakeholders in the building sector; • To encourage property developers and owners to plan, design, construct and sustainably manage buildings and sites to optimise energy and water efficiency, enhance indoor environment quality and to use materials and resources sustainably.	Implemen-tation of Green Building Index (GBI) certification as a private-sector regulated green building rating tool in line with the demand for good corporate social responsibility.	Green Building Index Sdn Bhd	Organisation of roadshows, awareness seminars, briefing sessions, training courses and certification consultation sessions Roll-out and updating of rating tools	Monthly performance data on electricity consumption savings and correspondin g emission reductions achieved by certified projects against set benchmarks under the BAU scenario as reported by GBI.	Data on electricity consumption of all completed, assessed and verified buildings is compiled by GBI based on findings of completion and verification assessments (CVAs) conducted. The difference in electricity use from the business-as-usual scenario in the various building categories is computed. Emissions avoidance are quantified based on the displacement and/or reduction of the consumption of grid-electricity. Monthly executive summaries reporting on the performance of all GBI certified projects by categories are published on the GBI website.	CO_2	Electricity savings from CVA projects (GWh): 2016: 228.91 Emissions avoidance (Gg CO_2 eq): 2016: 143.47

Table 3.9: Transport: Urban Rail-based Public Transport

Mitigation Action	Objectives	Description	Key Implementing Agencies	Progress of implementation / Steps taken or Envisaged to achieve action	Progress Indicators	Methodologies and Assumptions	Gas Covera-ge	Results Achieved
Urban rail-based public transport	• To expand and integrate the urban rail public transport system; • To promote reduced use of private transport and demand on road infrastructure through increasing public rail transport modal share.	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.	Ministry of Transport Land Public Transport Agency (APAD); Prasarana Malaysia Bhd; Express Rail Link Sdn Bhd; KTM Bhd	Completion and operation of the LRT Kelana Jaya extension in 2016. Building of additional lines (MRT2 and LRT3) to increase coverage.	Daily ridership volumes on the LRT, Monorail and KLIA Express Rail Link, KTM Komuter and MRT networks.	Annual ridership and average length travelled on the LRT, Monorail and KLIA Express Rail Link and KTM Komuter networks are compiled. 66.5% of the ridership is assumed to have shifted from cars to rail and 33.5% from motorcycles to rail. The number of cars and motorcycles and their corresponding commuting distance avoided are computed. The emissions avoided are calculated based on the carbon emission factor for the passenger vehicle category as reported by DEFRA, United Kingdom, or equivalent. Annual data on operational electricity consumption of the LRT, Monorail and KLIA Express Link networks are compiled and aggregated for the year. Emissions from electricity consumption are quantified using grid-electricity emission factor (Peninsular Malaysia 0.639 tonnes CO_2/MWh) The net emission reduction achieved is the difference between avoided emissions from not using private vehicles and emissions from rail-based public transport.	CO_2	Annual Ridership: 2016: 169,091,133 Emissions avoidance (Gg CO_2 eq): 2016: 212.93

Table 3.10: Transport: Energy-Efficient Vehicles (Hybrid and Electric Vehicles)

Mitigation Action	Objectives	Description	Key Implementing Agencies	Progress of implementation/ Steps taken or Envisaged to achieve action	Progress Indicators	Methodologies and Assumptions	Gas Cover-age	Results Achieved
Promo-ting the use of energy-efficient vehicles (EEVs)	To increase the number of on-the road EEVs in Malaysia	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.	Ministry of International Trade and Industry; Malaysia Automotive, Robotics and IoT Institute (MARii)	Six roadmaps have been established to support the implementation of National Automotive Policy 2014, viz. the Malaysia Automotive Technology Roadmap (MATR), Malaysia Automotive Supply Chain Development Roadmap (MASCR), Malaysia Automotive Human Capital Roadmap (MAHR), Development of Automotive Authorised Treatment Facilities Framework (ATF), Malaysia Automotive Bumiputera Development Roadmap (MABDR) and Malaysia Automotive Remanufacturing Roadmap (MARR). EEV incentives are given to OEMs that produce EEV certified models and based on merits of business proposal that evaluated through Cost Benefit Analysis (CBA) by MARii. Sale of Euro 5 diesel started in 2014. Rollout of EURO 4 Ron 97 petrol started in 2015.	Number of EEV vehicles registered under the Road Transport Depart-ment Malaysia.	Information on the number of registered EEV vehicles 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 consumption; 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 as reported by Department for Environment, Food and Rural Affairs (DEFRA), United Kingdom are used.	CO_2	Number of hybrid vehicles registered 2016: 53,310 Number of electric vehicles registered: 2016: 171 Emissions avoidance (Gg CO_2 eq): 2016: 90.65

Table 3.11: Transport: Palm oil-based fatty acid methyl ester (Biodiesel)

Mitigation Action	Objectives	Description	Key Implementing Agency	Progress of implementation/ Steps taken or Envisaged to achieve action	Progress Indicators	Methodologies and Assumptions	Gas Coverage	Results Achieved
Use of palm-based biodiesel in blended petroleum diesel	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 enhancing sustainable socio-economic develop-ment.	Blending 5% of palm methyl ester with 95% of petroleum diesel under the B5 programme, increasing to 7% palm biodiesel blended with 93% petroleum diesel under the B7 programme.	Ministry of Plantation Industries and Commodities	Completion of the B5 mandate nationwide by 2014. Launch of the B7 programme in November 2014.	Nationwide biodiesel consumption data compiled monthly	Monthly data on the quantity of biodiesel supplied to the domestic consumer market is captured from the records of the Ministry of Finance and aggregated annually. The annual GHG emissions of displaced petroleum diesel are calculated by applying the IPCC default carbon emission factor. Leakage emission relating to the production of biodiesel is not considered.	CO_2	Petroleum diesel displaced by palm oil-based biodiesel (tonnes) 2016: 358,586 Emissions avoidance (Gg CO_2 eq): 2016: 1,127.34

Table 3.12: Transport: Natural Gas Fuelled-Vehicles

Mitigation Actions	Objectives	Description	Key Implementing Agencies	Progress of Implementation/ Steps taken or envisaged to achieve action	Progress Indicators	Methodologies and Assumptions	Gas Coverage	Results Achieved
Use of natural gas as fuel in vehicles	To promote the use of compressed natural gas as an alternative fuel in automobiles for enhancing environmental quality and reducing carbon emissions.	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.	Economic Planning Unit, Prime Minister's Department Ministry of Finance	There are 103 PETRONAS NGV stations that are equipped for CNG/NGV operations in 2016.	Sale and consumption of NGV in the transport sector	Computation of the difference in emissions between the use of alternative fuels and motor gasoline. Default emission factors of fuels based on 2006 IPCC Guidelines for National Greenhouse Gas Inventories.	CO_2	Total consumption of NGV (toe) 2016: 208,000 Emissions avoidance (Gg CO_2 eq): 2016: 114.77

Table 3.13: Waste: Waste Paper Recycling

Mitigation Action	Objectives	Description	Key Implementing Agencies	Progress of Implementation/ Steps taken or Envisaged to achieve action	Progress Indicators	Methodologies and Assumptions	Gas Coverage	Results Achieved
Waste paper recycling	Methane avoidance through recycling of waste paper.	Sustainable waste management through recycling and utilisation of waste paper for manufacture of paper products.	National Solid Waste Management Department; Solid Waste Management and Public Cleansing Corporation; Paper products industry	Targets for recycling in the National Solid Waste Management Policy 2016. Promotion of recycling by the National Solid Waste Management Department and Solid Waste Management and Public Cleansing Corporation. Promotion of sustainable consumption and production by the Government. Continuous demand by paper products industry.	Amount of waste paper recycled	Data on the amount of waste paper recycled each year are based on the amount of waste paper recycled that is compiled by the Solid Waste Management and Public Cleansing Corporation through voluntarily participation of recycling manufacturers. The methane emissions avoided are calculated based on the total waste paper 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.	CH_4	Waste paper recycled (tonnes) 2016: 1,458,431 Emissions avoidance (Gg CO_2 eq): 2016: 3,937.76

Table 3.14: Waste: Biogas Recovery from Palm Oil Mill Effluent

Mitigation Action	Objectives	Description	Key Implementing Agency	Progress of Implementation/ Steps taken or Envisaged to achieve action	Progress Indica-tors	Methodologies and Assumptions	Gas Cover-age	Results Achieved
Biogas recovery from palm oil mill effluent (POME) treatment	To avoid release of methane from treatment of POME through biogas capture and destruction	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.	Ministry of Plantation Industries and Commodities Malaysian Palm Oil Board (MPOB)	Inclusion of 'Developing Biogas Facilities at Palm Oil Mills' as an Entry Point Project of the Palm Oil of the Palm Oil National Key Economic Area under the Economic Transformation Programme launched by the Government in 2010 and reiterated in the Green Technology Master Plan in 2017. Effective 1 January 2014, all new mills and all existing mills applying for throughput expansion mandated to install full biogas trapping or methane avoidance facilities. Ongoing studies to evaluate various strategies and measures, including formulating appropriate regulations and providing reasonable incentives to enforce the programme on all existing mills.	Number of mills equipped with on-site biogas capture facilities. Annual throughputs of mills with on-site biogas capture facilities.	Data on monthly Crude Palm Oil production is reported by MPOB and aggregated 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. Emission reduction from biogas projects under FiT and Other RE by public and private licensees are excluded to avoid double counting.	CH_4	CPO production (tonnes): 2016: 17,319,177 Total number of palm oil mills: 2016: 454 Total number of palm oil mills with biogas capture facilities: 2016: 94 Emissions avoidance (Gg CO_2 eq): 2016: 2,377.84

Table 3.15: Forestry (Sustainable Forest Management)

Mitigation Action	Objectives	Description	Key Implementing Agencies	Progress of Implementation / Steps taken or Envisaged to achieve action	Progress Indicators	Methodologies and Assumptions	Gas Coverage	Results Achieved
Reducing emissions from forests	To promote sustainable forest management and conservation	Sustainable forest management is practised in Malaysia to ensure that the 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 Energy and Natural Resources Ministry of Plantation Industries and Commodities State Forestry Departments	Establishment of Malaysian Timber Certification Council in 1998. Maximum harvest limit set at 85 m^3 per ha. Annual allowable cut is fixed at the beginning of each Malaysia Plan.	Changes in forest cover (hectares) Total commercial harvest from Permanent Reserved Forest	The Gain-Loss methodology from the IPCC 2006 Guidelines is used to quantify the removals and emissions from forest remaining forest category. National emission factors from National Forest Inventories and published literature are used As per the UNFCCC decisions, the results achieved are subtracted from the Forest Reference Level The harvesting intensity is subjected to the regulatory framework	CO_2	Emissions avoidance (Gg CO_2 eq): 2016: 20,307.50

3.5 Domestic Measurement, Reporting and Verification

Domestic measurement, reporting and verification of mitigation actions and their effects is coordinated by the Ministry of Environment and Water. Monitoring and measurement of emission reduction are at different levels of integration into the functions of the implementing agencies. Figure 3.1 shows an overview of MRV process. The mitigation action data is collated by the SWGs with the assistance of consultants. First level verification is carried out by the Greenhouse Gas Inventory and Reporting Unit with the assistance of independent experts. The results are then submitted to the TWG on Mitigation for second level verification and endorsement. The final verification and endorsement is carried out by the MRV TWG. The memberships of these TWGs are listed in the acknowledgement section.

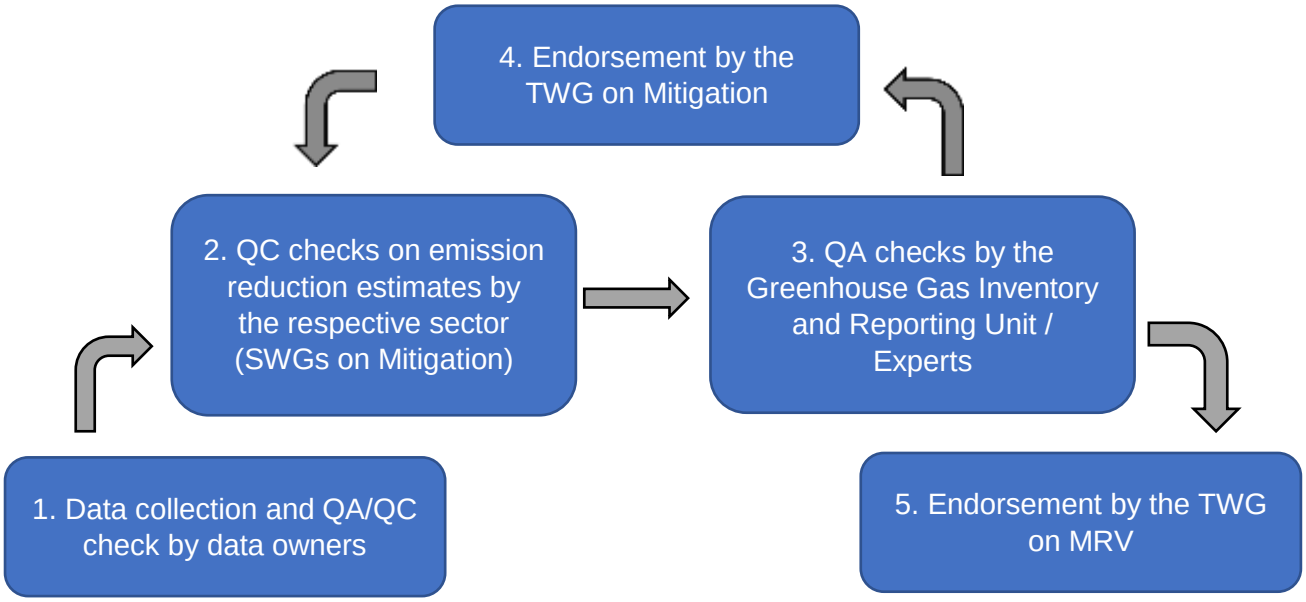


Figure 3.1: Schematic Diagram Showing the Domestic Measurement, Reporting and Verification for Mitigation Actions in Malaysia

3.6 International Market Mechanism

Malaysia participated in the Clean Development Mechanism under the UNFCCC and Voluntary Carbon Market. The GHG emissions reduction from the market mechanism is not accounted as part of the national mitigation actions.

3.6.1 Clean Development Mechanism

Malaysia ratified the Kyoto Protocol on 4th September 2002 and the Doha amendment to the Kyoto Protocol on 12th April 2017. Following the ratification of the Kyoto Protocol, Malaysia developed a national strategy on Clean Development Mechanism (CDM) which took into account both the short- and long-term perspectives of the country's position with regard to climate change mitigation measures. A National CDM Committee was established on 31st May 2002 to oversee the implementation of CDM projects in Malaysia and is assisted by three Technical Committees, namely for Energy, Agriculture and Forestry. The Committee is

chaired by the Deputy Secretary-General of the Ministry of Environment and Water with the secretariat at the same Ministry. The membership of this committee consists of representative from the relevant Ministries, Agencies and a representative from the non-governmental organisation as listed in the acknowledgment section of this report.

Through participation in the CDM, Malaysia benefited from investments in GHG emissions reduction projects which have contributed towards the overall improvement of the environment in line with its sustainable development agenda. As of December 2018, Malaysia has a total of 143 CDM projects and five Programme of Activities (PoAs) with ten Component Project Activities (CPAs) registered with the CDM Executive Board. This forms 1.8% of the total CDM project activities under the Kyoto Protocol. These projects involved an estimated investment of USD 1,529 million. From these projects, a total of 12,314,456 CERs had been issued from 2006 to 2018. Table 3.16 shows the distribution of CDM project activities, categorised according to project type, along with their potential annual emissions reductions, CERs issued and reported investments.

The bulk of the project activities are associated with oil palm processing residues, focusing on biomass energy, methane capture and co-composting using either the solid or liquid wastes, or both. Collectively, these oil palm-related project activities accounted for 78.3% of Malaysia's CDM pipeline of registered projects, contributing to 63.2% of the total potential emission reduction.

Table 3.16: 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_2eq/yr)	% of Total Annual Emission Reduction Potential	CERs Issued (2006-2012) (t CO_2eq)	CERs Issued (2013-2018) (t CO_2eq)	Total CERs Issued (2006-2018) (t CO_2eq)	Estimated Investment (mil USD)
Biomass energy	Oil palm solid biomass	31	21.68	2,547,431	28.92	2,188,896	3,415,962	5,604,858	148.55
	Agricultural residues	5	3.50	615,834	6.99	0.00	538,471	538,471	8.88
	Wood waste	4	2.80	110,777	1.26	0.00	0.00	0.00	27.97
	Gasification	1	0.70	26,983	0.31	0.00	0.00	0.00	0.00
Energy efficiency	Electronics	2	1.40	7,786	0.09	0.00	0.00	0.00	0.00
	Machinery	1	0.70	173	0.00	0.00	0.00	0.00	0.48
Hydropower	Run of river	3	2.10	105,083	1.19	0.00	42,922	42,922	48.80
	New dam	2	1.40	260,421	2.96	8,372	34,257	42,629	824.23
Landfill gas	LFG power	6	4.20	586,488	6.66	433,328	2,188,042	2,621,370	22.46
	LFG flaring	3	2.10	360,707	4.09	12,623	0.00	12,623	10.20
CH4 avoidance	Palm oil mill effluent	54	37.76	2,249,808	25.54	492,249	951,437	1,443,686	188.17
	Composting	27	18.88	770,107	8.74	31,381	171,826	203,207	47.88
EE supply side	Single to combined cycle	1	0.70	595,460	6.76	974,168	351,887	1,326,055	102.24

Type	Sub-Type	No. of Registered Projects	% of Total Number of Projects	Annual Emission Reduction Potential (t CO_2eq/yr)	% of Total Annual Emission Reduction Potential	CERs Issued (2006-2012) (t CO_2eq)	CERs Issued (2013-2018) (t CO_2eq)	Total CERs Issued (2006-2018) (t CO_2eq)	Estimated Investment (mil USD)
Fuel switch	New NG plant	1	0.70	299,832	3.40	0.00	477,057	477,057	99.83
Geothermal	Geothermal electricity	1	0.70	269,026	3.05	0.00	0.00	0.00	0.00
Transport Efficient	Efficient vehicles	1	0.70	3,156	0.04	0.00	1,578	1,578	0.00
	Total	**143**	**100.00**	**8,809,072**	**100.00**	**4,141,017**	**8,173,439**	**12,314,456**	**1,529.69**

Note: Data as of December 2018

3.6.2 Voluntary Carbon Market

In addition to the CDM, Malaysia also participated in 12 voluntary carbon market projects which were validated to the criteria of the Verified Carbon Standard (VCS). Of these, eight were methane emission avoidance projects, two hydropower projects and one each under biomass and reforestation projects respectively. Table 3.17 shows the status of these projects.

Table 3.17: Distribution of Voluntary Carbon Market Project Activities by Project Type

Project Type	No. of Projects	Project Estimate of Annual ERs (t CO_2eq)	Total VCUs Issued	Total VCUs Retired	Balance Issued VCUs in VCS Registry
CH_4 avoidance	8	217,714	25,087	25,087	0
Biomass energy	1	21,660	0	0	0
Hydropower	2	45,219	10,692	10,692	0
Reforestation	1	138,013	509,540	509,540	0
Total	**12**	**422,606**	**545,319**	**545,319**	**0**

Note: Data as of December 2018

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

4.1 Introduction

Integrating climate initiatives into development efforts require technological support, skill and capacity development and financial investment. Malaysia has allocated national resources to advance its low carbon development agenda and has received some financial, technical and capacity building support from international sources.

This chapter provides updated information on the support received by federal agencies from multilateral and bilateral sources to address climate change. Support received at sub-national level by governmental bodies and non-governmental organizations is also reported to the extent possible.

The chapter discusses in detail the constraints, gaps and needs that federal agencies have in executing tasks on GHG inventory, mitigation actions and adaptation efforts. A common constraint faced by federal and state agencies is the lack of sufficient technical and technological capacity to carry out initiatives. This is largely due to either the technology not being available yet in the country or agencies not having the local experts necessary for the initiatives. In order to strengthen Malaysia's capacity in addressing climate change effectively will require assistance from international sources to enhance technical capabilities and technology availabilities. Another constraint that was highlighted was the lack of adequate funding to implement large-scale climate initiatives.

4.2 Level of Support Received

The Global Environment Facility (GEF) has been the main source of funding. Table 4.1 shows the funding allocated and received by Malaysia from GEF cycle 1 to 6 (June 1994- June 2018) for climate change activities. The funding provided by GEF, other multilateral agencies and bilateral sources were provided through specific projects. Table 4.2 provides a summary of the financial supports received from 2014 onwards. 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

From GEF cycle 4 to 6 (June 2006 – June 2018), Malaysia was allocated an indicative sum of USD 37,082,779 and utilised USD 32,265,249. During GEF cycle 6, Malaysia faced challenges in getting climate change projects approved due to financial constraints faced by GEF as reported in the GEF Trust Fund Financial Report 2017. This has affected the continuity of Malaysia's climate change actions.

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 as shown in table 4.1. The United Nations Development Programme (UNDP) and the United Nations Industrial Development Organisation (UNIDO) have facilitated these actions.

The funding received under GEF-6 cycle were primarily used to build up technical and technological capacities. Sectors that have also received financial support for mitigation projects were transport, energy, forestry (peatland) and low carbon cities.

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	11,042,779	7,262,500

Note: N/A connotes that data is not available

4.2.2 Green Climate Fund (GCF)

Malaysia is also exploring opportunities to access the Green Climate Fund (GCF). An area of priority for the country is the development of a comprehensive National Adaptation Plan under which internal funding was used to carry out a scoping study in this area. In developing further a comprehensive plan, Malaysia is currently applying for funding from GCF.

4.2.3 Multilateral and Bilateral Funding and Support

Table 4.2 updates the information reported on BUR2 on financial support received from various sources.

Table 4.2: Financial Support Received from Various Sources

Source	Project Description	Focus of support	Project Durati-on	Implementing Agencies*	Delivery Partners	Approved Amount
GEF	Cleantech Programme for SMEs in Malaysia	Technical capacity building	2013-2016	Malaysian Industry-Government Group for High Technology	UNIDO	USD 990,000
GEF	Green Technology Application for the	Technical capacity building	2014-2020	Sustainable Energy Development Authority	UNDP	USD 4,354,794

Source	Project Description	Focus of support	Project Durati-on	Implementing Agencies*	Delivery Partners	Approved Amount
	Development of Low Carbon Cities					
GEF	GHG Emissions Reductions in Targeted Industrial Sub-sectors Through EE and Application of Solar Thermal System	Technical	2015-2019	Standards and Industrial Research Institute of Malaysia	UNIDO	USD 4,000,000
GEF	Energy Efficient Low Carbon Transport	Technical	2015-2020	Malaysian Green Technology Corporation	UNIDO	USD 2,000,000
GEF	Small Grant Projects for Climate Change Action	Technical capacity building	2014-2019	NGOs and CBOs	UNDP	USD 454,000 (cumulative)
Germany	Green Economy in the Heart of Borneo	Technical capacity building	2015-2020	WWF Malaysia	International Climate Initiative (IKI)	€ 2,100,000
UK	Demonstrations of Approaches to Accelerate the Rate of Deployment of Cost Effective, Energy Efficient Technologies in Malaysia	Technical capacity building	2014-2016	Malaysian Green Technology Corporation, SME Corp	Carbon Trust	£ 43,800
UK	Establishment of a Low Carbon City and Green Growth Strategy for Greater Kuala Lumpur	Technical capacity building	2016 - 2017	Kuala Lumpur City Council	Carbon Trust	£ 142,300

Source	Project Description	Focus of support	Project Durati-on	Implementing Agencies*	Delivery Partners	Approved Amount
UK	Developing Innovative Sustainable Mobility Solutions for Iskandar Regional Development Authority Within a Defined Urban Area Based on UK Smart City Experience and Expertise	Technical capacity building	2016-2017	Iskandar Regional Development Authority	Future Cities Catapult	£ 109,848
UK	Establishing the Policy Framework, Stakeholder Community and Business Case for Scaling Up Combined Heat and Power Deployment	Technical capacity building	2016-2017	KeTSA, Gas Malaysia	Carbon Trust	£ 118,500

4.2.4 Other Capacity Building Assistance

Malaysia has been the recipient of capacity-building support on a range of training programmes conducted by the UNFCCC's Consultative Group of Experts (CGEs), the Intergovernmental Panel on Climate Change (IPCC), different multilateral organizations and various Annex I Parties. Capacity building training received were in areas such as GHG inventory, mitigation (measurement, reporting and verifying emissions data), adaptation planning, implementing and enhancing nationally determined contributions (NDC), climate negotiations and climate finance.

Malaysia has received training for GHG inventory from the UNFCCC to enhance its technical capacity on compiling GHG emissions data using 2006 IPCC guidelines. Besides that, Japan through its National Institute for Environmental Studies (NIES) has also provided training in this area via the annual Workshop on GHG Inventories in Asia (WGIA).

Malaysia 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. Malaysia has participated in a scoping study on cooperative MRV towards a potential carbon market within ASEAN.

In the area of adaptation, the UNFCCC and IPCC provided training on identifying and reporting adaptation actions to enhance technical capacity in this area. Malaysia also received support from Germany via GIZ and Japan via JICA on climate change action formulation and implementation. Malaysia were also participants in an ASEAN-level symposium on Disaster Management.

Malaysia also attended a training workshop to enhance climate negotiation skills organized by the European Capacity Building Initiative (ECBI).

4.3 Constraints, Gaps and Needs

Malaysia's needs for external financial, technical/technology and capacity building support is summarised in Table 4.3.

Table 4.3: Summary of Needs for External Financial, Technical/Technology and Capacity Building Support

Sector/ Thematic Area	Activity	Lead Agencies	Status	International Support needed		
				Finance	Technical/ Technology	Capacity-building
Energy	Malaysia Distributed Solar and Energy Storage (MDSES) demonstration project	SEDA	Planning (2021-2025)	USD 4,900,000	Technology for battery storage Technical support to identify appropriate design for battery storage systems	Training to build up local understanding and knowledge in energy storage systems
	Energy Efficiency: Adoption of high efficiency motors	Energy Commissi-on	On-going	Not required	High efficiency motors	Training on promotion and awareness to increase usage of high efficiency motors
	Develop techno-economic model and roadmap for e-Bus, e-2-wheelers,	MOT, APAD	2021-2030	Not required	Technical expertise for the development of the techno-economic	Not required

Sector/ Thematic Area	Activity	Lead Agencies	Status	International Support needed		
				Finance	Technical/ Technology	Capacity-building
	e-goods transfer and e-company fleet and propose incentive mechanism for commercial electric vehicle nationwide				incentive mechanism	
	Second-generation biodiesel	MPIC, MPOB	New project	Not required	Hydrotrea-ting technology that can produce hydrocarbon diesel that is compatible with diesel in all blending ratios	Training and collaboration needed with international technology providers to develop biodiesel
Industrial processes and product use	Establishment of National Life Cycle Inventory Database (LCID) for major industries specifically for iron & steel, cement manufactu-ring and semiconductor industries.	MITI, SIRIM	Exten-sion to National program – new project	Not required	Expert technical reviewer	National LCID governance, IT -based capacity development for interoperable system to Global LCA Data Access (GLAD) network
	Iron and steel industry	MITI, MISIF	New project	USD 1,000,000	Heat exchangers that recycle part of the off gases from furnace to preheat combustion air; Recycle Blast Furnace off gas in	Training on energy efficient multi-slit rolling, efficient usage of energy with furnaces, and to build up capacity to recycle waste heat from furnaces' off gases

Sector/ Thematic Area	Activity	Lead Agencies	Status	International Support needed		
				Finance	Technical/ Technology	Capacity-building
					reheating furnace; Hydro turbine for cooling tower in water treatment plant; Electrode coating to reduce surface oxidation of graphite electrode at high temperature; Energy efficient burner	
Waste	Improvement of performance efficiency and optimisation of resource recovery for anaerobic digestion of industrial wastewater for palm oil mills and rubber factories	MPIC, MPOB, MRB	Ongoing	Not required	Technology concerning biotechnolo-gy/ biology synthesis and engineering	Not required
	Policy development on cleaner & climate-friendly sewerage treatment plants	KASA, MHLG, SSD, IWK	New project	Not required	Technical expertise and technologi-cal options for cleaner and climate-friendly sewerage treatment	Training on developing policy options for cleaner and climate-friendly sewerage treatment
Agriculture	Assessing climate change impact on crop	MPIC, MAFI, MARDI, MRB,	Ongoing	Not required	Using crop models and latest climate	Capacity building for crop modelling, climate

Sector/ Thematic Area	Activity	Lead Agencies	Status	International Support needed		
				Finance	Technical/ Technology	Capacity-building
	growth, productivity and fisheries	MCB, DOA, EPU, LKIM, DOF			models to assess crop growth and productivity under different future climate scenarios.	modelling, and climate change adaptation training
LULUCF	Soil organic carbon models	KeTSA	New project	Not required	Technical capacity for use of Yasso model	Training on utilising soil modelling tools
Cross-cutting sectors	Development of National Adaptation Plan	KASA	New project	USD 3,000,000	Policy tools to make decision on adaptation measures to take	Identification of priority adaptation sectors and spatial areas
	Vulnerability and adaptation assessments	KASA	New project	USD 5,000,000	Tools to carry out vulnerability and impact assessment on climate change	Training on identifying appropriate tools for climate risk assessment
Climate modelling	Downscaling climate change scenarios at local/city level and at finer resolution	NAHRIM, Met Malaysia, UKM	New project	USD 5,000,000	Technology to downscale and interpret climate outputs for adaptation policy options	Training to develop in-house expertise within NAHRIM to downscale climate change scenarios at national level
Disaster Risk Manage-ment	Incorporating Climate Change Factor into rainstorm drainage design	DID	Ongoing	Not required	Technical expertise to review and improve current climate change factors for rainstorm drainage design	Workshops to train local officers in reviewing climate change factors

Sector/ Thematic Area	Activity	Lead Agencies	Status	International Support needed		
				Finance	Technical/ Technology	Capacity-building
	National Flood Forecasting and Warning Programme	DID	Ongoing	Not required	Technical assistance to enhance accuracy of Numerical Weather Prediction (NWP) products needed for flood forecasting	Training to improve local expertise on hydrometeorology, specifically on utilising NWP and radar data
Water	Enhancing water resources security	KASA, DID	Ongoing	USD 50,000,000	Technology that can capture and integrate flood water as part of water resources in urban areas	Not required
Public Health	Assessing and modelling public health vulnerability and impact from climate change	MOH, IMR	New project	USD 3,000,000	Advanced data coding and modelling software for data preparation, blending, and analytics	Training of local officers on data coding and advanced modelling, satellite imagery; Training to develop country-specific health vulnerability and adaptation assessment tools; Networking for global collaboration and partnership

TECHNICAL ANNEX

Table A1: Mapping of Methods and Emission Factors Used

		CO_2		CH_4		N_2O	
		Method	EF	Method	EF	Method	EF
ENERGY							
1A Fuel Combustion Activities							
1A1 Energy Industries							
1A1a	Electricity and Heat Production	T1	D	T1	D	T1	D
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	T1	D	T1	D	T1	D
1A1 b	Petroleum Refining	T1	D	T1	D	T1	D
1A1 c	Manufacture of Solid Fuels and Other Energy Industries	T1	D	T1	D	T1	D
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
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

		CO_2		CH_4		N_2O	
		Method	EF	Method	EF	Method	EF
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	Stationary	-	-	-	-	-	-
1A5 b	Mobile	T1	D	T1	D	T1	D
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	-	-
1B1b	Uncontrolled combustion and burning coal dumps	-	-	-	-	-	-
1B1c	Solid fuel transformation	-	-	-	-	-	-
1B2 Oil and Natural Gas							
1B2a	Oil	T1	D	T1	D	-	-
1B2b	Natural Gas	T1	D	T1	D	-	-
Industrial Processes and Product Use							
2A Mineral Industry							
2A1	Cement Production	T2	CS				
2A2	Lime Production	T1	D				
2A3	Glass Production	T2	CS				
2A4	Other Process Uses of Carbonates	T2	D				
2B Chemical Industry							
2B1	Ammonia Production	T2	D				
2B5	Carbide Production	T1	D				
2B8	Petrochemicals and Carbon Black Production	T1	D				
2C Metal Industry							
2C1	Iron & Steel Production	T1	D				
2C3	Aluminium Production	T1	D				
2E Electronics Industry							
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	-	-	-	-	-	-
2G3a	N_2O in Medical Applications	-	-	-	-	T1	D
AFOLU							
3A Livestock							
3A1	Enteric Fermentation	-	-	T1	CS, D	-	-

		CO_2		CH_4		N_2O	
		Method	EF	Method	EF	Method	EF
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	T1	D	-	D	-	-
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	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	-	-
Waste							
4A	**Solid Waste Disposal Sites**	-	-	T1	D	-	-
4B	**Biological Treatment of Solid Waste**	-	-	T1	D	-	-
4C Incineration and Open Burning of Waste							
4C1	Incineration	-	-	T2a	D	-	-
4C2	Open Burning	-	-	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	-	-

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

Table A2: Summary of Emission Factors Used

		Emission factors								
		CO_2 (tC/TJ)	CH_4 (kg/TJ)	N_2O (kg/TJ)	HFCs	PFCs	SF_6	NF_3	NO_X	CO
ENERGY										
1A Fuel Combustion Activities										
1A1 Energy Industries										
1A1a	Electricity and Heat Production									
1A1ai	Electricity Generation									
	Diesel oil Residual Fuel Oil Sub-bituminous coal Natural Gas	20.2 21.1 26.2 15.3	3 3 1 1	0.6 0.6 1.5 0.1						
1A1 b	Petroleum Refining									
	Crudel oil	20.0	3	0.6						
1A1 c	Manufacture of Solid Fuels and Other Energy Industries									
	Natural gas	15.3	1	0.1						
1A2 Manufacturing Industries and Construction										
	Gasoline Other kerosene Diesel oil Residual Fuel Oil LPG Sub-bituminous coal Natural gas	18.9 19.6 20.2 21.1 17.2 26.2 15.3	3 3 3 3 1 10 1	0.6 0.6 0.6 0.6 0.1 1.5 0.1						
1A3 Transport										
1A3 a	Civil Aviation									
1A3 aii	Domestic Aviation									
	Jet kerosene	19.5	0.5	2						
1A3 b	Road Transportation									
	Natural gas	15.3	92	3						

		Emission factors								
		CO_2 (tC/TJ)	CH_4 (kg/TJ)	N_2O (kg/TJ)	HFCs	PFCs	SF_6	NF_3	NO_X	CO
	Gasoline Diesel Oil	18.9 20.2	33 3.9	3.2 3.9						
1A3 c	Railways									
	Diesel Oil	20.2	4.15	28.6						
1A3 d	Water-borne Navigation									
1A3 dii	Domestic Water-borne Navigation									
	Diesel Oil Residual Fuel Oil	20.2 21.1	7 7	2 2						
1A4 Other Sectors										
1A4 a	Commercial/Institutional									
	Diesel Oil Residual Fuel Oil LPG Natural Gas	20.2 21.1 17.2 15.3	10 10 5 5	0.6 0.6 0.1 0.1						
1A4 b	Residential									
	Other kerosene LPG Natural Gas	19.6 17.2 15.3	10 5 5	0.6 0.1 0.1						
1A4 c	Agriculture/Forestry/Fishing/Fish Farms									
1A4 ci	Stationary									
	Diesel Oil Residual Fuel Oil	20.2 21.1	10 10	0.6 0.6						
1A4 cii	Off-road Vehicles and Other Machinery									
1A4 ciii	Fishing (mobile combustion)									
	Diesel Oil Residual Fuel Oil	20.2 21.1	5 5	0.6 0.6						
1A5 Non-Specified										
1A5 a	Stationary									

		Emission factors								
		CO_2 (tC/TJ)	CH_4 (kg/TJ)	N_2O (kg/TJ)	HFCs	PFCs	SF_6	NF_3	NO_X	CO
1A5 b	Mobile									
	Gasoline Jet kerosene Gas/Diesel Oil	18.9 19.5 20.2	33 0.5 7	3.2 2 2						
1B Fugitive Emissions from Fuels		CO_2	CH_4 (m^3 CH_4/t)	N_2O						
1B1 Solid Fuels										
1B1a	Coal mining and handling									
	<u>Underground mines</u> Mining Post Mining <u>Surface mines</u> Mining Post Mining		 10 2.45 0.3 0.1							
1B2 Oil and Natural Gas			(kg CH_4/PJ)							
1B2a	Oil									
	Production/processing Refining Storage	1.1744	16.114 595.38 135							
1B2b	Natural Gas									
	Production Processing Transmission Distribution <u>Other leakage</u> Non-residential gas Residential gas	2,746.7 566.33 40,776 2,704.20 NA NA	345.200 7,079.1 17,900 51,000 87500 43500							
	Venting (oil) Flaring (oil) Venting (natural gas) Flaring (natural gas)	3,072.50 1,324,600 N/A 39,600	23,400 805.68 N/A 24,919							

		Emission factors								
		CO_2 (tC/TJ)	CH_4 (kg/TJ)	N_2O (kg/TJ)	HFCs	PFCs	SF_6	NF_3	NO_X	CO
INDUSTRIAL PROCESSES AND PRODUCT USE										
2A Mineral Industry										
2A1	Cement Production	0.515								
2A2	Lime Production	0.75								
2A3	Glass Production	0.2								
2A4	Limestone used Dolomite used	0.439 0.477								
2B Chemical Industry										
2B1	Ammonia Production	2.772								
	Urea production	0.73								
2B5	Carbide Production	1.1								
2B8	<u>Petrochemicals</u>: Ethylene Styrene Ethylene Oxide Methanol Carbon black	 N/A N/A N/A N/A	 0.14 4.00 1.79 2.30 0.06							
2C Metal Industry										
2C1	Iron & Steel Production									
	Iron production (Direct Reduced Iron) Steel production (Electric Arc Furnace) Hot metal (Basic Oxygen Furnace)	0.7 0.08 1.46								
2C3	Aluminium Production	1.5	N/A	N/A	N/A	0.31 kg CF_4/t Al 0.04 kg C_2F_6/t Al				

		Emission factors								
		CO_2 (tC/TJ)	CH_4 (kg/TJ)	N_2O (kg/TJ)	HFCs	PFCs	SF_6	NF_3	NO_X	CO
2E Electronic Industry										
2E1	Semiconductor production					0.9 kg/m^2 CF_4 1.0 kg/m^2 C_2F_6 0.04 (CHF_3) 0.05 (	0.2 kg/m^2	0.04 kg/m^2		
2E3	Photovoltaics Production					0.04 kg/m^2 CHF_3 0.05 kg/m^2 C_3F_8 5g/m^2 CF_4 0.2g/m^2 C_2F_6				
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						0.01(loss factor SF_6			
2G3a	Medical Applications			1.0						
AGRICULTURE, FORESTRY, AND OTHER LAND USE										
3A Livestock			Kg/head/yr							
3A1	Enteric Fermentation		Dairy cattle: 68 Other cattle: 58.65 Buffalo: 55 Sheep: 5							

		Emission factors								
		CO_2 (tC/TJ)	CH_4 (kg/TJ)	N_2O (kg/TJ)	HFCs	PFCs	SF_6	NF_3	NO_X	CO
			Goat: 5 Horse: 18 Swine: 1 Poultry: 0							
3A2	Manure Management Anaerobic lagoons Solid storage		**Kg CH_4/ (Head Year)** Dairy cattle: 31 Other cattle: 124 Buffalo: 2 Sheep: 0.2 Goat: 0.22 Horse: 2.19 Swine: 7 Poultry (chicken): 0.02 Poutry (duck) : 0.02	Kg N_2O/-N (kg N in MMS) 0.000 0.005						
	3.A.3 Poultry Manure with litter			0.001						
	3.A.4 Poultry Manure without Litter			0.001						
3B Land		C (tC/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 Drainded peat swamp 2.49 Plantation forest: 2.44 Fallow :1.70								

		Emission factors								
		CO_2 (tC/TJ)	CH_4 (kg/TJ)	N_2O (kg/TJ)	HFCs	PFCs	SF_6	NF_3	NO_X	CO
		Root shoot ratio: 0.18 Root shoot ratio (mangrove): 0.49 Forest fire: 13.16 drained peat swamp 1.2								
3B2a	Cropland Remaining Cropland	MAI: Rubber: 2.6 Oil palm: 6.0 Cocoa: 2.6 Harvest: Rubber: 1.21 Oil palm: 4.45 Cocoa: 0.26 Oil palm cultivated on peatland: 7.5								
3B5bi	Forest Land converted to Settlement	32.71								
3C Aggregate Sources and Non CO_2 Emissions Sources on Land										
3C1	Biomass burning in Cropland		0.005	0.007					0.121	0.06
3C1a	Biomass burning in Forest land		2	0.11					4	58
3C1b	Biomass burning in Cropland		0.005	0.007					0.121	0.06
3C4	Direct N_2O Emissions from Managed Soils									
	<u>Amount of N input</u>: Synthetic fertiliser N Animal waste Crop residue			0.0125 0.0125 0.0125						
3C5	Indirect N_2O Emissions from Managed Soils									
	Deposition									

		Emission factors								
		CO_2 (tC/TJ)	CH_4 (kg/TJ)	N_2O (kg/TJ)	HFCs	PFCs	SF_6	NF_3	NO_X	CO
	Synthetic fertiliser Animal waste			0.01 0.025						
3C7	Rice Cultivation:									
	Irrigated – continuously flooded		Scaling factor (1); EF (16 g/m^2)							
	Rainfed – Flood prone		Scaling factor (0.8); EF (16 g/m^2)							
	Rainfed – Drought prone		Scaling factor (0.468); EF (16 g/m^2)							
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): • Uncategorised SWDS: 0.6 • Unmanaged deep: 0.8 • Managed Anaerobic: 1							

		Emission factors								
		CO_2 (tC/TJ)	CH_4 (kg/TJ)	N_2O (kg/TJ)	HFCs	PFCs	SF_6	NF_3	NO_X	CO
4B	Biological Treatment of Solid Waste		4 gm CH_4/ kg waste treated	0.24 gm 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 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		Hazardous waste: 100 kg N_2O/ Gg wet waste Clinical waste: 100 kg N_2O/ Gg wet waste						

		Emission factors								
		CO_2 (tC/TJ)	CH_4 (kg/TJ)	N_2O (kg/TJ)	HFCs	PFCs	SF_6	NF_3	NO_X	CO
		• Oxidation factor: 1 Waste oil: • Fraction of fossil content of liquid waste: 0.8 • Oxidation factor:1								
	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 • Dry matter content:	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		BOD per capita per year: 15.9 kg Emission factor (kg CH_4/kg BOD):	Emission factor for indirect N_2O from waste						

		Emission factors								
		CO_2 (tC/TJ)	CH_4 (kg/TJ)	N_2O (kg/TJ)	HFCs	PFCs	SF_6	NF_3	NO_X	CO
			• Centralised Aerobic Treatment Plant: 0 • Septic Tank: 0.3 • Latrine 3 (Pour Flush): 0.42 • Sea, River and Lake Discharge: 0.06	water: 0.005 kg N_2O/kg N						
4D2 Industrial Wastewater			Waste Water Generated per tonne product (m^3/tonne product): • POME: 3.05 • Natural Rubber (SMR): 19.5 • Natural Rubber (Latex): 10.5 • Paper & Pulp: 85 • Petroleum Refineries: 0.6 • Meat & Poultry: 13 kg COD/m^3 waste water generated:							

	Emission factors								
	CO_2 (tC/TJ)	CH_4 (kg/TJ)	N_2O (kg/TJ)	HFCs	PFCs	SF_6	NF_3	NO_X	CO
		• POME: 53 • Natural Rubber (SMR):1.5 • Natural Rubber (Latex): 6 • Paper & Pulp: 2 • Petroleum Refineries:1 • Meat & Poultry: 4.1 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 A3: Summary of Sources of Activity Data

No	Sector	Data Type	#Data Source	*Main Data Provider
1. Energy				
1A1	Energy Industries	Amount of fuel consumption by type of fuel. Oil and gas production data.	National Energy Balance.	Energy Commission; Tenaga Nasional Berhad; Sarawak Energy Berhad; Sabah Electricity Sdn Bhd; Independent Power Plants; Oil Companies.
1A2	Manufacturing Industry and Construction	Amount of fuel consumption by type of fuel and by type of sub-sectors.	National Energy Balance.	Energy Commission (Sub-sectors data based on survey conducted by Energy Commission.)
1A3	Transport	Amount of fuel consumption by type of fuel, by type of transportation modes, i.e. Road, Rail, Aviation, and Navigation.	National Energy Balance.	Energy Commission; Ministry of Transport; Land Public Transport Agency; Malayan Railways; Sabah State Railway; Malaysia Airlines Berhad, Firefly; MAS Wings; Air Asia; Helistar; Malaysia Marine Department.
1A4	Others Sectors	Amount of fuel consumption by type of fuel.	National Energy Balance.	Energy Commission, Department of Statistics Malaysia.
1A5	Non- Specified	Amount of fuel consumption by type of fuel.	National Energy Balance.	Energy Commission, Ministry of Defence Malaysia.
1B	Fugitives Emissions	Amount of coal production, oil and gas production and refined.	National Energy Balance.	Energy Commission, Department of Mineral and Geosciences, PETRONAS.
2. Industrial processes and product used				
2A Mineral Industry				
2A1	Cement Production	Mass of clinker produced		Cement and Concrete Association of Malaysia (CNCA).
2A2	Lime Production	Mass of lime produced		Department of Statistics Malaysia.

No	Sector	Data Type	#Data Source	*Main Data Provider
2A3	Glass Production	Total glass production		Main Producer
2A4	Other Process Uses of Carbonates	Mass of carbonate consumed in limestone; dolomite	Malaysian Mineral Yearbook	Department of Mineral and Geoscience
2B Chemical Industry				
2B1	Ammonia Production	Amount of ammonia produced		PETRONAS
2B5	Carbide Production	Carbide produced	Company Production Capacity	MCB Industries Sdn Bhd
2B8	Petrochemicals and Carbon Black Production	Amount of methanol, ethylene, ethylene oxide, carbon black produced	Production data/ Company production capacity	PETRONAS; Cabot (M) Sdn Bhd; Lotte Chemical Titan
2C Metal Industry				
2C1	Iron & Steel Production	Amount of steel & iron produced according to steel making method	Eleventh MISIF Yearbook	Malaysian Iron & Steel Federation (MISIF)
2C3	Aluminium Production	Amount of aluminium produced based on type of technology	Malaysia Mineral Yearbook	Department of Mineral and Geoscience
2E Electronics Industry				
2E1	Semiconductor Production	Annual manufacturing design capacity		Semiconductor Equipment & Materials International (SEMI); IHS Technology. Publications on plant capacity
2E3	Photovoltaics Production	Annual manufacturing design capacity		Publications on plant capacity
2F Product Uses as Substitutes for Ozone Depleting Substances				
2F1	Mobile Air-Conditioning	Emissions during first-fill; Emissions during operation; Refrigerant charge.	Malaysia Automotive Association Market Review & Outlook; Ministry of Transport Annual Report.	Ministry of Transport; Malaysia Automotive Association; Denso (M) Sdn. Bhd.

No	Sector	Data Type	#Data Source	*Main Data Provider
2G Other Product Manufacture and Use				
2G1	SF_6 Use in Electrical Equipment	Amount of SF_6 consumed.		Gas Supplier in Malaysia
2G3a	N_2O in Medical Applications	Amount of N_2O consumed.		Gas Supplier in Malaysia
3. AFOLU				
3A Livestock				
3A1	Enteric Fermentation	Animal population	Livestock Statistics; UN Food and Agriculture Organisation (FAO)	Department of Veterinary Services (DVS); Food and Agriculture Organisation of the United Nations (FAO)
3A2	Manure Management	Animal population	Livestock Statistics	DVS
		Fractions of Manure, Waste Management Systems	Expert Judgement	Agriculture GHG Inventory Sub-Working Group.
3B Land				
3B1	Forest Land Remaining Forest Land	Total area of forest	www.ketsa.gov.my	Ministry of Energy and Natural Resources
		Biomass loss	www.epu.gov.my	Economic Planning Unit
		Drained peatlands		Department Reports
3B2	Cropland Remaining Cropland	Total area of cropland	www.mpic.gov.my	Ministry of Plantation Industries and Commodities
		Biomass loss	www.epu.gov.my	Economic Planning Unit
		Organic soil	Miettinen et al, 2016, Global Ecology and Conservation, 6: 67-78.	
3B3	Grassland Remaining Grassland	Pasture land		National data
3B4	Wetland Remaining Wetlands	Water bodies including lakes, rivers etc.		National data

No	Sector	Data Type	#Data Source	*Main Data Provider
3B5	Settlement Remaining Settlement	Urban area, roads, mining and ex-mining; poultry farm area, grave yards, abandoned projects		National data
3C Aggregate sources and Non CO_2 emissions sources on land				
3C1a	Biomass Burning in Forest land (Wildfire)	Forest area burnt	Department reports	
3C1b	Biomass Burning in Cropland	Fraction of area burnt in paddy fields	Expert Judgement	Agriculture GHG Inventory Sub-Working Group.
3C2	Liming	Annual amount of subsidised lime for paddy	Malaysia subsidy scheme	Ministry of Agriculture and Food Industries (MAFI)
3C3	Urea Application	Annual amount of import and export for urea	Harmonized system data	Department of Statistics Malaysia (DOSM)
		Annual amount of urea production	PETRONAS annual report	PETRONAS
3C4	Direct N_2O Emissions from Managed Soils	Annual amount of import and export for different types of N based fertilizers	Harmonized system data	DOSM
		Annual amount of urea production	PETRONAS annual report	PETRONAS
		Annual amount of Oil palm trunk (OPT) and Oil Palm Fronds (OPF) & Empty Fruit Bunches (EFB)	Malaysia Oil Palm Statistics 2015; Official Portal of Malaysian Palm Oil Board	Malaysian Palm Oil Board (MPOB)
		Amount of Rice Straw	Paddy Statistics	Department of Agriculture (DOA)
		Fractions of Manure, Waste Management Systems	Expert Judgment	Agriculture GHG Inventory Sub-Working Group.

No	Sector	Data Type	#Data Source	*Main Data Provider
3C5	Indirect N_2O Emissions from Managed Soils	*-Same as Direct Manure Management*		
3C6	Indirect N_2O Emissions from Manure Management	Animal population	Livestock Statistics	DVS
		Fractions of Manure, Waste Management Systems	Expert Judgment	Agriculture GHG Inventory Sub-Working Group.
3C7	Rice Cultivations	Annual rice production areas	Paddy Statistics	DOA
		Proportions of annual rice production areas under irrigated, rain fed and upland		
4. Waste				
4A	Solid Waste Disposal Sites	Population	Internal Communication	Department of Statistics Malaysia
		Waste per Capita	2006GL The Study on National Waste Minimisation in Malaysia (2006) Survey on Solid Waste Composition, Characteristics & Existing Practice of Solid Waste Recycling in Malaysia (2012)	JICA & Ministry of Housing and Local Government National Solid Waste Management Department
		Sludge	Amount of treated sewage disposed to landfills: 1. Peninsular Malaysia 2. Sarawak	Indah Water Konsortium Sdn Bhd; Sewerage Services Department Sarawak

No	Sector	Data Type	#Data Source	*Main Data Provider
4B	Biological Treatment of Solid Waste	Total annual amount treated by biological treatment facilities	Survey on amount of EFB treated in composting plant	Malaysian Palm Oil Board; Department of Environment.
4C	Incineration and Open Burning of Waste			
4C1	Incineration	Amount of waste incinerated	Data from Scheduled Waste Management	Department of Environment.
4C2	Open Burning	Amount of Waste Open Burned	Expert Judgment	Waste Sector GHG Inventory Sub-Working Group
4D	Wastewater Treatment and Discharge			
4D1	Domestic Wastewater Treatment and Discharge	Urban and Rural Population	Internal Communication	Department of Statistics Malaysia
		Degradable Organic Component (BOD)	Malaysian Sewerage Industry Guidelines Vol IV	National Water Services Commission
		Type of Treatment or Discharge Pathway	IWK Asset Database, Expert Judgement	IWK Waste Sector GHG Inventory Sub-Working Group
		Per capita protein consumption	Average protein consumption	Food and Agriculture Organisation
4D2	Industrial Wastewater Treatment and Discharge	Total Industry Product: Palm Oil Natural Rubber Pulp & Paper Petroleum Refineries	 MPOB Yearly Statistics Malaysian Rubber Statistics Annual production of pulp and paper National Energy Balance	 Malaysian Palm Oil Board Malaysian Rubber Board Food and Agriculture Organisation Energy Commission

No	Sector	Data Type	#Data Source	*Main Data Provider
		Wastewater generated:		
		Palm Oil	Vijaya et al., 2008, JOPR 20: 484-494; Vijaya et al., 2010, Amer. J. Geosc. 1(1): 1-6.	Malaysian Palm Oil Board
		Natural Rubber	Zaid I., 1993, Publication of Ministry of Science and the Environment, Malaysia, 137-151.	Malaysian Rubber Board
		Pulp & Paper	2006 IPCC Guidelines	
		Petroleum Refineries	2006 IPCC Guidelines	
		Chemical oxygen demand (COD):		
		Palm Oil	Survey on actual status of POME in palm oil mills, 2007 – 2008	Malaysian Palm Oil Board
		Natural Rubber	Zaid I. et al, 2006, Proc. IRRDB Conf.; Pretibaa S. et al, 2007, Proc. IRRDB Conf.; C.K. John and Ong C.T, 1982, Proc. Workshop; Zaid I., 1993, Publication of Ministry of Science and	Malaysian Rubber Board

No	Sector	Data Type	#Data Source	*Main Data Provider
			the Environment, Malaysia, 137-151,	
		Pulp & Paper	2006 IPCC Guidelines	
		Petroleum Refineries	2006 IPCC Guidelines	

Note: # refers to publication(s), * refers to the unpublished data provided by authority, experts etc.

Table B1: Short Summary Table for GHG Inventory Year 2016 (1 of 2)

Categories	Net CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Other halogena-ted gases with CO_2 equivalent conversio n factors	Other halogenate d gases without CO_2 equivalent conversion factors	NO_x	CO	NMVOCs	SO_2
Total National Emissions and Removals	4,430.47	2,288.44	25.89	757.00	4,976.27	348.17	50.85	NA, NE, NO	1,012.53	4,956.69	902.68	697.33
1 ENERGY	224,452.63	1,037.70	4.36						1,010.28	4,821.09	901.90	693.91
1A Fuel Combustion Activities	222,510.48	24.59	4.36						1010.10	4820.36	897.79	693.87
1B Fugitive emissions from fuels	1,942.15	1013.11	NA						0.18	0.73	4.11	0.04
1C Carbon dioxide Transport and Storage	NO								NO	NO	NO	NO
2 INDUSTRIAL PROCESSES AND PRODUCT USE	20,807.76	13.52	0.24	757.00	4,976.27	348.17	50.85	NA, NE, NO	1.97	91.32	0.78	3.42
2A Mineral Industry	13,415.57	NA, NE, NO	NO						NA, NO	NA, NO	NA, NO	NA, NO
2B Chemical Industry	4,791.69	12.867	NA, NO	NO	NO	NO	NO	NO	1.21	0.12	NA, NO	NA, NO
2C Metal Industry	2,600.51	0.66	NA, NE, NO	NO	2617.44	NO	NO	NO	0.76	91.20	0.78	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	2,358.83	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	713.25	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	0.24	NO	NE, NO	11.14	NE, NO	NE, 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	-240,860.98	167.11	20.02						0.28	44.29	IE, NA	IE, NA
3A Livestock		75.04	0.44						NA, NO	NA, NO	NA, NO	NA
3B Land	-241,392.81	IE, NA	IE, NA						IE, NA, NO	IE, NA, NO	IE, NA, NO	NA
3C Aggregate Sources and Non-CO_2 Emissions Sources on Land	531.83	92.07	19.58						0.28	44.29	NA, NO	NA, NO
3D Other	NE, NO	NO	NO						NE, NO	NE, NO	NE, NO	NE, NO

Table B1: Short Summary Table for GHG Inventory Year 2016 (2 of 2)

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
4 WASTE	31.06	1,070.10	1.27						0.00	0.00	NA, NE	0.00
4A Solid Waste Disposal		448.57	NA						NA	NA	NA	NA
4B Biological Treatment of Solid Waste		0.01	0.00						NA	NA	NA	NA
4C Incineration and Open Burning of Waste	31.06	0.08	0.01						0.00	0.00	NE	0.00
4D Wastewater Treatment and Discharge		621.44	1.26						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	8,231.15	0.11	0.23						42.44	0.89	6.79	43.69
International Aviation (International Bunkers)	7,561.08	0.05	0.21						26.03	0.33	2.65	27.28
International Water-borne Transport (International Bunkers)	670.08	0.06	0.02						16.41	0.56	4.14	16.41
Multilateral Operations	NO	NO	NO						NO	NO	NO	NO

Table B2: Summary Table for GHG Inventory Year 2016 (1 of 5)

Categories	Net CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Other halogenated gases with CO_2 eq. conversion factors	Other halogenated gases without CO_2 eq. conversion factors	NO_x	CO	NMVOCs	SO_2
	(Gg)			CO_2 equivalents (Gg)				(Gg)	(Gg)			
Total National Emissions and Removals	4,430.47	2,288.44	25.89	757.00	4,976.27	348.17	50.85	NA, NE, NO	1,012.53	4,956.69	902.68	697.33
1 ENERGY	224,452.63	1,037.70	4.36						1,010.28	4,821.09	901.90	693.91
1A Fuel Combustion Activities	222,510.48	24.59	4.36						1,010.10	4,820.36	897.79	693.87
1A1 Energy Industries	130,923.78	2.32	1.28						241.25	48.45	3.54	585.89
1A2 Manufacturing Ind & Const	23,855.75	1.14	0.17						84.12	77.16	9.33	67.69
1A3 Transport	61,904.10	20.59	2.88						658.86	4,687.07	883.22	35.97
1A4 Other Sectors	5,318.94	0.51	0.02						21.59	4.10	1.01	3.63
1A5 Non-Specified	507.91	0.02	0.02						4.27	3.58	0.69	0.70
1B Fugitive emissions from fuels	1,942.15	1,013.11	NA						0.18	0.73	4.11	0.04
1B1 Solid Fuels	NA	0.79	NA						NA	NA	3.86	NA
1B2 Oil and Natural Gas	1,942.15	1,012.33	NA						0.18	0.73	0.24	0.04
1B3 Other emissions from Energy Production	NA	NA	NA						NA	NA	NA	NA
1C CO_2 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 IPPU	20,807.76	13.52	0.24	757.00	4,976.27	348.17	50.85	NA, NE, NO	1.97	91.32	0.78	3.42
2A Mineral Industry	13,415.57	NA,NE, NO	NO						NA, NO	NA, NO	NA, NO	NA, NO
2A1 Cement Production	9,125.80	NA							NA	NA	NA	NA
2A2 Lime Production	77.00	NA							NA	NA	NA	NA
2A3 Glass Production	28.71	NA							NA	NA	NA	NA
2A4 Other Process Uses of Carbonates	4,184.05	NE, NO							NA	NA	NA	NA
2A5 Other (please specify)	NO	NO	NO						NO	NO	NO	NO

Table B2: Summary Table for GHG Inventory Year 2016 (2 of 5)

Categories	Net CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Other halogen-nated gases with CO_2 eq.conversion factors	Other halogen-nated gases without CO_2 eq.conversion factors	NO_x	CO	NMVOCs	SO_2
	(Gg)			CO_2 equivalents (Gg)				(Gg)	(Gg)			
2B Chemical Industry	4,791.69	12.87	NA, NO	NO	NO	NO	NO	NO	1.21	0.12	NA, NO	NA, NO
2B1 Ammonia Production	1,170.28	NA	NA						1.21	0.12	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 & Carbon Black	3583.39	12.87	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
2C Metal Industry	2,600.51	0.66	NA,NE,NO	NO	2,617.44	NO	NO	NO	0.76	91.20	0.78	3.42
2C1 Iron and Steel Production	1,384.51	0.66	NA						NA	NA	0.78	NA
2C2 Ferroalloys Production	NE	NE	NE						NA	NA	NA	NA
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	NO								NO	NO	NO	NO
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

Table B2: Summary Table for GHG Inventory Year 2016 (3 of 5)

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)			
2D4 Other (please specify)	NO	NO	NO						NO	NO	NO	NO
2E Electronics Industry	NA, NO	NO	NA,NO	43.75	2,358.83	337.03	50.85	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
2E1 Integrated Circuit/ 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	713.25	NA, NE, NO		NA, NE, NO	NA, NE, NO	NA. NO	NA, NO	NA, NO	NA, NO
2F1 Refrigeration & Air Cond.	NA, NE			713.25	NA, NE		NA, NE	NA, NE	NA	NA	NA	NA
2F2 Foam Blowing Agents	NE			NE	NE		NE	NE	NA	NA	NA	NA
2F3 Fire Protection	NE			NE	NE		NE	NE	NA	NA	NA	NA
2F4 Aerosols				NE	NE		NE	NE	NA	NA	NA	NA
2F5 Solvents				NE	NE		NE	NE	NA	NA	NA	NA
2F6 Other Applications	NO	NO	NO	NO	NO		NO	NO	NO	NO	NO	NO
2G Other Product Manufacture & Use	NO	NO	0.24	NO	NE, NO	11.14	NE, NO	NE, NO	NA, NO	NA, NO	NA, NO	NA, NO
2G1 Electrical Equipment					NE	11.14	NE	NE	NA	NA	NA	NA
2G2 SF6 and PFCs from Other Product Uses					NE, NO	NE, NO	NE, NO	NE, NO	NA, NO	NA, NO	NA, NO	NA, NO
2G3 N_2O from Product Uses			0.24						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

Table B2: Summary Table for GHG Inventory Year 2016 (4 of 5)

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)			
2H3 Other (please specify)	NO	NO	NO						NO	NO	NO	NO
3 AFOLU	-240,860.98	167.11	20.02						0.28	44.29	IE, NA, NO	IE, NA
3A Livestock		75.04	0.44						NA, NO	NA, NO	NA, NO	NA
3A1 Enteric Fermentation		54.82							NA, NO	NA, NO	NA, NO	NA
3A2 Manure Management		20.23	0.44						NA, NO	NA, NO	NA, NO	NA
3B Land	-241,392.81	IE, NA, NO	IE, NA, NO						IE, NA, NO	IE, NA, NO	IE, NA, NO	NA
3B1 Forest Land	-243,831.71	IE, NA, NO	IE, NA, NO						IE, NA, NO	IE, NA, NO	IE, NA, NO	NA
3B2 Cropland	-15,314.31	IE, NA	IE, NO						IE, NO	IE, NO	IE, NO	NA
3B3 Grassland	NA, NO	NA, NO	NA, NO						NA, NO	NA, NO	NA, NO	NA
3B4 Wetlands	IE, NA, NO	NA, NO	IE, NA, NO						NA, NO	NA, NO	NA, NO	NA
3B5 Settlements	17,753.21	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	531.83	92.07	19.58						0.28	44.29	NA, NO	NA, NO
3C1 Biomass Burning	NO	1.46	0.07						0.28	44.29	NA	NA
3C2 Liming	4.54								NA	NA	NA	NA
3C3 Urea Application	527.29								NA	NA	NA	NA
3C4 Direct N_2O Emissions from Managed Soils			13.60						NA	NA	NA	NA
3C5 Indirect N_2O Emissions from Managed Soils			3.882						NA	NA	NA	NA
3C6 Indirect N_2O Emissions from Manure Management			2.03						NA	NA	NA	NA

Table B2: Summary Table for GHG Inventory Year 2016 (5 of 5)

Categories	Net CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Other halogenated gases with CO_2 eq.conversion factors	Other halogenated gases without CO_2 eq.conversion factors	NO_x	CO	NMVOCs	SO_2
	(Gg)			CO_2 equivalents (Gg)				(Gg)	(Gg)			
3C7 Rice Cultivations		90.61	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	31.06	1,070.10	1.27						0.00	0.00	NA, NE	0.00
4A Solid Waste Disposal		448.57	NA						NA	NA	NA	NA
4B Biological Treatment of Solid Waste		0.01	0.00						NA	NA	NA	NA
4C Incineration and Open Burning of Waste	31.06	0.08	0.01						0.00	0.00	NE	0.00
4D Wastewater Treatment and Discharge		621.44	1.26						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_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	8,231.15	0.11	0.23						42.44	0.89	6.79	43.69
International Aviation (Int. Bunkers)	7,561.08	0.05	0.21						26.03	0.33	2.65	27.28
Int. Water-borne Transport (Int. Bunkers)	670.08	0.06	0.02						16.41	0.56	4.14	16.41
Multilateral Operations	NO	NO	NO						NO	NO	NO	NO

Table B3: Energy Sectoral Table for GHG Inventory Year 2016 (1 of 5)

Categories		CO_2	CH_4	N_2O	NO_x	CO	NMVOCs	SO_2
		(Gg)						
1 Energy		224,452.63	1,037.70	4.36	1,010.28	4,821.09	901.90	693.91
1A	**Fuel Combustion Activities**	222,510.48	24.59	4.36	1,010.10	4,820.36	897.79	693.87
1A1	**Energy Industries**	130,923.78	2.32	1.28	241.25	48.45	3.54	585.89
1A1a	Main Activity Electricity and Heat Production	103,046.91	1.61	1.17	203.93	30.58	2.35	585.77
1A1ai	Electricity Generation	100,339.53	1.38	1.14	199.26	28.24	2.19	585.60
1A1aii	Combined Heat and Power Generation (CHP)	2,707.38	0.23	0.03	4.67	2.35	0.16	0.16
1A1aiii	Heat Plants	NO	NO	NO	NO	NO	NO	NO
1A1b	Petroleum Refining	9,498.10	0.39	0.08	8.16	5.09	0.33	0.04
1A1c	Manufacture of Solid Fuels and Other Energy Industries	18,378.76	0.33	0.03	29.16	12.78	0.85	0.09
1A1ci	Manufacture of Solid Fuels	NO	NO	NO	NO	NO	NO	NO
1A1cii	Other Energy Industries	18,378.76	0.33	0.03	29.16	12.78	0.85	0.09
1A2	**Manufacturing Industries and Construction**	23,855.75	1.14	0.17	84.12	77.16	9.33	67.69
1A2a	Iron and Steel	5,860.72	0.13	0.02	22.46	3.71	0.92	1.05
1A2b	Non-Ferrous Metals	187.78	0.00	0.00	0.50	0.10	0.02	0.00
1A2c	Chemicals	2,478.92	0.07	0.01	10.94	1.68	0.47	0.67
1A2d	Pulp, Paper and Print	603.35	0.02	0.00	2.81	0.42	0.12	0.18
1A2e	Food Processing, Beverages and Tobacco	3,883.15	0.08	0.01	11.50	2.17	0.41	0.21
1A2f	Non-Metallic Minerals	7,647.55	0.73	0.11	16.77	66.47	6.49	63.99
1A2g	Transport Equipment	1,641.69	0.06	0.01	10.77	1.41	0.52	0.95
1A2h	Machinery	191.39	0.01	0.00	1.33	0.17	0.06	0.12
1A2i	Mining (excluding fuels) and Quarrying	IE	IE	IE	IE	IE	IE	IE
1A2j	Wood and wood products	406.84	0.02	0.00	2.58	0.34	0.12	0.23
1A2k	Construction	IE	IE	IE	IE	IE	IE	IE
1A2l	Textile and Leather	543.51	0.01	0.00	2.21	0.35	0.09	0.12
1A2m	Non-specified Industry	410.86	0.01	0.00	2.23	0.32	0.10	0.17
1A3	**Transport**	61,904.10	20.59	2.88	658.86	4,687.07	883.22	35.97

Table B3: Energy Sectoral Table for GHG Inventory Year 2016 (2 of 5)

Categories		CO_2	CH_4	N_2O	NO_x	CO	NMVOCs	SO_2
		(Gg)						
1A3a	Civil Aviation	1,132.99	0.01	0.03	4.85	2.10	0.10	0.47
1A3ai	International Aviation (International Bunkers)							
1A3aii	Domestic Aviation	1,132.99	0.01	0.03	4.85	2.10	0.10	0.47
1A3b	Road Transportation	55,188.34	20.06	2.67	513.35	4,671.56	878.03	0.00
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	77.73	0.00	0.03	1.31	0.27	0.12	NA
1A3d	Water-borne Navigation	5,505.04	0.52	0.15	139.35	13.14	4.97	35.50
1A3di	International water-borne navigation (International bunkers)							
1A3dii	Domestic Water-borne Navigation	5,505.04	0.52	0.15	139.35	13.14	4.97	35.50
1A3e	Other Transportation	NE	NE	NE	NE	NE	NE	NE
1A3ei	Pipeline Transport	NE	NE	NE	NE	NE	NE	NE
1A3eii	Off-road	NE	NE	NE	NE	NE	NE	NE
1A4	**Other Sectors**	5,318.944	0.514	0.019	21.59	4.10	1.01	3.63
1A4a	Commercial/Institutional	2,576.30	0.23	0.01	19.90	2.60	0.97	1.82
1A4b	Residential	1,600.71	0.13	0.00	1.29	1.44	0.02	1.77
1A4c	Agriculture/Forestry/Fishing/Fish Farms	1,141.927	0.154	0.009	0.40	0.05	0.02	0.04
1A4ci	Stationary	57.236	0.008	0.000	0.40	0.05	0.02	0.04

Table B3: Energy Sectoral Table for GHG Inventory Year 2016 (3 of 5)

Categories		CO_2	CH_4	N_2O	NO_x	CO	NMVOCs	SO_2
		(Gg)						
1A4cii	Off-road Vehicles and Other Machinery	15.382	0.002	0.000	NA	NA	NA	NA
1A4ciii	Fishing (mobile combustion)	1,069.31	0.144	0.009	0.00	0.00	0.00	NA
1A5	**Non-Specified**	507.91	0.02	0.02	4.27	3.58	0.69	0.70
1A5a	Stationary	NE	NE	NE	NE	NE	NE	NE
1A5b	Mobile	507.91	0.02	0.02	4.27	3.58	0.69	0.70
1A5bi	Mobile (aviation component)	337.45	0.00	0.01	1.16	0.23	0.01	0.11
1A5bii	Mobile (water-borne component)	90.31	0.01	0.00	2.29	0.22	0.08	0.58
1A5biii	Mobile (Other)	80.15	0.01	0.00	0.82	3.13	0.60	0.00
1A5c	Multilateral Operations							
1B	**Fugitive emissions from fuels**	1,942.15	1,013.11	NA	0.18	0.73	4.11	0.04
1B1	**Solid Fuels**	NA, NO	0.79	NA	NA	NA	3.86	NA
1B1a	Coal mining and handling	NA	0.79		NA	NA	3.86	NA
1B1ai	Underground mines	NA, NO	0.14		NA	NA	0.03	NA
1B1ai1	Mining	NA	0.10		NA	NA	0.01	NA
1B1ai2	Post-mining seam gas emissions	NA	0.03		NA	NA	0.01	NA
1B1ai3	Abandoned underground mines	NA	0.01		NA	NA	NA	NA
1B1ai4	Flaring of drained methane or conversion of methane to CO_2	NO	NO	NO	NA	NA	NA	NA
1B1aii	Surface mines	NA	0.64	NA	NA	NA	3.84	NA
1B1aii1	Mining	NA	0.48		NA	NA	1.92	NA
1B1aii2	Post-mining seam gas emissions	NA	0.16		NA	NA	1.92	NA
1B1b	Uncontrolled combustion and burning coal dumps	NO	NO		NA	NA	NA	NA
1B1c	Solid fuel transformation	NO	NO		NA	NA	NA	NA
1B2	**Oil and Natural Gas**	1,942.15	1,012.33	NA, NE	0.18	0.73	0.24	0.04
1B2a	Oil	1,846.14	34.45	NA	0.11	0.43	0.14	0.04
1B2ai	Venting	4.27	32.47	NA	0.05	0.21	0.06	0.00
1B2aii	Flaring	1,841.86	1.12	NA	0.05	0.21	0.06	0.00

Table B3: Energy Sectoral Table for GHG Inventory Year 2016 (4 of 5)

Categories		CO_2	CH_4	N_2O	NO_x	CO	NMVOCs	SO_2
		(Gg)						
1B2aiii	All Other	NA	0.86	NA	0.02	0.01	0.02	0.03
1B2aiii1	Exploration	NE	NE	NE	NE	NE	NE	NE
1B2aiii2	Production and Upgrading	NA	0.02	NA	NA	NA	0.01	NA
1B2aiii3	Transport	NE	NE	NE	NE	NE	NE	NE
1B2aiii4	Refining	NA	0.69	NA	0.01	0.00	0.01	0.02
1B2aiii5	Distribution of oil products	NE	NE	NE	NE	NE	NE	NE
1B2aiii6	Other	NA	0.16	NA	0.01	0.01	0.01	0.02
1B2b	Natural Gas	96.01	977.88	NA	0.07	0.31	0.10	0.00
1B2bi	Venting	NO	NO	NA	NO	NO	NO	NO
1B2bii	Flaring	80.90	0.05	NA	0.07	0.31	0.09	0.00
1B2biii	All Other	15.12	977.82	NA	NA	NA	0.01	NA
1B2biii1	Exploration	NE	NE	NE	NE	NE	NE	NE
1B2biii2	Production	5.60	704.37	NA	NA	NA	NA	NA
1B2biii3	Processing	1.62	20.22	NA	NA	NA	NA	NA
1B2biii4	Transmission and Storage	0.12	52.16	NA	NA	NA	NA	NA
1B2biii5	Distribution	7.77	146.54	NA	NA	NA	0.01	NA
1B2biii6	Other	NA	54.54	NA	NA	NA	NA	NA
1B3	**Other emissions from Energy Production**	NO	NO	NO	NO	NO	NO	NO
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

Table B3: Energy Sectoral Table for GHG Inventory Year 2016 (5 of 5)

Categories	Emissions (Gg)						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOCs	SO_2
Memo Items							
International Bunkers	8,231.15	0.11	0.23	42.45	6.59	0.81	6.67
International Aviation (International Bunkers)	7,561.08	0.05	0.21	26.03	5.05	0.25	2.53
International water-borne navigation (International bunkers)	670.08	0.06	0.02	16.41	1.53	0.56	4.14
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO
Information Items							
CO_2 from Biomass Combustion for Energy Production	2,030.13						

Table B4: IPPU Sectoral Table for GHG Inventory Year 2016 (1 of 4)

Category		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	NMV OCs	SO_2
		(Gg)			CO_2 equivalents (Gg)					(Gg)			
2 INDUSTRIAL PROCESSES AND PRODUCT USE		20,807.76	13.52	0.24	757.00	4,976.27	348.17	50.85	NA, NE, NO	1.97	91.32	0.78	3.42
2A	**Mineral Industry**	13,415.57	NA, NE, NO	NO	NO	NO	NO	NO	NO	NA, NO	NA, NO	NA, NO	NA, NO
2A1	Cement Production	9,125.80	NA							NA	NA	NA	NA
2A2	Lime Production	77.00	NA							NA	NA	NA	NA
2A3	Glass Production	28.71	NA							NA	NA	NA	NA
2A4	Other Process Uses of Carbonates	4,184.05	NE, NO							NA	NA	NA	NA
2A4a	Ceramics	NE	NE							NA	NA	NA	NA
2A4b	Other Uses of Soda Ash	NO	NO							NO	NO	NO	NO
2A4c	Non Metallurgical Magnesia Production	NO	NO							NO	NO	NO	NO
2A4d	Other (please specify)	NO	NO							NO	NO	NO	NO
2A5	Other (please specify)	NO	NO	NO						NO	NO	NO	NO
2B	**Chemical Industry**	4,791.69	12.87	NA, NO	NO	NO	NO	NO	NO	1.21	0.12	NA, NO	NA, NO
2B1	Ammonia Production	1,170.28	NA	NA						1.21	0.12	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

Table B4: IPPU Sectoral Table for GHG Inventory Year 2016 (2 of 4)

Category		CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Other halogen-nated gases with CO_2 eq. conversion factors	Other halogen-ated gases without CO_2 eq. conversion factors	NO_x	CO	NMVOCs	SO_2
		(Gg)			CO_2 equivalents (Gg)					(Gg)			
2B7	Soda Ash Production	NO	NO	NO						NO	NO	NO	NO
2B8	Petrochemical and Carbon Black Production	3,583.40	12.87	NA						NA, NO	NA,NO	NA,NO	NA, NO
2B8a	Methanol	1,434.07	4.92	NA						NA	NA	NA	NA
2B8b	Ethylene	2,062.94	7.71	NA						NA	NA	NA	NA
2B8c	Ethylene Dichloride and Vinyl Chloride Monomer	NO	NO	NO						NO	NO	NO	NO
2B8d	Ethylene Oxide	86.39	0.23	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
2C	**Metal Industry**	2,600.51	0.66	NA,NE,NO	NO	2,617.44	NO	NO	NO	0.76	91.20	0.78	3.42
2C1	Iron and Steel Production	1,384.51	0.66	NA						NA	NA	0.78	NA
2C2	Ferroalloys Production	NE	NE	NE						NA	NA	NA	NA
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	NO								NO	NO	NO	NO
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

Table B4: IPPU Sectoral Table for GHG Inventory Year 2016 (3 of 4)

Category		CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Other halogen-nated gases with CO_2 eq. conversion factors	Other halogen-ated gases without CO_2 eq. conversion factors	NO_x	CO	NMVOCs	SO_2
		(Gg)			CO_2 equivalents (Gg)					(Gg)			
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	2,358.83	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
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 ODS	NA, NE, NO	NO	NO	713.25	NA, NE, NO		NA, NE, NO	NA, NE, NO	NA, NO	NA, NO	NA, NO	NA, NO
2F1	Refrigeration and Air Conditioning	NA, NE			713.25	NA, NE		NA, NE	NA, NE	NA	NA	NA	NA
2F1a	Refrigeration and Stationary Air Conditioning	NE			NE	NE		NE	NE	NA	NA	NA	NA
2F1b	Mobile Air Conditioning	NA			713.25			NA	NA	NA	NA	NA	NA
2F2	Foam Blowing Agents	NE			NE	NE		NE	NE	NA	NA	NA	NA
2F3	Fire Protection	NE			NE	NE		NE	NE	NA	NA	NA	NA
2F4	Aerosols				NE	NE		NE	NE	NA	NA	NA	NA
2F5	Solvents				NE	NE		NE	NE	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	0.24	NO	NE, NO	11.14	NE, NO	NE, NO	NA, NO	NA, NO	NA, NO	NA, NO
2G1	Electrical Equipment					NE	11.14		NE	NA	NA	NA	NA
2G1a	Manufacture of Electrical Equipment					NE	NE	NE	NE	NA	NA	NA	NA
2G1b	Use of Electrical Equipment					NE	NE	NE	NE	NA	NA	NA	NA

Table B4: IPPU Sectoral Table for GHG Inventory Year 2016 (4 of 4)

Category		CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Other halogen-nated gases with CO_2 eq. conversion factors	Other halogen-ated gases without CO_2 eq. conversion factors	NO_x	CO	NMVOCs	SO_2
		(Gg)			CO_2 equivalents (Gg)					(Gg)			
2G1c	Disposal of Electrical Equipment					NE	NE	NE	NE	NA	NA	NA	NA
2G2	SF6 and PFCs from Other Product Uses					NE, NO	NE, NO	NE, NO	NE, NO	NA, NO	NA, NO	NA, NO	NA, NO
2G2a	Military Applications					NE	NE	NE	NE	NA	NA	NA	NA
2G2b	Accelerators					NE	NE	NE	NE	NA	NA	NA	NA
2G2c	Other (please specify)					NO	NO	NO	NO	NO	NO	NO	NO
2G3	N2O from Product Uses			0.24						NA	NA	NA	NA
2G3a	Medical Applications			0.24						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	**Others**	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 B5: AFOLU Sectoral Table for GHG Inventory Year 2016 (1 of 4)

Categories		(Gg)					
		Net CO2 emissions / removals	Emissions				
			CH4	N2O	NOx	CO	NMVOCs
3 AFOLU		-240,860.98	167.11	20.02	0.28	44.29	NA, NE, NO
3A	**Livestock**		75.04	0.44	NA, NO	NA, NO	NA, NO
3A1	**Enteric Fermentation**		54.82	NA, NO	NA, NO	NA, NO	NA, NO
3A1a	Cattle		43.76	NA	NA	NA	NA
3A1ai	Dairy Cows		3.14	NA	NA	NA	NA
3A1aii	Other Cattle		40.62	NA	NA	NA	NA
3A1b	Buffalo		6.55	NA	NA	NA	NA
3A1c	Sheep		0.69	NA	NA	NA	NA
3A1d	Goats		2.08	NA	NA	NA	NA
3A1e	Camels		NE	NA	NA	NA	NA
3A1f	Horses		0.07	NA	NA	NA	NA
3A1g	Mules and Asses		NE	NA	NA	NA	NA
3A1h	Swine		1.65	NA	NA	NA	NA
3A1j	Other (please specify)		NO	NO	NO	NO	NO
3A2	**Manure Management**		20.23	0.44	NA, NO	NA, NO	NA, NO
3A2a	Cattle		2.29	0.09	NA	NA	NA
3A2ai	Dairy cows		1.43	0.01	NA	NA	NA
3A2aii	Other cattle		0.86	0.09	NA	NA	NA
3A2b	Buffalo		0.24	0.00	NA	NA	NA
3A2c	Sheep		0.03	0.01	NA	NA	NA
3A2d	Goats		0.09	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		11.58	0.02	NA	NA	NA
3A2i	Poultry		5.99	0.28	NA	NA	NA
3A2j	Other (please specify)		NO	NO	NO	NO	NO

Table B5: AFOLU Sectoral Table for GHG Inventory Year 2016 (2 of 4)

Categories		(Gg)					
		Net CO2 emissions / removals	Emissions				
			CH4	N2O	NOx	CO	NMVOCs
3B	**Land**	-241,392.81	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	NA, NO
3B1	**Forest land**	-243,831.71	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	NA, NO
3B1a	Forest land Remaining Forest land	-243,831.71	IE	IE	IE	IE	NA
3B1b	Land Converted to Forest land	0.00	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
3B1bi	Cropland converted to Forest Land	0.00	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**	-15,314.31	IE, NO	IE, NO	IE, NO	IE, NO	IE, NO
3B2a	Cropland Remaining Cropland	-15,314.31	IE	IE	IE	IE	IE
3B2b	Land Converted to Cropland	NO	NO	NO	NO	NO	NO
3B2bi	Forest Land converted to Cropland	NO	NO	NO	NO	NO	NO
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**	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
3B3a	Grassland Remaining Grassland	NA	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
3B4	**Wetlands**	IE, NA, NO	NA, NO	IE, NA, NO	NA, NO	NA, NO	NA, NO
3B4a	Wetlands Remaining Wetlands	IE, NA	NA	IE, NA	NA	NA	NA
3B4ai	Peatlands remaining peatlands	IE	NA	IE	NA	NA	NA
3B4aii	Flooded land remaining flooded land	NA	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

Table B5: AFOLU Sectoral Table for GHG Inventory Year 2016 (3 of 4)

Categories		(Gg)					
		Net CO2 emissions / removals	Emissions				
			CH4	N2O	NOx	CO	NMVOCs
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**	17,753.21	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
3B5a	Settlements Remaining Settlements	0	NA	NA	NA	NA	NA
3B5b	Land Converted to Settlements	17,753.21	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
3B5bi	Forest Land converted to Settlements	17,753.21	NA	NA	NA	NA	NA
3B5bii	Cropland converted to Settlements	0.00	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
3C	**Aggregate sources and non-CO2 emissions sources on land**	531.83	92.07	19.58	0.28	44.29	NA, NO
3C1	Emissions from biomass burning	NO	1.46	0.07	0.28	44.29	NA, NO
3C1a	Biomass burning in forest lands	NO	1.16	0.06	2.33	33.85	NA
3C1b	Biomass burning in croplands	NO	0.31	0.01	0.28	10.43	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	4.54			NA	NA	NA
3C3	Urea application	527.29			NA	NA	NA
3C4	Direct N2O Emissions from managed soils			13.60	NA	NA	NA
3C5	Indirect N2O Emissions from managed soils			3.88	NA	NA	NA
3C6	Indirect N2O Emissions from manure management			2.03	NA	NA	NA
3C7	Rice cultivation		90.61		NA	NA	NA

Table B5: AFOLU Sectoral Table for GHG Inventory Year 2016 (4 of 4)

Categories		(Gg)					
		Net CO2 emissions / removals	Emissions				
			CH4	N2O	NOx	CO	NMVOCs
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 B6: Waste Sectoral Table for GHG Inventory Year 2016

Categories	CO_2	CH_4	N_2O	NO_x	CO	NMVOCs	SO_2
	(Gg)						
4 WASTE	31.06	1,070.10	1.27	0.00	0.00	NA, NE	0.00
4A Solid Waste Disposal		448.57	NA	NA	NA	NA	NA
4A1 Managed Waste Disposal Sites		22.43	NA	NA	NA	NA	NA
4A2 Unmanaged Waste Disposal Sites		426.14	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	31.06	0.08	0.01	0.00	0.00	NE	0.00
4C1 Waste Incineration	30.36	0.00	0.01	0.00	0.00	NE	0.00
4C2 Open Burning of Waste	0.70	0.08	0.00	0.00	0.00	NE	0.00
4D Wastewater Treatment and Discharge		621.44	1.26	NA	NA	NA	NA
4D1 Domestic Wastewater Treatment and Discharge		64.32	1.26	NA	NA	NA	NA
4D2 Industrial Wastewater Treatment and Discharge		557.12	NA	NA	NA	NA	NA
4E Other (please specify)	NO	NO	NO	NO	NO	NO	NO

Table B7a: Energy Background Table for GHG Inventory Year 2016 – 1A1 – 1A2

2006 IPCC Categories	Activity (TJ)				Emissions (Gg)										Total emissions (Gg)			Information Items (Gg)	
					Solid			Liquid			Gas			Bio-mass						
	Solid Fuel	Liquid Fuel	Gas	Biomass	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 Cap-tured	Biomass CO_2 emitted
1A Fuel Combustion Activities	780,274.16	1,184,343.54	1,132,156.93	25,464.40	74,984.35	1.42	1.17	84,299.18	20.99	3.01	63,514.00	1.93	0.14	0.30	0.04	222,510.48	24.59	4.36	0.00	2,030.13
1A1 Energy Industries	709,564.56	145,017.44	928,178.56	9,188.64	68,189.15	0.71	1.06	10,663.81	0.44	0.09	52,070.82	0.93	0.09	0.25	0.03	130,923.78	2.32	1.28	0.00	877.81
1A1a Main Activity Electricity and Heat Production	709,564.56	15,438.96	600,571.36	9,188.64	68,189.15	0.71	1.06	1,165.70	0.05	0.01	33,692.05	0.60	0.06	0.25	0.03	103,046.91	1.61	1.17	0.00	877.81
1A1ai Electricity Generation	709,564.56	13,556.16	554,798.40	3,138.00	68,189.15	0.71	1.06	1,026.19	0.04	0.01	31,124.19	0.55	0.06	0.07	0.01	100,339.53	1.38	1.14	0.00	279.61
1A1aii Combined Heat and Power Generation (CHP)	NO	1,882.80	45,772.96	6,050.64	NO	NO	NO	139.52	0.01	0.00	2,567.86	0.05	0.00	0.18	0.02	2,707.38	0.23	0.03	0.00	598.20
1A1aiii Heat Plants	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00	NO	NO
1A1b Petroleum Refining	NO	129,578.48	NO	NO	NO	NO	NO	9,498.10	0.39	0.08	NO	NO	NO	NO	NO	9,498.10	0.39	0.08	0.00	NO
1A1c Manufacture of Solid Fuels and Other Energy Industries	NO	NO	327,607.20	NO	NO	NO	NO	NO	NO	NO	18,378.76	0.33	0.03	NO	NO	18,378.76	0.328	0.03	0.00	NO
1A1ci Manufacture of Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00	NO	NO
1A1cii Other Energy Industries	NO	NO	327,607.20	NO	NO	NO	NO	NO	NO	NO	18,378.76	0.328	0.03	NO	NO	18,378.76	0.32	0.03	0.00	NO
1A.2 Manufacturing Ind. and Construction	70,709.60	83,341.10	194,229.65	NO	6,795.19	0.71	0.11	6,164.27	0.24	0.05	10,896.28	0.19	0.02	NO	NO	23,855.75	1.14	0.17	0.00	NO
1A2a Iron and Steel	NO	21,284.01	76,968.86	NO	0.00	0.00	0.00	1,542.77	0.06	0.01	4,317.95	0.08	0.01	NO	NO	5,860.72	0.13	0.02	0.00	NO
1A2b Non-Ferrous Metals	NO	0.00	3,347.20	NO	0.00	0.00	0.00	0.00	0.00	0.00	187.78	0.00	0.00	NO	NO	187.78	0.00	0.00	0.00	NO
1A2c Chemicals	NO	13,819.75	25,685.58	NO	0.00	0.00	0.00	1,037.96	0.04	0.01	1,440.96	0.03	0.00	NO	NO	2,478.92	0.07	0.01	0.00	NO
1A2d Pulp, Paper and Print	NO	3,794.89	5,773.92	NO	0.00	0.00	0.00	279.43	0.01	0.00	323.92	0.01	0.00	NO	NO	603.35	0.02	0.00	0.00	NO
1A2e Food Processing, Beverages and Tobacco	NO	3,531.30	64,588.41	NO	0.00	0.00	0.00	259.74	0.01	0.00	3,623.41	0.06	0.01	NO	NO	3,883.15	0.08	0.01	0.00	NO
1A2f Non-Metallic Minerals	70,709.60	7,317.82	5,230.00	NO	6,795.19	0.71	0.11	558.96	0.02	0.00	293.40	0.01	0.00	NO	NO	7,647.55	0.73	0.11	0.00	NO
1A2g Transport Equipment	NO	20,263.11	2,510.40	NO	0.00	0.00	0.00	1,500.85	0.06	0.01	140.83	0.00	0.00	NO	NO	1,641.69	0.06	0.01	0.00	NO
1A2h Machinery	NO	2,564.79	125.52	NO	0.00	0.00	0.00	184.35	0.01	0.00	7.04	0.00	0.00	NO	NO	191.39	0.01	0.00	0.00	NO
1A2i Mining (excluding fuels) and Quarrying	IE	0.00	0.00	NO	0.00	0.000	0.000	0.00	0.00	0.00	0.00	0.00	0.00	NO	NO	0.00	0.00	0.00	0.00	NO
1A2j Wood and Wood Products	NO	4,803.23	753.12	NO	0.00	0.00	0.00	364.59	0.01	0.00	42.25	0.00	0.00	NO	NO	406.84	0.02	0.00	0.00	NO
1A2k Construction	IE	0.00	0.00	NO	0.00	0.000	0.000	0.00	0.00	0.00	0.00	0.00	0.00	NO	NO	0.00	0.00	0.00	0.00	NO
1A2l Textile and Leather	NO	2,418.35	6,485.20	NO	0.00	0.00	0.00	179.69	0.01	0.00	363.82	0.01	0.00	NO	NO	543.51	0.01	0.00	0.00	NO
1A2m Non-specified Industry	NO	3,543.85	2,761.44	NO	0.00	0.00	0.00	255.94	0.01	0.00	154.92	0.00	0.00	NO	NO	410.86	0.01	0.00	0.00	NO

NOTE: No usage of other fossil fuel and peat

Table B7b: Energy Background Table for GHG Inventory Year 2016 – 1A3 – 1A5 (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
1A3 Transport	NO	865,387.60	8,702.72	NO	NO	16,275.76	NO	NO	NO	61,415.88	19.74	2.84	488.22	0.80	0.03	IE, NO	NO	NO	NO	NO	NO	0.05	0.01	61,904.10	20.59	2.88
1A3a Civil Aviation		15,846.06	NO	NO	NO	NO				1,132.99	0.01	0.03	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1,132.99	0.01	0.03
1A3ai International Aviation (International Bunkers)																										
1A3aii Domestic Aviation		15,846.06	NO	NO	NO	NO				1,132.99	0.01	0.03	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1,132.99	0.01	0.03
1A3b Road Transportation		774,226.61	8,702.72	NO	NO	16,275.76				54,700.12	19.21	2.63	488.22	0.80	0.03	IE	NO	NO	NO	NO	NO	0.05	0.01	55,188.34	20.06	2.67
1A3bi Cars		IE	IE	NO	NO	IE				IE	IE	IE	IE	IE	IE	IE	NO	NO	NO	NO	NO	IE	IE	IE, NO	IE, NO	IE, NO
1A3bi1 Passenger cars with 3-way catalysts		IE	IE	NO	NO	IE				IE	IE	IE	IE	IE	IE	IE	NO	NO	NO	NO	NO	IE	IE	IE, NO	IE, NO	IE, NO
1A3bi2 Passenger cars without 3-way catalysts		IE	IE	NO	NO	IE				IE	IE	IE	IE	IE	IE	IE	NO	NO	NO	NO	NO	IE	IE	IE, NO	IE, NO	IE, NO
1A3bii Light-duty trucks		IE	IE	NO	NO	IE				IE	IE	IE	IE	IE	IE	IE	NO	NO	NO	NO	NO	IE	IE	IE, NO	IE, NO	IE, NO
1A3bii1 Light-duty trucks with 3-way catalysts		IE	IE	NO	NO	IE				IE	IE	IE	IE	IE	IE	IE	NO	NO	NO	NO	NO	IE	IE	IE, NO	IE, NO	IE, NO
1A3bii2 Light-duty trucks without 3-way catalysts		IE	IE	NO	NO	IE				IE	IE	IE	IE	IE	IE	IE	NO	NO	NO	NO	NO	IE	IE	IE, NO	IE, NO	IE, NO
1A3biii Heavy-duty trucks and buses		IE	IE	NO	NO	IE				IE	IE	IE	IE	IE	IE	IE	NO	NO	NO	NO	NO	IE	IE	IE, NO	IE, NO	IE, NO
1A3biv 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
1A3bv Evaporative emissions from vehicles		NE	NO																							
1A3bvi Urea-based catalysts																								NO		
1A3c Railways	NO	1,048.93	NO	NO	NO	NO	NO	NO	NO	77.73	0.00	0.03	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	77.726	0.004	0.030
1A3d Water-borne Navigation	NO	74,266.00	NO	NO	NO	NO	NO	NO	NO	5,505.04	0.52	0.15	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	5,505.044	0.520	0.149
1A3di International water-borne navigation (International bunkers)																										
1A3dii Domestic Water-borne Navigation	NO	74,266.00	NO	NO	NO	NO	NO	NO	NO	5,505.04	0.52	0.15	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	5,505.044	0.520	0.149
1A3e Other Transportation	NO	IE, NE	NE, NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NE, NO	NE, NO	NE, NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1A3ei Pipeline Transport	NO	NE	NE, NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NE	NE	NE	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1A3eii Off-road	NO	IE	NO	NO	NO	NO	NO	NO	NO	IE	IE	IE	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1A4 Other Sectors	NO	79,416.50	1,046.00	NO	NO	NO	NO	NO	NO	5,260.26	0.51	0.02	58.68	0.01	0.00	NO	NO	NO	NO	NO	NO	NO	NO	5,318.944	0.514	0.019
1A4a Commercial/Institutional	NO	38,702.00	1,004.16	NO	NO	NO	NO	NO	NO	2,519.97	0.23	0.01	56.33	0.01	0.00	NO	NO	NO	NO	NO	NO	NO	NO	2,576.302	0.233	0.007
1A4b Residential	NO	25,313.20	41.84	NO	NO	NO	NO	NO	NO	1,598.37	0.13	0.00	2.35	0.00	0.00	NO	NO	NO	NO	NO	NO	NO	NO	1,600.715	0.127	0.003
1A4c Agriculture/Forestry/Fishing/Fish Farms	NO	15,401.30	NO	NO	NO	NO	NO	NO	NO	1,141.93	0.15	0.01	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1,141.927	0.154	0.009

Table B7b: Energy Background Table for GHG Inventory Year 2016 – 1A3 – 1A5 (2 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
1A4ci Stationary	NO	771.95	NO	NO	NO	NO	NO	NO	NO	57.24	0.01	0.00	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	57.236	0.008	0.000
1A4cii 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	15.382	0.002	0.000
1A4ciii Fishing (mobile combustion)	NO	14,430.62	NO	NO	NO	NO	NO	NO	NO	1,069.31	0.14	0.01	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1,069.309	0.144	0.009
1A5 Non-Specified	NO	7,038.74	NO	NO	NO	NO	NO	NO	NO	507.91	0.02	0.02	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	507.906	0.024	0.016
1A5a Stationary	NO	IE	IE	NO	NO	NO	NO	NO	NO	IE	IE	IE	IE	IE	IE	NO	NO	NO	NO	NO	NO	NO	NO	0.000	0.000	0.000
1A5b Mobile	NO	7,038.74	NO	NO	NO	NO	NO	NO	NO	507.91	0.02	0.02	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	507.906	0.024	0.016
1A5bi Mobile (aviation component)	NO	4,719.55	NO	NO	NO	NO	NO	NO	NO	337.45	0.00	0.01	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	337.448	0.002	0.009
1A5bii Mobile (water-borne component)	NO	1,218.80	NO	NO	NO	NO	NO	NO	NO	90.31	0.01	0.00	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	90.313	0.009	0.002
1A5biii Mobile (Other)	NO	1,100.39	NO	NO	NO	NO	NO	NO	NO	80.15	0.01	0.00	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	80.145	0.013	0.004
1A5c Multilateral Operations																										
Memo Items																										
International Bunkers	NO	114,410.22	NO	NO	NO	NO	NO	NO	NO	8,231.15	0.11	0.23	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	8,231.15	0.11	0.23
International Aviation (International Bunkers)	NO	105,749.34	NO	NO	NO	NO	NO	NO	NO	7,561.08	0.05	0.21	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	7,561.08	0.05	0.21
International water-borne navigation (International bunkers)	NO	8,660.88	NO	NO	NO	NO	NO	NO	NO	670.08	0.06	0.02	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	670.08	0.06	0.02
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

Table B7c: Energy Background Table for GHG Inventory Year 2016 – 1B

2006 IPCC Categories	Activity Data			Emissions (Gg)			Info. Item: Amount Captured(Gg)
	Description	Unit	Value	CO_2	CH_4	N_2O	CO_2
1.B - Fugitive emissions from fuels				1,942.15	1,013.11	NA	NO
1.B.1 - Solid Fuels				NA	0.79	NA	NO
1.B.1.a - Coal mining and handling				NA	0.79		NO
1.B.1.a.i - Underground mines				NA	0.14		NO
1.B.1.a.i.1 - Mining	coal produced	ktonnes	15.66	NA	0.10		NO
1.B.1.a.i.2 - Post-mining seam gas emissions	coal produced	ktonnes	15.66	NA	0.03		NO
1.B.1.a.i.3 - Abandoned underground mines	number of mines	number	1.00	NA	0.01		NO
1.B.1.a.i.4 - Flaring of drained methane/conversion of methane to CO_2	gas flared	10^6 Sm^3	NO	NO	NO	NO	NO
1.B.1.a.ii - Surface mines					0.64	NA	NO
1.B.1.a.ii.1 - Mining	coal produced	ktonnes	2,399.11		0.48		NO
1.B.1.a.ii.2 - Post-mining seam gas emissions	coal produced	ktonnes	2,399.11		0.16		NO
1.B.1.b - Uncontrolled combustion and burning coal dumps	solid fuel combusted	ktonnes	NO				NO
1.B.1.c - Solid fuel transformation			NO				NO
1.B.2 - Oil and Natural Gas				1,942.15	1,012.33	NA, NE	NO
1.B.2.a - Oil				1,846.14	34.45	NA	NO
1.B.2.a.i - Venting	total gas vented from oil production	10^6 Sm^3	37,976.53	4.27	32.47	NA	NO
1.B.2.a.ii - Flaring	gas flared from oil production	10^3 m^3	37,976.53	1,841.86	1.12	NA	NO
1.B.2.a.iii - All Other				0.00	0.86	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 m^3	37,976.53	0.00	0.02	NA	NO
1.B.2.a.iii.3 - Transport	crude oil transported	10^3 m^3		NE	NE	NE	NO
1.B.2.a.iii.4 - Refining	refinery crude oil throughput	10^3 m^3	31,451.70	0.00	0.69	NA	NO
1.B.2.a.iii.5 - Distribution of oil products	amount distributed	10^3 m^3		NE	NE	NE	NO
1.B.2.a.iii.6 - Other			1,151.60	0.00	0.16	NA	NO
1.B.2.b - Natural Gas				96.01	977.88	NA	NO
1.B.2.b.i - Venting	total gas vented from natural gas prod.	10^6 Sm^3	0.00	0.00	0.00	NA	NO
1.B.2.b.ii - Flaring	gas flared from natural gas production	10^6 Sm^3	57,782.33	80.90	0.05	NA	NO
1.B.2.b.iii - All Other				15.12	977.82	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 Sm^3	57,782.33	5.60	704.37	NA	NO
1.B.2.b.iii.3 - Processing	amount of gas processed at facilities	10^6 Sm^3	80,894.62	1.62	20.22	NA	NO
1.B.2.b.iii.4 - Transmission and Storage	amount transported and stored	10^6 Sm^3	82,405.19	0.12	52.16	NA	NO
1.B.2.b.iii.5 - Distribution	amount of gas distributed	10^6 Sm^3	81,408.80	7.77	146.54	NA	NO
1.B.2.b.iii.6 - Other			652.45	0.00	54.54	NA	NO
1.B.3 - Other emissions from Energy Production		NO	NO	NO	NO	NO	NO

Table B7c: Energy Background Table for GHG Inventory Year 2016 – 1B

2006 IPCC Categories	Activity Data			Emissions (Gg)			Info. Item: Amount Captured(Gg)
	Description	Unit	Value	CO_2	CH_4	N_2O	CO_2
1.B - Fugitive emissions from fuels				1,942.15	1,013.11	NA	NO
1.B.1 - Solid Fuels				NA	0.79	NA	NO
1.B.1.a - Coal mining and handling				NA	0.79		NO
1.B.1.a.i - Underground mines				NA	0.14		NO
1.B.1.a.i.1 - Mining	coal produced	ktonnes	15.66	NA	0.10		NO
1.B.1.a.i.2 - Post-mining seam gas emissions	coal produced	ktonnes	15.66	NA	0.03		NO
1.B.1.a.i.3 - Abandoned underground mines	number of mines	number	1.00	NA	0.01		NO
1.B.1.a.i.4 - Flaring of drained methane or conversion of methane to CO_2	gas flared	10^6 Sm^3	NO	NO	NO	NO	NO
1.B.1.a.ii - Surface mines					0.64	NA	NO
1.B.1.a.ii.1 - Mining	coal produced	ktonnes	2,399.11		0.48		NO
1.B.1.a.ii.2 - Post-mining seam gas emissions	coal produced	ktonnes	2,399.11		0.16		NO
1.B.1.b - Uncontrolled combustion and burning coal dumps	solid fuel combusted	ktonnes	NO				NO
1.B.1.c - Solid fuel transformation			NO				NO
1.B.2 - Oil and Natural Gas				1,942.15	1,012.33	NA, NE	NO
1.B.2.a - Oil				1,846.14	34.45	NA	NO
1.B.2.a.i - Venting	total gas vented from oil production	10^6 Sm^3	37,976.53	4.27	32.47	NA	NO
1.B.2.a.ii - Flaring	gas flared from oil production	10^3 Sm^3	37,976.53	1,841.86	1.12	NA	NO
1.B.2.a.iii - All Other				0.00	0.86	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 Sm^3	37,976.53	0.00	0.02	NA	NO
1.B.2.a.iii.3 - Transport	crude oil transported	10^3 Sm^3		NE	NE	NE	NO
1.B.2.a.iii.4 - Refining	refinery crude oil throughput	10^3 Sm^3	31,451.70	0.00	0.69	NA	NO
1.B.2.a.iii.5 - Distribution of oil products	amount distributed	10^3 Sm^3		NE	NE	NE	NO
1.B.2.a.iii.6 - Other			1,151.60	0.00	0.16	NA	NO
1.B.2.b - Natural Gas				96.01	977.88	NA	NO
1.B.2.b.i - Venting	total gas vented from natural gas prod.	10^6 Sm^3	0.00	0.00	0.00	NA	NO
1.B.2.b.ii - Flaring	gas flared from natural gas production	10^6 Sm^3	57,782.33	80.90	0.05	NA	NO
1.B.2.b.iii - All Other				15.12	977.82	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 Sm^3	57,782.33	5.60	704.37	NA	NO
1.B.2.b.iii.3 - Processing	amount of gas processed at facilities	10^6 Sm^3	80,894.62	1.62	20.22	NA	NO
1.B.2.b.iii.4 - Transmission and Storage	amount transported and stored	10^6 Sm^3	82,405.19	0.12	52.16	NA	NO
1.B.2.b.iii.5 - Distribution	amount of gas distributed	10^6 Sm^3	81,408.80	7.77	146.54	NA	NO
1.B.2.b.iii.6 - Other			652.45	0.00	54.54	NA	NO
1.B.3 - Other emissions from Energy Production		NO	NO	NO	NO	NO	NO

Table B 7d(i): Energy Background Table for GHG Inventory Year 2016 – 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 B 7d(ii): Energy Background Table for GHG Inventory Year 2016 - 1C CO_2 Transport, Injection and Storage – Overview

Category	CO_2 (Gg)
Total amount captured for storage (A)	NO
Total amount of import for storage (B)	NO
Total amount of export for storage (C)	NO
Total amount of CO_2 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 B7e: Energy Background Table for GHG Inventory Year 2016 – 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	33,234.00	10,854.00	16,605.00		-71.00	27,554.00	41.84	1,152,859.36	20.00	23,057,187.20	23,057.19	0.00	23,057.19	1	23,057.19	84,543.02
		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		8,552.00	458.00	0.00	-274.00	8,368.00	41.84	350,117.12	18.90	6,617,213.57	6,617.21	0.00	6,617.21	1	6,617.21	24,263.12
		Jet Kerosene		1,450.00	1,068.00	2,527.47	-100.00	-2,045.47	41.84	-85,582.46	19.50	-1,668,858.06	-1,668.86	0.00	-1,668.86	1	-1,668.86	-6,119.15
		Other Kerosene		0.00	76.00	0.00	-13.00	-63.00	41.84	-2,635.92	19.60	-51,664.03	-51.66	0.00	-51.66	1	-51.66	-189.43
		Shale Gas		NO	NO	NO	NO	NO	NO	NO	-	NO	NO	NO	NO	-	NO	NO
		Gas/Diesel Oil		3,896.00	4,805.00	1.00	-101.00	-809.00	41.84	-33,848.56	20.20	-683,740.91	-683.74	0.00	-683.74	1	-683.74	-2,507.05
		Residual Fuel Oil		51.00		296.00	-39.00	-811.00	41.84	-33,932.24	21.10	-715,970.26	-715.97	0.00	-715.97	1	-715.97	-2,625.22
		LPG		490.00	355.00		-30.00	165.00	41.84	6,903.60	17.20	118,741.92	118.74	1,437.14	-1,318.40	1	-1,318.40	-4,834.12
		Ethane		0.00	0.00		0.00	0.00	41.84	0.00	16.80	0.00	0.00	855.16	-855.16	1	-855.16	-3,135.60
		Naphtha		375.80	1,509.20		-239.00	-894.40	41.84	-37,421.70	20.00	-748,433.92	-748.43	0.00	-748.43	1	-748.43	-2,744.26
		Bitumen		300.90	2,807.20		0.00	-2,506.30	41.84	-104,863.59	22.00	-2,306,999.02	-2,307.00	426.79	-2,733.79	1	-2,733.79	-10,023.89
		Lubricants		189.70	294.70	NO	0.00	-105.00	41.84	-4,393.20	20.00	-87,864.00	-87.86	155.93	-243.79	1	-243.79	-893.91
		Petroleum Coke		5.10	3.90		0.00	1.20	41.84	50.21	26.60	1,335.53	1.34	0.00	1.34	1	1.34	4.90
		Refinery Feedstocks		34.00	34.00		0.00	0.00	41.84	0.00	20.00	0.00	0.00	0.00	0.00	1	0.00	0.00
		Other Oils		31.50	232.00		0.00	-200.50	41.84	-8,388.92	20.00	-167,778.40	-167.78	0.00	-167.78	1	-167.78	-615.19
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	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
		Sub-bit. Coal	1,522.00	17,113.00	15.00	0.00	-125.00	18,745.00	41.84	784,290.80	26.20	20,548,418.96	20,548.42	0.00	20,548.42	1	20,548.42	75,344.20
		Lignite	NO	NO	NO		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
		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	NO	NO	NO		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Solid Fossil Totals																		
Gaseous Fossil		Natural Gas (Dry)	62,722.00	6,832.00	28,298.00		0.00	41,256.00	41.84	1,726,151.04	15.30	26,410,110.91	26,410.11	3,115.24	23,294.88	1	23,294.88	85,414.54
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			**97,478.00**	**50,175.00**	**56,561.00**	**2,824.47**	**-992.00**	**88,654.53**		**3,709,305.54**		**70,321,699.48**	**70,321.70**	**5,990.25**	**64,331.44**		**64,331.44**	**235,881.96**

Table B8a: IPPU Background Table for GHG Inventory Year 2016 – 2A Mineral Industry, 2B (2B1-2B8, 2B10) Chemical 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	Info. item Captured and Stored	(memo) Other reduc-tion	Emissions	Info. item reduction	Emiss-ions	Info. item reduc-tion
2A Mineral Industry				13,415.57	NE, NO	NE, NO	NA,NE,NO	NA,NE,NO	NO	NO
2A1 Cement production	Prod. of clinker	17,720,000.00	Tonnes	9,125.80	NO	NO	NA	NA		
2A2 Lime production	Prod. of Quicklime	102,671.00	Tonnes	77.00	NO	NO	NA	NA		
2A3 Glass Production	Production of Glass	191,424.37	Tonnes	28.71	NO	NO	NA	NA		
2A4 Other Process Uses of Carbonates				4,184.05	NO	NO	NE, NO	NE, NO		
2A4a Ceramics	NE	NE	NE	NE	NE	NE	NE	NE		
2A4b Other Uses of Soda Ash	NO	NO	NO	NO	NO	NO	NO	NO		
2A4c Non Metallurgical Magnesia Production	NO	NO	NO	NO	NO	NO	NO	NO		
2A4d Other	NO	NO	NO	NO	NO	NO	NO	NO		
2A5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B Chemical Industry				4,791.70	NO	NO	12.87	NA, NO	NA, NO	NA, NO
2B1 Ammonia Production	Prod. of ammonia	C	Tonnes	1,170.28		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 Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B5 Carbide Production	Prod. 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				3,583.39	NO	NO	12.87	NO	NA, NO	NO
2B8a Methanol	Conventional Steam Reforming, without primary reformer	C	Tonnes	1,434.07	NO	NO	4.92	NO	NA	NA
2B8b Ethylene	Ethane and Naphtha	C	Tonnes	2,062.94	NO	NO	7.71	NO	NA	NA
2B8c Ethylene Dichloride and Vinyl Chloride Monomer	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B8d Ethylene Oxide	Oxygen Process	C	Tonnes	86.39	NO	NO	0.23	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

Table B8b: IPPU Background Table for GHG Inventory Year 2016 – 2B Chemical Industry, HCFs, PFCs, SF6 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-C_4F_8	C_5F_{12}	C_6F_{14}	Other HFCs (please specify)	Total PFCs	SF_6	Other halogenated gases (please specify)
CO_2 equivalent conversion factors [Source of the factor: IPCC AR4, *AR5]	4,800	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	,0300	9,160	9,300			22,800	
Emissions in original mass unit (tonne)																																
2B Fluorochemical Prod.	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
2B9aBy-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 CO_2 equivalent unit ($Gg\text{-}CO_2$)																																
2B9Fluorochemical Prod.	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 B8c: IPPU Background Table for GHG Inventory Year 2016 – 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				2,600.51	NA, NE, NO	NA, NE, NO	0.66	NA, NE, NO	NA, NE, NO	NA, NE, NO
2C1 Iron and Steel Production	Production of iron & steel	3,941,713	tonne	1,384.51	NO	NO	0.66	NO	NA	NA
2C2 Ferroalloys Production	NE	NE	tonne	NE	NE	NE	NE	NE	NE	NE
2C3 Aluminum Production	Production of aluminium	760,000	tonne	1,216.00	NA	NA	NA	NA		
2C4 Magnesium Production	NO	NO	tonne	NO	NO	NO				
2C5 Lead Production	NO	NO	tonne	NO	NO	NO				
2C6 Zinc Production	NO	NO	tonne	NO	NO	NO				
2C7 Other (please specify)	NO	NO	tonne	NO	NO	NO	NO	NO	NO	NO

Table B8d: IPPU Background Table for GHG Inventory Year 2016 – 2C (2C3, 2C4, 2C7) Metal Industry HCFs, 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-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)														
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 B8e: IPPU Background Table for GHG Inventory Year 2016 - 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 B8f: IPPU Background Table for GHG Inventory Year 2016 - 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 CO_2 equivalent unit (Gg-CO_2)															
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 B8g: IPPU Background Table for GHG Inventory Year 2016 - 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	0.50	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, NE, NO
2F1 Refrigeration and Air Conditioning	NA, NE	NA, NE	NA, NE	NA, NE	0.50	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, 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
2F1b Mobile Air Conditioning	NA	NA	NA	NA	0.50	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		NE
2F3 Fire Protection	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
2F5 Solvents		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
Emissions in CO_2 equivalent unit (Gg-CO_2)																					
2F Product Uses as Substitutes for Ozone Depleting Substances		NA, NE, NO	NA, NE, NO	NA, NE, NO	713.25	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	NA, NE, NO	713.25	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	713.25	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	713.25	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	713.25	NA	NA	NA	NA	NA	NA	NA	NA	713.25	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 B8h: IPPU Background Table or GHG Inventory Year 2016 - 2G (2G1, 2G2, 2G4) Other Product Manufacture and Use – PFCs, SF_6 and other halogenated gases

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 (please specify)	Total PFCs	SF_6	Other halogen-ated gases (please specify)
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 (tonne)											
2G Other Product Manufacture and Use	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO		0.00	NE, NO
2G1 Electrical Equipment	NE	NE	NE	NE	NE	NE	NE	NE		0.00	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		0.00	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 SF_6 and PFCs from Other Product Uses	NE	NE	NE	NE	NE	NE	NE	NE		NE	NE
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
Emissions in CO_2 equivalent unit (Gg-CO_2)											
2G Other Product Manufacture and Use	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	11.49	NE, NO
2G1 Electrical Equipment	NE	NE	NE	NE	NE	NE	NE	NE	NE	11.49	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	11.14	NE
2G1c Disposal of Electrical Equipment	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2G2 SF_6 and PFCs from Other Product Uses	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
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 B8i: IPPU Background Table for GHG Inventory Year 2016 - 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	Informa-tion Reduction	Emissi-ons	Informa-tion Reduction	Emissi-ons	Information Reduction
2G3	N_2O from Product Uses				0.24	NO				
	2G3a Medical Applications	N_2O supplied	237.24	tonne	0.24	NO				
	2G3b Propellant for Pressure and Aerosol Products	N_2O supplied	NE	tonne	NE	NO				
	2G3c Other (please specify)	N_2O supplied	NO	tonne	NO	NO				
2G4	Other (please specify)	NO	NO	tonne			NO	NO	NO	NO

Table B8j: IPPU Background Table for GHG Inventory Year 2016 - 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	NO	NE, NO	NO	NO	NO
	2H1 Pulp and Paper Industry	NE	NE	NE	NO	NE	NO		
	2H2 Food and Beverages Industry	NE	NE	NE	NO	NE	NO		
	2H3 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO

Table B8k: IPPU Background Table for GHG Inventory Year 2016 - Greenhouse gases without CO_2 equivalent conversion factors

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	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
2E1 Integrated Circuit or Semiconductor	NA	NA	NA	NA	NA
2E2 TFT Flat Panel Display	NO	NO	NO	NO	NO
2E3 Photovoltaics	NA	NA	NA	NA	NA
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	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
2F1a Refrigeration and Stationary Air Conditioning	NE	NE	NE	NE	NE
2F1b Mobile Air Conditioning	NA	NA	NA	NA	NA
2F2 Foam Blowing Agents	NE	NE	NE	NE	NE
2F3 Fire Protection	NE	NE	NE	NE	NE
2F4 Aerosols	NE	NE	NE	NE	NE
2F5 Solvents	NE	NE	NE	NE	NE
2F6 Other Applications (please specify)	NO	NO	NO	NO	NO
2G. Other Product Uses	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
2G1 Electrical Equipment	NE	NE	NE	NE	NE
2G1a Manufacture of Electrical Equipment	NE	NE	NE	NE	NE
2G1b Use of Electrical Equipment	NE	NE	NE	NE	NE
2G1c Disposal of Electrical Equipment	NE	NE	NE	NE	NE
2G2 SF6 and PFCs from Other Product Uses	NE	NE	NE	NE	NE
2G2a Military Applications (AWACS)	NE	NE	NE	NE	NE
2G2b Accelerators	NE	NE	NE	NE	NE
2G2c Other (please specify)	NO	NO	NO	NO	NO
2G4 Other (please specify)	NO	NO	NO	NO	NO

Table B8l: IPPU Background Table for GHG Inventory Year 2016 - Allocation of CO_2 emissions from Non-Energy Use of fossil fuels: IPPU and other sectors (1 of 2)

Category	Reported in year: 2016			
	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	1,170.28	
2B5 Carbide Production	petroleum coke	oil	38.02	
2B6 Titanium Dioxide Production			NO	
2B8 Petrochemical and Carbon Black Production			3,583.40	
2B8a Methanol	natural gas	coal, oil	1,434.07	
2B8b Ethylene	naphtha	gas oil; butane, ethane, propane, LPG	2,062.94	
2B8f Carbon Black			NO	
2B10 Other			86.3889	
2C Metal Industry				
2C1 Iron and Steel Production	coke	coal, petroleum coke (carbon electrode), graphite electrode	1,384.51	
2C2 Ferroalloys Production			NO	
2C3 Aluminium Production	(carbon electrode)	coke, coal	1216.00	
2C5 Lead Production	coke	NA	NO	
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	
2H Other				
2H1 Pulp and Paper Industry	NA	NA	NE	

Table B8l: IPPU Background Table for GHG Inventory Year 2016 - Allocation of CO_2 emissions from Non-Energy Use of fossil fuels: IPPU and other sectors (2 of 2)

Category	Reported in year: 2016			
	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
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 B9a: AFOLU Background Table for GHG Inventory Year 2016 - 3A1 - 3A2 Agriculture/Livestock

Categories	Activity data	Emissions	
		CH_4	N_2O
	(number of animals)	(Gg)	
3A Livestock		75.04	0.44
3A1 Enteric Fermentation		54.82	
3A1a Cattle	738,774	43.76	
3A1ai Dairy Cows	46,238	3.14	
3A1aii Other Cattle	692,536	40.62	
3A1b Buffalo	119,133	6.55	
3A1c Sheep	138,479	0.69	
3A1d Goats	416,529	2.08	
3A1e Camels	NE	NE	
3A1f Horses	4,145	0.07	
3A1g Mules and Asses	NE	NE	
3A1h Swine	1,654,381	1.65	
3A1j Other (please specify)	NO	NO	
3A2 Manure Management		20.23	0.44
3A2a Cattle	738,774	2.29	0.09
3A2ai Dairy Cows	46,238	1.43	0.01
3A2aii Other Cattle	692,536	0.86	0.09
3A2b Buffalo	119,133	0.24	0.00
3A2c Sheep	138,479	0.03	0.01
3A2d Goats	416,529	0.09	0.02
3A2e Camels	NE	NE	NE
3A2f Horses	4,145	0.01	0.00
3A2g Mules and Asses	NE	NE	NE
3A2h Swine	1,654,381	11.58	0.02
3A2i Poultry	299,299,187	5.99	0.28
3A2j Other (please specify)	NO	NO	NO

Table B9b: AFOLU Background Table for GHG Inventory Year 2016 - 3B Carbon Stock Changes in FOLU (1 of 2)

Categories	Activity Data		Net carbon stock change and CO_2 emissions									Net CO_2 emissions
			Biomass				Dead organic matter			Soils		
	Total Area	Thereof: Area of organic soils	Increase	Decrease	Carbon emitted as CH_4 and CO from fires	Net carbon stock change	Carbon stock change	Carbon emitted as CH_4 and CO from fires	Net carbon stock change	Net carbon stock change in mineral soils	Carbon loss from drained organic soils	
	(ha)		(Gg C)									(Gg CO_2)
3B Land	30,065,422.00	1,577,457.00	112,801.16	33,971.93	0.00	73,987.44	0.00	0.00	0.00	0.00	8,153.045	-241,392.811
3B1 Forest land	17,661,716.00	517,947.00	75,525.18	8,818.90	0.00	66,706.28	0.00	0.00	0.00	0.00	206.72	243,831.7127
3B1a Forest land Remaining Forest Land	17,661,716.00	517,947.00	75,525.18	8,818.90	0.00	66,706.28	0.00	0.00	0.00	0.00	206.72	243,831.7127
3B1b 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
3B1bi 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
3B1bii Grassland converted to Forest Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3B1biii Wetlands converted to Forest Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3B1biv Settlements converted to Forest Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3B1bv Other Land converted to Forest Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3B2 Cropland	7,892,909.00	1,059,510.00	37,275.99	25,153.03	0.00	12,122.96	0.00	0.00	0.00	0.00	7,946.325	-1,5314.31
3B2a Cropland Remaining Cropland	7,892,909.00	1,059,510.00	37,275.99	25,153.03	0.00	12,122.96	0.00	0.00	0.00	0.00	7,946.325	-1,5314.31
3B2b Land Converted to Cropland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3B2bi Forest Land converted to Cropland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3B2bii Grassland converted to Cropland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3B2biii Wetlands converted to Cropland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3B2biv Settlements converted to Cropland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3B2bv Other Land converted to Cropland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3B3 Grassland	100,000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3B3a Grassland Remaining Grassland	100,000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3B3b 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
3B3bi Forest Land converted to Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3B3bii Cropland converted to Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table B9b: AFOLU Background Table for GHG Inventory Year 2016 - 3B Carbon Stock Changes in FOLU (2 of 2)

Categories	Activity Data		Net carbon stock change and CO_2 emissions									Net CO_2 emissions
	Total Area	Thereof: Area of organic soils	Biomass				Dead organic matter			Soils		
			Increase	Decrease	Carbon emitted as CH4 and CO from fires	Net carbon stock change	Carbon stock change	Carbon emitted as CH_4 and CO from fires	Net carbon stock change	Net carbon stock change in mineral soils	Carbon loss from drained organic soils	
	(ha)		(Gg C)									(Gg CO_2)
3B3biii Wetlands converted to Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3B3biv Settlements converted to Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3B3bv Other Land converted to Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3B4 Wetlands												
3B5 Settlements	4,410,797.00	0.00	0.00	0.00	0.00	-4,841.79	0.00	0.00	0.00	0.00	0.00	17,753.21
3B5a Settlements Remaining Settlements	4,262,827.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3B5b Land Converted to Settlements	147,970.00	0.00	0.00	4,841.79	0.00	-4,841.79	0.00	0.00	0.00	0.00	0.00	17,753.21
3B5bi Forest Land converted to Settlements	147,970.00	0.00	0.00	4,841.79	0.00	-4,841.79	0.00	0.00	0.00	0.00	0.00	17,753.21
3B5bii Cropland converted to Settlements	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3B5biii Grassland converted to Settlements	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3B5biv Wetlands converted to Settlements	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3B5bv Other Land converted to Settlements	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3B6 Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3B6a Other land Remaining Other land	NO	NO			NO			NO				
3B6b Land Converted to Other land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3B6bi Forest Land converted to Other Land	NO	NO	NO	NO	NO	NO		NO	NO	NO	NO	NO
3B6bii Cropland converted to Other Land	NO	NO	NO	NO	NO	NO		NO	NO	NO	NO	NO
3B6biii Grassland converted to Other Land	NO	NO	NO	NO	NO	NO		NO	NO	NO	NO	NO
3B6biv Wetlands converted to Other Land	NO	NO	NO	NO	NO	NO		NO	NO	NO	NO	NO
3B6bv Settlements converted to Other Land	NO	NO	NO	NO	NO	NO		NO	NO	NO	NO	NO

Table B9c: AFOLU Background Table for GHG Inventory Year 2016 - Emissions in Wetlands (3B4)

Categories	Activity Data	Emissions		
	Area (ha)	CO_2 (Gg)	CH_4 (Gg)	N_2O (Gg)
3B4 Wetlands	0	0	0	0
3B4a Wetlands Remaining Wetlands	0	0	0	0
3B4ai Peatlands remaining peatlands		0		0
3B4aii Flooded land remaining flooded land				
3B4b Land Converted to Wetlands	0	0	0	0
3B4bi Land converted for peat extraction				0
3B4bii Land converted to flooded land		0		
3B4biii Land converted to other wetlands				

Table B9d: AFOLU Background Table for GHG Inventory Year 2016 - Biomass Burning (3C1) (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		
					Bio-mass	DOM		Bio-mass	DOM		Bio-mass	DOM
		(ha or kg dm)			(Gg)						(C Gg)	
3C1 Biomass Burning			41,462.69	0.00	1.16	0.31	0.07	33.85	10.43	2.62	1.23	4.70
3C1a Biomass Burning in Forest Land				0.00	1.16	0.00	0.06	33.85	0.00	2.33	1.23	0.00
Controlled Burning				NO	NO	NO	NO	NO	NO	NO	NO	NO
Wildfires	Area burned	ha	20,845.99	0.00	1.16	0.00	0.06	33.85	0.00	2.33	1.23	0.00
3C1b Biomass Burning in Cropland				0.00	0.00	0.31	0.01	0.00	10.43	0.28	0.00	4.70
Biomass Burning in Cropland Remaining Cropland				0.00	0.00	0.31	0.01	0.00	10.43	0.28	0.00	4.70
Controlled Burning	Area burned	ha	20,616.70	NA	NA	0.31	0.01	NA	10.43	0.28	NA	4.70
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
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 B9d: AFOLU Background Table for GHG Inventory Year 2016 - Biomass Burning (3C1) (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		
					Bio-mass	DOM		Bio-mass	DOM		Bio-mass	DOM
		(ha or kg dm)			(Gg)						(C Gg)	
Biomass Burning in Forest Land Converted to 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
Biomass Burning in Non Forest Land Converted to 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 B9e: AFOLU Background Table for GHG Inventory Year 2016 – CO_2 Emissions from Liming (3C2)

Categories	Activity Data			Emissions
	Limestone $CaCO_3$	Dolomite $CaMg(CO_3)_2$	Total amount of lime categories applied	CO_2
	(Mg/yr)		(Mg/yr)	(Gg)
3C2 Liming	10,309.28	NE	10,309.28	4.54
Forest Land	NA	NA	NA	NA
Cropland	10,309.28	NE	10,309.28	4.54
Grassland	NA	NA	NA	NA
Wetland	NA	NA	NA	NA
Other Land	NA	NA	NA	NA
Other				

Table B9f: AFOLU Background Table for GHG Inventory Year 2016 – CO_2 Emissions from Urea Fertilisation (3C3)

Categories	Activity Data	Emissions
	Total amount of urea applied	CO_2
	(Mg/yr)	(Gg)
3C3 Urea applied	71,9034.72	527.29
Forest Land	NA	NA
Cropland	71,9034.72	527.29
Grassland	NA	NA
Settlements	NA	NA
Other Land	NA	NA

Table B9g: AFOLU Background Table for GHG Inventory Year 2016 - Direct N_2O Emissions from Managed Soils (3C4)

Categories	Activity Data	Emissions
	Total amount of nitrogen applied	N_2O
	(Gg N/yr)	(Gg)
3C4 Direct N_2O Emissions from Managed Soils	765.61	13.60
Inorganic N fertiliser Application	526.35	7.56
Forest Land	NA	NA
Cropland	526.35	7.56
Grassland	NA	NA
Settlements	NA	NA
Other Land	NA	NA
Organic N applied as fertilizer (Manure and Sewage Sludge)	68.13	1.07
Forest Land	NA	NA
Cropland	68.13	1.07
Grassland	NA	NA
Settlements	NA	NA
Other Land	NA	NA
Urine and dung N deposited on pasture, range and paddock by grazing animals	42.60	1.20
N in crop residues	128.53	1.77
	Area	
	(ha)	
N mineralisation/immobilisation associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soils	NA	NA
Drainage/management of organic soils (i.e., Histosols)	**1,059,510.00**	2.00

Table B9h: AFOLU Background Table for GHG Inventory Year 2016 - Indirect N_2O Emissions from Managed Soils and Manure Management (3C5 and 3C6)

Categories	Activity Data	Emissions
	Total amount of nitrogen applied / excreted	N_2O
	(Gg N/yr)	(Gg)
3C5 Indirect N_2O Emissions from managed soils	1,402.61	3.88
From atmospheric deposition of N volatilised from managed soils from agricultural inputs of N (synthetic N fertilisers; organic N applied as fertiliser; urine and dung N deposited on pasture, range and paddock by grazing animals; N in crop residues; and N mineralisation/immobilisation associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soils)	637.08	1.18
Forest Land	NA	NA
Cropland	637.08	1.18
Grasslands	NA	NA
Settlements	NA	NA
Other Land	NA	NA
From N leaching/runoff from managed soils (i.e. from synthetic N fertilizers; organic N applied as fertiliser; urine and dung N deposited on pasture, range and paddock by grazing animals; N in crop residues; and N mineralisation/immobilisation associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soils)	765.60	2.71
Forest Land	NA	NA
Cropland	765.60	2.71
Grasslands	NA	NA
Settlements	NA	NA
Other Land	NA	NA
3C6 Indirect N_2O Emissions from Manure Management	**262.41(excreted)**	**2.03**

Table B9i: AFOLU Background Table for GHG Inventory Year 2016 - Non-CO_2 GHG Emissions Not Included Elsewhere (3C7 and 3C8)

Categories	Activity Data	Emissions	
		CH_4	N_2O
	(ha)	(Gg)	
3C7 Rice Cultivations	688,769.00	90.61	0.00
3C8 Other (please specify)			

Table B9j: AFOLU Background Table for GHG Inventory Year 2016 - Harvested Wood Products (3D1) – Annual Carbon HWP Contribution to Total AFOLU CO_2 Removals and Emissions and Background Information (1 of 2)

Inventory Year	Variable Number										
	Gg C/yr									Gg CO_2/yr	
	1A Annual Change in stock of HWP in use from consump-tion	1B Annual Change in stock of HWP in SWDS from consump-tion	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	Annual Imports of wood, and paper products + wood fuel, pulp, recovered paper, roundwood/ chips	Annual Exports of wood, and paper products + wood fuel, pulp, recovered paper, roundwood/ chips	Annual Domes-tic Harvest	Annual release of carbon to the atmosphere from HWP consumption (from fuelwood & products in use and products in SWDS)	Annual release of carbon to the atmosphere from HWP (including fuelwood) where wood came from domestic harvest (from products in use and products in SWDS)	HWP Contributi on to AFOLU CO_2 emissions / removals	Approach used to estimate HWP Contribu-tion
	$\Delta C_{HWP\ IU\ DC}$	$\Delta C_{HWP\ SWDS\ DC}$	$\Delta C_{HWP\ IU\ DH}$	$\Delta C_{HWP\ SWDS\ DH}$	P_{IM}	P_{EX}	H	$\uparrow C_{HWP\ DC}$	$\uparrow C_{HWP\ DH}$		
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

Note: SC: stock change approach

Table B9j: AFOLU Background Table for GHG Inventory Year 2016 - Harvested Wood Products (3D1) – Annual Carbon HWP Contribution to Total AFOLU CO_2 Removals and Emissions and Background Information (2 of 2)

Inventory Year	Variable Number										
	Gg C/yr									Gg CO_2/yr	
	1A Annual Change in stock of HWP in use from consump-tion	1B Annual Change in stock of HWP in SWDS from consump-tion	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	Annual Imports of wood, and paper products + wood fuel, pulp, recovered paper, round-wood /chips	Annual Exports of wood, and paper products + wood fuel, pulp, recovered paper, round-wood/ chips	Annual Domestic Harvest	Annual release of carbon to the atmospher e from HWP consump-tion (from fuelwood & products in use and products in SWDS)	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)	HWP Contribution to AFOLU CO_2 emissions/ removals	Approach used to estimate HWP Contribution
	$\Delta C_{HWP\ IU\ DC}$	$\Delta C_{HWP\ SWDS\ DC}$	$\Delta C_{HWP\ IU\ DH}$	$\Delta C_{HWP\ SWDS\ DH}$	P_{IM}	P_{EX}	H	$\uparrow C_{HWP\ DC}$	$\uparrow C_{HWP\ DH}$		
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
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

Note: SC: stock change approach

Table B10a: Waste Background Table for GHG Inventory Year 2016 – CO_2, CH_4, N_2O Emissions

Categories	Type of 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							448.57	NA, NO
4A1 Managed Waste Disposal Sites	675.52	Gg		1.00	NA		22.43	NA
4A2 Unmanaged Waste Disposal Sites	12,834.93	Gg		0.80	NA		426.14	NA
4A3 Uncategorised Waste Disposal Sites	NO	Gg		0.60	NO		NO	NO
4B Biological Treatment of Solid Waste	2.49	Gg		4.00	0.24		0.01	0.00
4C Incineration and Open Burning of Waste						31.06	0.08	0.01
4C1 Waste Incineration	60.21	Gg				30.36	-	0.01
Hazardous Waste	43.92	Gg	0.48	0	0.00	21.04	-	0.00
Clinical Waste	16.29	Gg	0.57	0	0.00	9.32	-	0.00
Fossil Liquid Waste	0.00	Gg	2.93	NA	NA	0.01	NA	NA
4C2 Open Burning of Waste	11.85	Gg	0.06	0.01	0.00	0.70	0.08	0.00
4D Wastewater Treatment and Discharge							621.44	1.26
4D1 Domestic Wastewater Treatment and Discharge							64.33	1.26
CH_4 Emissions	502,972,650.00	kg					64.33	
Centralized Aerobic Treatment Plant	318,661,340.24	kg		0			0.00	
Septic Tank	86,714,496.75	kg		0.00			24.97	
Latrine 3 (Pour Flush)	97,596,813.01	kg		0.00			39.35	
Sea, River and Lake Discharge	0.00	kg		0.00			0.00	
N_2O Emissions	160,566,584.64	kg			0.00			1.26
4D2 Industrial Wastewater Treatment and Discharge							557.12	NA
CH_4 Emissions	3,229,744,342.75	kg					557.12	
Palm Oil Mill Effluent	2,799,644,962.00	kg		0.00			550.66	
Natural Rubber (SMR/Latex)	21,228,927.75	kg		0.00			4.25	
Pulp and Paper	319,770,000.00	kg		0.00			1.10	
Petroleum Refineries	14,726.00	kg		0.00			0.00	
Meat & Poultry	89,085,727.00	kg		0.00			1.11	
N_2O Emissions	NA	kg			NA			NA
4E Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO

Table B10b: Waste Background Table for GHG Inventory Year 2016 – CH_4 Recovery

Categories	Unit	CH_4	
	Gg CH_4	Flared	Energy Recovery
4A Solid Waste Disposal	14.67		14.67
4B Biological Treatment of Solid Waste			
4C Incineration and Open Burning of Waste			
4D Wastewater Treatment and Discharge	79.26	26.42	52.84
4D1 Domestic Wastewater Treatment and Discharge			
4D2 Industrial Wastewater Treatment and Discharge	79.26	26.42	52.84
4E Other (please specify)			

Table B10c: Waste Background Table for GHG Inventory Year 2016 - Long-term Storage of Carbon Information Items

Categories	C
	(Gg)
Information Items	
Long-term storage of carbon in waste disposal sites	16.17
Annual change in total long-term storage of carbon stored	12.53
Annual change in long-term storage of carbon in HWP waste	3.64

Table B11: Cross-sectoral Table for GHG Inventory Year 2016 – Indirect Emissions of N_2O

Categories	Activity data/Source emissions		Emissions
	Emissions NH_3 (Gg NH_3)	Emissions NOx (Gg NO_2-equivalents)	N_2O (Gg N_2O)
1 Energy	NO	1,010.28	NE
2 Industrial Processes and Product Use	0.01	1.97	NE
3 Agriculture, Forestry and Other Land Use	NE	NE	NE
3C5 Indirect N_2O Emissions from managed soils	NE	NE	NE
3C6 Indirect N_2O Emissions from manure management	NE	NE	NE
Other (Biomass Burning)	NO	0.28	NE
4 Waste	NA	0.00	NE
5 Other (Please specify)	NO	NO	NO

Table B12: Trends of CO_2 (Gigagrams) (1 of 14)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Total National Emissions and Removals	**-30,365.70**	**-113,255.43**	**-93,676.70**	**-125,497.16**	**13,063.55**	**-116,943.68**	**-115,083.42**	**-101,472.54**	**-112,916.26**	**-120,538.44**	**-45,830.17**	**-81,236.95**	**-83,570.50**
1 ENERGY	60,793.62	70,393.09	76,220.20	75,301.52	81,494.74	83,576.11	97,016.66	113,537.58	102,583.90	114,273.55	124,259.04	130,070.29	137,130.91
1A Fuel Combustion Activities	59,070.82	68,598.85	74,400.85	73,475.63	79,634.64	81,582.04	94,978.33	111,500.06	100,535.18	112,385.04	122,474.78	128,172.92	135,124.43
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	54,615.10	60,006.07	62,588.92	66,192.37
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	23,071.71	25,891.29	26,343.90	28,470.96
1A3 Transport	14,528.47	15,633.69	16,714.74	17,394.69	19,213.61	20,438.32	23,341.22	26,873.02	25,102.01	30,350.11	32,141.77	34,896.16	35,713.47
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	4,225.56	4,298.32	4,199.18	4,575.42
1A5 Non-Specified	56.86	61.77	67.50	74.13	82.63	94.58	108.34	120.23	126.18	122.56	137.33	144.76	172.22
1B Fugitive Emissions from Fuels	1,722.80	1,794.24	1,819.36	1,825.89	1,860.10	1,994.06	2,038.32	2,037.53	2,048.71	1,888.52	1,784.26	1,897.36	2,006.48
1B1 Solid Fuels	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1B2 Oil and Natural Gas	1,722.80	1,794.24	1,819.36	1,825.89	1,860.10	1,994.06	2,038.32	2,037.53	2,048.71	1,888.52	1,784.26	1,897.36	2,006.48
1B3 Other emissions from Energy Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1C Carbon Dioxide Transport and Storage	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
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	8,630.27	10,473.51	10,472.19	11,973.41
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	5,786.90	6,911.77	6,685.39	7,480.14
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	5,479.60	6,587.95	6,327.25	7,145.68
2A2 Lime Production	77.50	85.00	92.50	100.00	107.50	115.00	122.50	130.00	137.50	145.00	153.00	159.00	168.00

Table B12: Trends of CO_2 (Gigagrams) (2 of 14)

Categories	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total National Emissions and Removals	**-76,817.36**	**-52,279.74**	**-9,531.30**	**-42,434.83**	**-9,332.77**	**-17,495.45**	**-37,086.00**	**-20,162.52**	**-25,146.39**	**-24,475.69**	**-20,832.61**	**-18,952.16**	**-48.77**	**4,430.47**
1 ENERGY	149,113.73	162,370.82	174,709.74	173,411.02	188,656.18	195,671.06	186,202.70	200,130.83	199,217.47	215,863.40	222,210.20	228,457.69	231,335.28	224,452.63
1A Fuel Combustion Activities	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	214,159.46	220,533.56	226,728.76	229,446.95	222,510.48
1A1 Energy Industries	75,164.74	81,484.98	91,750.26	92,979.81	101,019.60	107,367.35	104,918.68	119,138.35	121,730.90	126,714.18	129,331.89	133,097.15	137,225.95	130,923.78
1A2 Manufacturing Industries and Construction	29,618.13	33,358.89	35,197.35	33,870.18	37,254.40	36,394.15	31,022.13	26,066.98	23,261.78	27,334.61	24,865.05	22,906.47	25,185.96	23,855.75
1A3 Transport	38,018.34	40,844.55	40,766.80	38,992.41	41,367.91	43,414.22	42,543.91	43,918.12	44,470.74	51,975.31	58,204.44	63,019.56	59,944.13	61,904.10
1A4 Other Sectors	4,008.18	4,281.44	4,621.39	5,258.46	6,789.51	6,216.41	5,534.53	8,809.61	7,835.90	7,526.67	7,657.03	7,195.28	6,582.81	5,318.94
1A5 Non-Specified	175.31	208.83	279.22	314.82	249.36	287.43	275.82	313.84	249.29	608.69	475.15	510.30	508.09	507.91
1B Fugitive Emissions from Fuels	2,129.03	2,192.12	2,094.72	1,995.35	1,975.40	1,991.50	1,907.62	1,883.93	1,668.86	1,703.94	1,676.64	1,728.93	1,888.34	1,942.15
1B1 Solid Fuels	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1B2 Oil and Natural Gas	2,129.03	2,192.12	2,094.72	1,995.35	1,975.40	1,991.50	1,907.62	1,883.93	1,668.86	1,703.94	1,676.64	1,728.93	1,888.34	1,942.15
1B3 Other emissions from Energy Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1C Carbon Dioxide Transport and Storage	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2 INDUSTRIAL PROCESSES AND PRODUCT USE	13,394.73	13,501.58	13,102.13	13,936.21	13,932.78	14,533.04	14,650.48	13,885.36	14,239.73	15,734.39	15,483.45	15,814.69	16,209.61	20,807.77
2A Mineral Industry	8,209.94	8,196.90	8,062.24	8,603.50	8,345.58	8,863.22	8,385.92	7,413.25	8,105.37	8,504.81	9,368.97	9,856.73	8,981.14	13,415.57
2A1 Cement Production	7,731.19	7,774.56	7,615.98	8,135.97	7,872.29	8,416.13	7,929.97	7,059.11	7,766.20	8,111.04	8,793.36	9,467.91	8,672.60	9,125.80
2A2 Lime Production	286.50	239.25	239.24	239.23	239.21	239.20	239.19	160.55	139.19	133.86	134.12	130.65	131.33	77.00

Table B12: Trends of CO_2 (Gigagrams) (3 of 14)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
2A3 Glass Production	17.10	17.88	18.65	19.43	20.21	20.98	21.76	22.53	23.31	24.09	24.86	25.64	26.42
2A4 Other Process Uses of Carbonates	102.67	121.51	74.54	125.99	129.77	128.78	153.72	143.04	117.62	138.21	145.96	173.51	140.05
2A5 Other (please specify)	NO	NO	NO	NO	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	1,956.77	2,401.73	2,742.00	3,373.53
2B1 Ammonia Production	132.00	199.49	213.95	207.01	235.64	227.09	225.81	179.01	241.74	285.30	400.70	635.88	891.16
2B2 Nitric Acid Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2B3 Adipic Acid Production	NO	NO	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	NO	NO
2B5 Carbide Production	27.74	27.35	26.97	26.58	26.19	25.81	25.42	25.03	24.65	24.26	23.15	24.93	22.38
2B6 Titanium Dioxide Production	NO	NO	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	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	1,647.22	1,977.89	2,081.18	2,459.98
2B9 Fluorochemical Production													
2B10 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C Metal Industry	558.49	522.30	511.83	584.30	838.44	1,020.60	1,077.20	1,277.16	766.82	886.60	1,160.00	1,044.80	1,119.74
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	886.60	1,160.00	1,044.80	1,119.74
2C2 Ferroalloys Production	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

Table B12: Trends of CO_2 (Gigagrams) (4 of 14)

Categories	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
2A3 Glass Production	25.98	29.99	28.34	29.11	32.54	31.07	29.65	29.25	29.06	29.56	30.73	28.44	29.73	28.71
2A4 Other Process Uses of Carbonates	166.26	153.11	178.68	199.19	201.54	176.82	187.12	164.36	170.92	230.35	410.75	229.73	147.48	4,184.05
2A5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B Chemical Industry	3,747.99	3,651.84	3,671.91	3,972.10	3,725.90	3,786.09	4,164.63	4,343.66	3,611.53	4,342.08	3,925.53	4,063.32	4,396.44	4,791.70
2B1 Ammonia Production	998.37	1,013.56	988.52	1,097.49	985.38	1,007.48	1,068.01	970.99	789.60	971.47	994.78	1,046.35	1,236.83	1,170.28
2B2 Nitric Acid Production	NA	NA	NA	NA	NA	NA	NO	NO	NO	NO	NO	NO	NO	NO
2B3 Adipic Acid Production	NO	NO	NO	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	NO	NO	NO
2B5 Carbide Production	68.20	51.70	49.49	47.28	45.06	42.85	40.64	38.43	36.22	38.02	38.02	38.02	38.02	38.02
2B6 Titanium Dioxide Production	NO	NO	NO	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	NO	NO	NO
2B8 Petrochemical and Carbon Black Production	2,681.42	2,586.58	2,633.90	2,827.34	2,695.46	2,735.76	3,055.98	3,334.25	2,785.72	3,332.60	2,892.73	2,978.96	3,121.59	3,583.40
2B9 Fluorochemical Production														
2B10 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C Metal Industry	1,436.80	1,652.84	1,367.98	1,360.62	1,861.30	1,883.74	2,099.92	2,128.44	2,522.83	2,887.50	2,188.95	1,894.64	2,832.04	2,600.51
2C1 Iron and Steel Production	1,436.80	1,652.84	1,367.98	1,360.62	1,861.30	1,883.74	2,099.92	2,128.44	2,522.73	2,311.50	1,612.95	1,318.64	1,616.04	1,384.51
2C2 Ferroalloys Production	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

Table B12: Trends of CO_2 (Gigagrams) (5 of 14)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
2C3 Aluminium Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C4 Magnesium production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C5 Lead Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C6 Zinc Production	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
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	NE, NO	NE, NO
2D1 Lubricant Use	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2D2 Paraffin Wax Use	NE	NE	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	NO	NO
2E Electronics Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA, NO	NA, NO	NA, NO
2E1 Integrated Circuit or Semiconductor	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	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	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	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	NA, NE	NA, NE

Table B12: Trends of CO_2 (Gigagrams) (6 of 14)

Categories	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
2C3 Aluminium Production	NO	NO	NO	NO	NO	NO	NO	NO	0.10	576.00	576.00	576.00	1,216.00	1,216.00
2C4 Magnesium production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C5 Lead Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C6 Zinc 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
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	NE, NO	NE, NO	NE, NO
2D1 Lubricant Use	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2D2 Paraffin Wax Use	NE	NE	NE	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	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	NA, NO	NA, NO	NA, NO
2E1 Integrated Circuit or Semiconductor	NA	NA	NA	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	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	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	NA, NE	NA, NE	NA, NE

Table B 12: Trends of CO_2 (Gigagrams) (7 of 14)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
2F2 Foam Blowing Agents	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
2F4 Aerosols													
2F5 Solvents													
2F6 Other Applications	NO	NO	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	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	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	NE,NO	NE,NO
2H1 Pulp and Paper Industry	NE	NE	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	NE	NE
2H3 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3 AGRICULTURE, FORESTRY AND OTHER LAND USE	-95,435.37	-188,125.60	-174,234.67	-205,414.61	-73,927.45	-206,478.57	-220,053.34	-223,613.27	-223,778.39	-243,457.12	-180,577.44	-221,794.06	-232,695.18
3A Livestock													
3A1 Enteric Fermentation													

Table B12: Trends of CO_2 (Gigagrams) (8 of 14)

Categories	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
2F2 Foam Blowing Agents	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
2F4 Aerosols														
2F5 Solvents														
2F6 Other Applications	NO	NO	NO	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	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	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	NE,NO	NE, NO	NE, NO
2H1 Pulp and Paper Industry	NE	NE	NE	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	NE	NE	NE
2H3 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3 AGRICULTURE, FORESTRY AND OTHER LAND USE	-239,344.35	-228,175.53	-197,373.55	-229,809.87	-211,956.68	-227,734.60	-237,970.94	-234,210.49	-238,636.47	-256,106.52	-258,561.13	-263,263.51	-247,632.09	-240,860.98
3A Livestock														
3A1 Enteric Fermentation														

Table B12: Trends of CO_2 (Gigagrams) (9 of 14)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
3A2 Manure Mngmt													
3B Land	-95,732.23	-188,301.57	-174,420.93	-205,785.86	-74,321.11	-206,705.33	-220,268.81	-223,920.75	-224,122.15	-243,825.37	-180,945.50	-222,078.95	-233,047.64
3B1 Forest Land	-183,616.22	-182,971.36	-173,562.15	-188,055.81	-188,115.79	-188,818.89	-197,612.71	-200,368.20	-217,764.61	-219,056.67	-213,414.57	-220,428.04	-229,689.79
3B2 Cropland	-23,098.68	-23,425.21	-23,692.94	-23,520.45	-23,727.32	-23,449.36	-23,876.22	-24,772.67	-25,190.12	-25,988.83	-21,829.72	-22,172.37	-22,907.35
3B3 Grassland	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,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	IE,NA,NO	IE,NA,NO
3B5 Settlements	110,982.67	18,095.00	22,834.17	5,790.40	137,522.00	5,562.92	1,220.12	1,220.12	18,832.59	1,220.12	54,298.79	20,521.45	19,549.49
3B6 Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3C Aggregate sources and Non-CO_2 Emissions Sources on Land	296.87	175.97	186.26	371.25	393.66	226.76	215.47	307.47	343.76	368.26	368.06	284.90	352.47
3C1 Emissions from Biomass Burning	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3C2 Liming	NE	NE	NE	NE	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	368.26	368.06	284.90	352.47
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													
3C8 Other (please specify)	NO	NO	NO	NO	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	NE, NO	NE, NO	NE, NO	NE, NO
3D1 Harvested Wood Products	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
3D2 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table B12: Trends of CO_2 (Gigagrams) (10 of 14)

Categories	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
3A2 Manure Mngmt.														
3B Land	-239,700.76	-228,603.86	-197,948.62	-230,274.19	-212,608.91	-228,475.39	-238,397.08	-234,696.02	-239,025.78	-256,763.91	-259,128.55	-263,847.86	-248,188.00	-241,392.81
3B1 Forest Land	-221,437.09	-216,131.87	-215,305.31	-219,477.81	-213,751.85	-218,073.26	-220,526.30	-224,058.50	-227,477.70	-244,526.36	-247,723.56	-252,612.56	-235,702.17	-243,831.71
3B2 Cropland	-23,585.32	-20,378.65	-18,612.73	-18,703.04	-19,378.51	-19,342.79	-19,090.91	-15,200.90	-15,108.49	-14,503.44	-14,513.67	-14,535.21	-14,685.97	-15,314.31
3B3 Grassland	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA, 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	IE,NA,NO	IE, NA, NO	IE, NA, NO
3B5 Settlements	5,321.65	7,906.65	35,969.41	7,906.65	20,521.45	8,940.65	1,220.12	4,563.39	3,560.41	2,265.89	3,108.68	3,299.90	2,200.13	17,753.21
3B6 Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3C Aggregate sources and Non-CO_2 Emissions Sources on Land	356.41	428.33	575.07	464.32	652.23	740.80	426.14	485.53	389.31	657.39	567.42	584.35	555.92	531.83
3C1 Emissions from Biomass Burning	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3C2 Liming	NE	NE	NE	NE	NE	NE	NE	NE	9.07	9.07	9.07	9.07	9.07	4.54
3C3 Urea Application	356.41	428.33	575.07	464.32	652.23	740.80	426.14	485.53	380.24	648.31	558.35	575.28	546.84	527.29
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 Cultivation														
3C8 Other (please specify)	NO	NO	NO	NO	NO	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	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
3D1 Harvested Wood Products	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
3D2 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table B12: Trends of CO_2 (Gigagrams) (11 of 14)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
4 WASTE	0.77	0.79	0.79	0.80	0.80	0.80	0.80	0.80	8.18	14.85	14.73	14.63	20.35
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	14.85	14.73	14.63	20.35
4C1 Waste Incineration	NO	NO	NO	NO	NO	NO	NO	NO	7.39	14.06	13.95	13.85	19.57
4C2 Open Burning of Waste	0.77	0.79	0.79	0.80	0.80	0.80	0.80	0.80	0.79	0.79	0.78	0.78	0.78
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	NO	NO	NO	NO
5 OTHER	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5A Indirect N_2O Emissions from the Atmospheric Deposition of Nitrogen in NOx and NH_3													
5B Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table B12: Trends of CO_2 (Gigagrams) (12 of 14)

Categories	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
4 WASTE	18.53	23.39	30.38	27.80	34.94	35.04	31.76	31.78	32.88	33.04	34.87	38.97	38.42	31.06
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	18.53	23.39	30.38	27.80	34.94	35.04	31.76	31.78	32.88	33.04	34.87	38.97	38.42	31.06
4C1 Waste Incineration	17.76	22.62	29.61	27.04	34.19	34.29	31.02	31.05	32.16	32.32	34.15	38.26	37.72	30.36
4C2 Open Burning of Waste	0.77	0.77	0.77	0.76	0.75	0.75	0.74	0.73	0.72	0.72	0.72	0.71	0.70	0.70
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	NO	NO	NO	NO	NO
5 OTHER	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5A Indirect N_2O Emissions from the Atmospheric Deposition of Nitrogen in NOx and NH_3														
5B Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table B12: Trends of CO_2 (Gigagrams) (13 of 14)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Memo items													
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	4,576.79	4,356.09	4,602.82	4,447.49
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	3,322.79	3,672.80	4,111.48	4,165.15
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	1,254.01	683.29	491.34	282.34
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Information items													
CO_2 from Biomass Burning for Energy Production	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	203.90	203.90	210.60
CO_2 captured	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
For domestic storage	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
For storage in other countries	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Long-term storage of carbon in waste disposal sites	9.27	9.37	10.98	11.25	11.38	11.38	11.38	11.52	11.90	12.11	12.35	187.85	12.77
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	7.93	8.06	92.90	18.86
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	4.39	4.46	52.22	-0.76
Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table B12: Trends of CO_2 (Gigagrams) (14 of 14)

Categories	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Memo items														
International Bunkers	4,552.89	5,066.31	4,884.86	6,162.77	5,244.95	5,134.03	5,107.65	5,712.17	6,638.75	5,818.77	8,110.19	8,601.03	8,539.96	8,231.15
International Aviation (International Bunkers)	4,328.16	4,800.02	4,698.90	5,889.72	5,036.80	4,941.94	4,971.43	5,535.37	5,989.76	5,637.42	6,983.50	7,930.95	7,869.88	7,561.08
International Water-borne Transport (International Bunkers)	224.73	266.29	185.96	273.04	208.15	192.10	136.21	176.79	648.99	181.35	1,126.69	670.08	670.08	670.08
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Information items														
CO_2 from Biomass Burning for Energy Production	313.70	1,792.72	2,324.30	351.00	380.41	545.09	585.59	744.21	795.30	1,119.66	1,813.26	1,611.19	790.50	824.43
CO_2 captured	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
For domestic storage	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
For storage in other countries	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Long-term storage of carbon in waste disposal sites	14.10	13.64	202.22	-4.71	-5.48	0.53	-5.48	-7.75	-10.35	141.94	-36.71	12.15	25.01	16.17
Annual change in total long-term storage of carbon stored	18.97	19.53	146.99	12.01	12.11	17.06	13.92	12.61	11.05	135.08	-33.01	9.68	15.86	12.53
Annual change in long-term storage of carbon in HWP waste	-0.31	-0.89	57.05	-8.93	-9.43	-8.03	-10.56	-11.18	-12.00	24.83	-9.51	3.08	9.15	3.64
Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table B13: Trends of CH_4 (Gigagrams) (1 of 14)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Total National Emissions and Removals	**848.61**	**893.21**	**925.28**	**1,047.94**	**1,073.69**	**1,167.77**	**1,270.06**	**1,372.91**	**1,357.01**	**1,467.79**	**1,553.91**	**1,606.34**	**1,623.97**
1 ENERGY	248.23	288.85	307.72	386.50	407.29	476.72	552.96	621.81	631.81	665.04	731.93	745.84	745.24
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	13.22	13.69
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	1.29	1.42
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	1.13	1.20
1A3 Transport	4.36	4.71	5.00	5.45	6.14	6.63	7.62	8.34	8.55	9.98	9.64	10.36	10.60
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	0.42	0.45
1A5 Non-Specified	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1B Fugitive Emissions from Fuels	242.27	282.32	300.66	379.11	399.04	467.86	542.69	610.53	620.74	652.55	719.44	732.62	731.55
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	0.32	0.27
1B2 Oil and Natural Gas	242.18	282.25	300.59	378.90	398.89	467.76	542.62	610.43	620.47	652.30	719.14	732.29	731.29
1B3 Other emissions from Energy Production	NA	NA	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	6.43	8.50
2A Mineral 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	NA,NE,NO	NA,NE,NO
2A1 Cement Production	NA	NA	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	NA	NA

Table B13: Trends of CH_4 (Gigagrams) (2 of 14)

Categories	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total National Emissions and Removals	**1,711.36**	**1,821.61**	**1,955.99**	**1,995.99**	**2,051.57**	**2,163.57**	**2,135.44**	**2,193.28**	**2,233.30**	**2,170.86**	**2,228.09**	**2,240.98**	**2,254.08**	**2,288.44**
1 ENERGY	762.24	833.69	918.55	896.01	930.64	962.59	928.11	1,002.90	993.88	935.32	965.02	951.86	938.11	1,037.70
1A Fuel Combustion Activities	14.54	15.97	17.02	15.54	17.49	18.15	17.78	19.38	17.66	21.36	23.92	24.08	24.01	24.59
1A1 Energy Industries	1.59	2.08	2.44	1.81	1.89	1.99	1.94	2.13	2.34	2.31	2.53	2.46	2.31	2.32
1A2 Manufacturing Industries and Construction	1.25	1.39	1.46	1.41	1.55	1.60	1.42	1.28	1.15	1.30	1.15	1.10	1.21	1.14
1A3 Transport	11.28	12.07	12.66	11.79	13.31	13.90	13.86	14.95	13.30	16.89	19.39	19.73	19.77	20.59
1A4 Other Sectors	0.39	0.41	0.44	0.51	0.71	0.63	0.54	0.99	0.85	0.82	0.82	0.77	0.70	0.51
1A5 Non-Specified	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.04	0.02	0.02	0.02	0.02
1B Fugitive Emissions from Fuels	747.70	817.72	901.53	880.46	913.15	944.45	910.32	983.52	976.23	913.96	941.10	927.78	914.10	1,013.11
1B1 Solid Fuels	0.28	0.54	0.99	0.95	1.30	1.68	1.78	1.68	2.28	1.08	1.96	1.27	0.91	0.79
1B2 Oil and Natural Gas	747.42	817.18	900.54	879.51	911.85	942.77	908.54	981.84	973.95	912.88	939.14	926.51	913.19	1,012.33
1B3 Other emissions from Energy Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1C Carbon Dioxide Transport and Storage														
2 INDUSTRIAL PROCESSES AND PRODUCT USE	10.06	9.76	9.46	10.42	10.41	10.72	12.34	13.50	11.79	12.98	10.23	10.61	11.65	13.52
2A Mineral 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	NA,NE,NO	NA, NE, NO	NA, NE, NO
2A1 Cement Production	NA	NA	NA	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	NA	NA	NA

Table B13: Trends of CH_4 (Gigagrams) (3 of 14)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
2A3 Glass Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2A4 Other Process Uses of Carbonates	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
2A5 Other (please specify)	NO	NO	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	5.41	7.44
2B1 Ammonia Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2B2 Nitric Acid Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2B3 Adipic Acid Production	NO	NO	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	NO	NO
2B5 Carbide Production	NA	NA	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	NO	NO
2B7 Soda Ash Production	NO	NO	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	5.41	7.44
2B9 Fluorochemical Production													
2B10 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
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	1.02	1.06
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	1.02	1.06
2C2 Ferroalloys Production	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

Table B13: Trends of CH_4 (Gigagrams) (4 of 14)

Categories	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
2A3 Glass Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2A4 Other Process Uses of Carbonates	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
2A5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B Chemical Industry	8.46	8.05	8.11	9.14	8.54	8.76	9.95	11.11	8.97	11.01	9.22	10.02	10.70	12.87
2B1 Ammonia Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2B2 Nitric Acid Production	NA	NA	NA	NA	NA	NA	NO	NO	NO	NO	NO	NO	NO	NO
2B3 Adipic Acid Production	NO	NO	NO	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	NO	NO	NO
2B5 Carbide Production	NA	NA	NA	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	NO	NO	NO
2B7 Soda Ash Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B8 Petrochemical and Carbon Black Production	8.46	8.05	8.11	9.14	8.54	8.76	9.95	11.11	8.97	11.01	9.22	10.02	10.70	12.87
2B9 Fluorochemical Production														
2B10 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C Metal Industry	1.60	1.71	1.35	1.28	1.87	1.96	2.39	2.39	2.82	1.97	1.00	0.59	0.96	0.66
2C1 Iron and Steel Production	1.60	1.71	1.35	1.28	1.87	1.96	2.39	2.39	2.82	1.97	1.00	0.59	0.96	0.66
2C2 Ferroalloys Production	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

Table B13: Trends of CH_4 (Gigagrams) (5 of 14)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
2C3 Aluminium Production	NO	NO	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	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	NE,NO	NE,NO
2D1 Lubricant Use													
2D2 Paraffin Wax Use	NE	NE	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	NO	NO
2E Electronics Industry	NO	NO	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	NO	NO
2F Product Uses as Substitutes for Ozone Depleting Substances	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F1 Refrigeration and Air Conditioning													

Table B13: Trends of CH_4 (Gigagrams) (6 of 14)

Categories	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
2C3 Aluminium Production	NO	NO	NO	NO	NO	NO	NO	NO	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	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	NE, NO	NE, NO	NE, NO
2D1 Lubricant Use														
2D2 Paraffin Wax Use	NE	NE	NE	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	NO	NO	NO
2E Electronics Industry	NO	NO	NO	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	NO	NO	NO
2F Product Uses as Substitutes for Ozone Depleting Substances	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F1 Refrigeration and Air Conditioning														

Table B13: Trends of CH_4 (Gigagrams) (7 of 14)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
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	NO	NO
2G Other Product Manufacture and Use	NO	NO	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	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	NE, NO	NE, NO
2H1 Pulp and Paper Industry	NE	NE	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	NE	NE
2H3 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3 AGRICULTURE, FORESTRY AND OTHER LAND USE	161.56	159.50	161.29	163.36	170.07	168.26	165.13	169.37	167.80	159.36	160.55	159.01	158.92
3A Livestock	78.18	75.85	76.98	77.66	84.49	83.58	80.08	82.16	81.24	72.27	73.59	75.18	73.51
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	55.92	53.34

Table B13: Trends of CH_4 (Gigagrams) (8 of 14)

Categories	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
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	NO	NO	NO
2G Other Product Manufacture and Use	NO	NO	NO	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	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	NE, NO	NE, NO	NE, NO
2H1 Pulp and Paper Industry	NE	NE	NE	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	NE	NE	NE
2H3 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3 AGRICULTURE, FORESTRY AND OTHER LAND USE	161.37	163.81	163.93	164.79	168.66	168.12	169.76	169.11	164.49	162.25	160.81	166.04	166.48	167.11
3A Livestock	76.44	79.42	78.45	78.50	82.52	83.09	82.74	82.52	77.62	76.59	77.21	77.15	77.12	75.04
3A1 Enteric Fermentation	55.73	58.17	58.08	57.98	61.81	62.61	63.01	61.74	57.47	55.83	56.07	55.65	55.33	54.82

Table B13: Trends of CH_4 (Gigagrams) (9 of 14)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
3A2 Manure Mngmt	21.99	19.46	21.89	21.85	26.24	26.47	25.20	27.60	25.07	17.86	18.43	19.25	20.15
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	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	IE,NA,NO	IE,NA,NO
3B2 Cropland	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA
3B3 Grassland	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
3B4 Wetlands	NA,NO	NA, NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,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	NA,NO	NA,NO
3B6 Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3C Aggregate sources and Non-CO_2 Emissions Sources on Land	83.39	83.66	84.31	85.70	85.57	84.68	85.05	87.21	86.56	87.09	86.96	83.83	85.41
3C1 Emissions from Biomass Burning	0.40	0.30	0.36	0.29	0.31	0.28	0.28	0.30	0.60	0.29	0.29	0.34	0.54
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	83.49	84.87
3C8 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3D Other	NO	NO	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	NO	NO

Table B13: Trends of CH_4 (Gigagrams) (10 of 14)

Categories	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
3A2 Manure Mngmt.	20.64	21.16	20.27	20.44	20.66	20.48	19.73	20.78	20.15	20.76	21.13	21.49	21.79	20.23
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	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	IE,NA,NO	IE, NA, NO	IE, NA, NO
3B2 Cropland	IE,NA	IE,NA	IE,NA	IE,NA	IE, NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE,NA	IE, NA	IE, NA
3B3 Grassland	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA, NO	NA, NO
3B4 Wetlands	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA, NO	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	NA,NO	NA, NO	NA, NO
3B6 Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3C Aggregate sources and Non-CO_2 Emissions Sources on Land	84.93	84.40	85.48	86.29	86.14	85.03	87.02	86.59	86.87	85.66	83.60	88.89	89.36	92.07
3C1 Emissions from Biomass Burning	0.53	0.53	0.75	0.54	0.54	0.29	0.58	0.76	0.29	0.36	0.54	0.80	0.35	1.46
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 Cultivation	84.39	83.87	84.73	85.75	85.60	84.74	86.44	85.83	86.59	85.30	83.06	88.08	89.01	90.61
3C8 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3D Other	NO	NO	NO	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	NO	NO	NO

Table B13: Trends of CH_4 (Gigagrams) (11 of 14)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
4 WASTE	438.15	444.24	455.71	497.45	495.37	521.62	547.68	576.65	552.87	638.74	655.44	695.06	711.31
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	189.15	202.98
4A1 Managed Waste Disposal Sites	NO	NO	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	NO	NO
4A3 Uncategorised Waste Disposal Sites	139.05	143.23	147.39	151.64	156.00	160.44	164.97	169.56	174.22	178.95	183.77	188.68	202.47
4B Biological Treatment of Solid Waste	NO	0.00	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	0.09	0.09
4C1 Waste Incineration	NO	NO	NO	NO	NO	NO	NO	NO	0.00	0.00	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	0.09	0.09
4D Wastewater Treatment and Discharge	298.67	300.57	307.87	345.34	338.90	360.68	382.21	406.58	378.13	459.26	471.12	505.83	508.24
4D1 Domestic Wastewater Treatment and Discharge	67.37	67.63	66.94	67.27	67.63	68.10	68.53	69.04	68.59	69.19	69.75	69.92	68.49
4D2 Industrial Wastewater Treatment and Discharge	231.48	233.25	241.30	278.50	271.72	293.06	314.16	338.02	310.03	390.56	401.84	436.41	440.29
4E Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5 OTHER	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5A Indirect N_2O Emissions from the Atmospheric Deposition of Nitrogen in NOx and NH_3													
5B Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table B13: Trends of CH_4 (Gigagrams) (12 of 14)

Categories	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
4 WASTE	777.69	814.34	864.05	924.77	941.87	1,022.14	1,025.24	1,007.78	1,063.13	1,060.31	1,092.03	1,112.48	1,137.84	1,070.10
4A Solid Waste Disposal	216.61	230.09	243.50	270.13	293.75	312.22	333.25	346.73	359.55	370.42	394.15	412.22	431.71	448.57
4A1 Managed Waste Disposal Sites	NO	NO	4.86	5.39	5.86	15.57	16.62	17.29	17.93	18.47	19.66	20.56	21.59	22.43
4A2 Unmanaged Waste Disposal Sites	NO	NO	238.03	264.07	287.16	295.87	315.79	328.55	340.69	350.98	373.47	390.58	410.13	426.14
4A3 Uncategorised Waste Disposal Sites	216.07	229.52	NO	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	0.01	0.01	0.01	0.01	0.01	0.01	0.01
4C Incineration and Open Burning of Waste	0.09	0.09	0.084	0.08	0.08	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	0.00	0.00	0.00	0.00	0.00
4C2 Open Burning of Waste	0.09	0.09	0.084	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
4D Wastewater Treatment and Discharge	560.99	584.17	620.46	654.56	648.03	709.83	691.90	660.97	703.49	689.81	697.80	700.17	706.04	621.44
4D1 Domestic Wastewater Treatment and Discharge	67.94	66.95	67.76	67.31	66.77	66.27	67.32	66.79	66.59	67.36	67.13	66.08	65.08	64.32
4D2 Industrial Wastewater Treatment and Discharge	493.61	517.84	553.34	587.93	581.98	644.32	625.37	595.02	637.78	623.36	631.63	635.14	640.97	557.12
4E Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5 OTHER	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5A Indirect N_2O Emissions from the Atmospheric Deposition of Nitrogen in NOx and NH_3														
5B Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table B13: Trends of CH_4 (Gigagrams) (13 of 14)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Memo items													
International Bunkers	0.04	0.04	0.03	0.03	0.09	0.07	0.08	0.07	0.16	0.14	0.09	0.07	0.06
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	0.03	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	0.04	0.03
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Information items													
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	NO	NO

Table B13: Trends of CH_4 (Gigagrams) (14 of 14)

Categories	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Memo items														
International Bunkers	0.05	0.06	0.05	0.07	0.05	0.05	0.05	0.06	0.10	0.06	0.15	0.12	0.12	0.11
International Aviation (International Bunkers)	0.03	0.03	0.03	0.04	0.04	0.03	0.03	0.04	0.04	0.04	0.05	0.06	0.06	0.05
International Water-borne Transport (International Bunkers)	0.02	0.02	0.02	0.03	0.02	0.02	0.01	0.02	0.06	0.02	0.10	0.06	0.06	0.06
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Information items														
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	NO	NO	NO

Table B14: Trends of N_2O (Gigagrams) (1 of 14)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Total National Emissions and Removals	**11.83**	**12.34**	**12.49**	**13.73**	**15.23**	**13.81**	**14.13**	**18.38**	**19.26**	**19.63**	**20.46**	**17.86**	**21.00**
1 ENERGY	0.99	1.07	1.14	1.16	1.25	1.33	1.51	1.73	1.58	1.83	1.96	2.11	2.22
1A Fuel Combustion Activities	0.99	1.07	1.14	1.16	1.25	1.33	1.51	1.73	1.58	1.83	1.96	2.11	2.22
1A1 Energy Industries	0.17	0.18	0.19	0.19	0.17	0.18	0.21	0.27	0.20	0.23	0.25	0.28	0.34
1A2 Manufacturing Industries and Construction	0.12	0.13	0.14	0.15	0.15	0.17	0.18	0.19	0.19	0.17	0.20	0.19	0.20
1A3 Transport	0.69	0.74	0.79	0.82	0.90	0.96	1.09	1.25	1.17	1.41	1.49	1.62	1.66
1A4 Other Sectors	0.01	0.01	0.02	0.01	0.02	0.02	0.03	0.02	0.02	0.01	0.02	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	0.00	0.00	0.00	0.01
1B Fugitive Emissions from Fuels	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1B1 Solid Fuels													
1B2 Oil and Natural Gas	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1B3 Other emissions from Energy Production	NA	NA	NA	NA	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	0.57	0.74	0.40	0.50
2A Mineral Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2A1 Cement Production													
2A2 Lime Production													

Table B14: Trends of N_2O (Gigagrams) (2 of 14)

Categories	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total National Emissions and Removals	**21.34**	**24.29**	**26.37**	**24.64**	**27.69**	**28.90**	**24.39**	**26.06**	**26.06**	**29.90**	**29.26**	**31.06**	**25.59**	**25.89**
1 ENERGY	2.44	2.75	2.82	2.66	2.88	3.04	2.99	3.30	3.34	3.78	4.02	4.24	4.18	4.36
1A Fuel Combustion Activities	2.44	2.75	2.82	2.66	2.88	3.04	2.99	3.30	3.34	3.78	4.02	4.24	4.18	4.36
1A1 Energy Industries	0.45	0.58	0.64	0.57	0.67	0.70	0.76	1.01	1.06	1.11	1.10	1.10	1.17	1.28
1A2 Manufacturing Industries and Construction	0.21	0.23	0.24	0.23	0.26	0.26	0.23	0.20	0.17	0.20	0.18	0.16	0.18	0.17
1A3 Transport	1.76	1.92	1.91	1.83	1.92	2.04	1.97	2.03	2.06	2.40	2.69	2.93	2.78	2.88
1A4 Other Sectors	0.02	0.01	0.02	0.02	0.03	0.03	0.02	0.05	0.04	0.04	0.04	0.03	0.03	0.02
1A5 Non-Specified	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.02	0.02	0.02
1B Fugitive Emissions from Fuels	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1B1 Solid Fuels														
1B2 Oil and Natural Gas	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1B3 Other emissions from Energy Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1C Carbon Dioxide Transport and Storage														
2 INDUSTRIAL PROCESSES AND PRODUCT USE	0.73	0.77	0.80	0.67	0.67	0.52	0.08	0.09	0.09	0.09	0.09	0.09	0.17	0.24
2A Mineral Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2A1 Cement Production														
2A2 Lime Production														

Table B14: Trends of N_2O (Gigagrams) (3 of 14)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
2A3 Glass Production													
2A4 Other Process Uses of Carbonates													
2A5 Other (please specify)	NO	NO	NO	NO	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	0.51	0.68	0.33	0.43
2B1 Ammonia Production	NA	NA	NA	NA	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	0.51	0.68	0.33	0.43
2B3 Adipic Acid Production	NO	NO	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	NO	NO
2B5 Carbide Production	NA	NA	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	NO	NO
2B7 Soda Ash Production	NO	NO	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	NA	NA
2B9 Fluorochemical Production													
2B10 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
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	NA,NE,NO	NA,NE,NO
2C1 Iron and Steel Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2C2 Ferroalloys Production	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

Table B14: Trends of N_2O (Gigagrams) (4 of 14)

Categories	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
2A3 Glass Prod.														
2A4 Other Process Uses of Carbonates														
2A5 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B Chemical Industry	0.66	0.70	0.73	0.59	0.59	0.44	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	NA	NA	NA
2B2 Nitric Acid Production	0.66	0.70	0.73	0.59	0.59	0.44	NO	NO	NO	NO	NO	NO	NO	NO
2B3 Adipic Acid Production	NO	NO	NO	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	NO	NO	NO
2B5 Carbide Production	NA	NA	NA	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	NO	NO	NO
2B7 Soda Ash Production	NO	NO	NO	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	NA	NA	NA
2B9 Fluorochemical Production														
2B10 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
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	NA,NE,NO	NA, NE, NO	NA, NE, NO
2C1 Iron and Steel Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2C2 Ferroalloys Production	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

Table B14: Trends of N_2O (Gigagrams) (5 of 14)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
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	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	NE, NO	NE, NO
2D1 Lubricant Use													
2D2 Paraffin Wax Use	NE	NE	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	NO	NO
2E Electronics Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA, NO	NA, NO	NA, NO
2E1 Integrated Circuit or Semiconductor	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	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	NO	NO
2F Product Uses as Substitutes for Ozone Depleting Substances	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F1 Refrigeration and Air Conditioning													

Table B14: Trends of N_2O (Gigagrams) (6 of 14)

Categories	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
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	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	NE, NO	NE, NO	NE, NO
2D1 Lubricant Use														
2D2 Paraffin Wax Use	NE	NE	NE	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	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	NA, NO	NA, NO	NA, NO
2E1 Integrated Circuit or Semiconductor	NA	NA	NA	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	NO	NO	NO
2F Product Uses as Substitutes for Ozone Depleting Substances	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F1 Refrigeration and Air Conditioning														

Table B14: Trends of N_2O (Gigagrams) (7 of 14)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
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	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	0.06	0.06	0.07	0.07
2G1 Electrical Equipment													
2G2 SF_6 and PFCs from Other Product Uses													
2G3 N_2O from Product Uses	0.02	0.04	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.07	0.07
2G4 Other (Please specify)													
2H Other	NO	NO	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	NO	NO
3 AGRICULTURE, FORESTRY AND OTHER LAND USE	8.37	8.58	8.46	9.61	10.82	9.18	8.98	12.66	13.92	13.72	13.98	11.38	14.19
3A Livestock	0.17	0.17	0.18	0.19	0.20	0.23	0.22	0.26	0.24	0.24	0.24	0.27	0.29
3A1 Enteric Fermentation													

Table B14: Trends of N_2O (Gigagrams) (8 of 14)

Categories	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
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	NO	NO	NO
2G Other Product Manufacture and Use	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.09	0.09	0.09	0.09	0.09	0.17	0.24
2G1 Electrical Equipment														
2G2 SF_6 and PFCs from Other Product Uses														
2G3 N_2O from Product Uses	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.09	0.09	0.09	0.09	0.09	0.17	0.24
2G4 Other (Please specify)														
2H Other	NO	NO	NO	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	NO	NO	NO
3 AGRICULTURE, FORESTRY AND OTHER LAND USE	13.87	16.13	18.02	16.60	19.09	20.20	16.33	17.51	17.40	20.44	19.28	20.58	19.98	20.02
3A Livestock	0.30	0.32	0.30	0.31	0.33	0.34	0.35	0.36	0.37	0.38	0.40	0.42	0.44	0.44
3A1 Enteric Fermentation														

Table B14: Trends of N_2O (Gigagrams) (9 of 14)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
3A2 Manure Mngmt	0.20	0.20	0.21	0.22	0.24	0.26	0.25	0.29	0.27	0.26	0.26	0.29	0.31
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	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	IE, NA, NO	IE, NA, NO
3B2 Cropland	IE, NO	IE, NO	IE, NO	IE, NO	IE, NO	IE, NO	IE, NO	IE, NO	IE, NO	IE, NO	IE, NO	IE, NO	IE, 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	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	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	NA, NO	NA, NO
3B6 Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3C Aggregate sources and Non-CO_2 Emissions Sources on Land	8.20	8.41	8.28	9.42	10.61	8.96	8.76	12.40	13.68	13.48	13.73	11.11	13.90
3C1 Emissions from Biomass Burning	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01
3C2 Liming													
3C3 Urea Application													
3C4 Direct N_2O Emissions from Managed Soils	6.00	6.15	6.05	6.88	7.77	6.43	6.27	8.91	9.94	9.74	9.98	7.93	9.97
3C5 Indirect N_2O Emissions from Managed Soils	2.01	2.05	2.01	2.28	2.58	2.13	2.08	2.94	3.25	3.18	3.18	2.50	3.17
3C6 Indirect N_2O Emissions from Manure Management	1.04	0.95	1.06	1.10	1.29	1.41	1.38	1.59	1.43	1.20	1.24	1.38	1.50
3C7 Rice Cultivations	NA	NA	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	NO	NO
3D Other	NO	NO	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	NO	NO

Table B14: Trends of N_2O (Gigagrams) (10 of 14)

Categories	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
3A2 Manure Mngmt.	0.33	0.34	0.32	0.33	0.35	0.36	0.37	0.38	0.39	0.40	0.42	0.44	0.44	0.44
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	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	IE, NA, NO	IE, NA, NO	IE, NA, NO
3B2 Cropland	IE, NO	IE, NO	IE, NO	IE, NO	IE, NO	IE, NO	IE, NO	IE, NO	IE, NO	IE, NO	IE, NO	IE, NO	IE, NO	IE, 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	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	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	NA, NO	NA, NO	NA, NO
3B6 Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3C Aggregate sources and Non-CO_2 Emissions Sources on Land	13.57	15.81	17.72	16.29	18.75	19.86	15.98	17.14	17.04	20.05	18.87	20.16	19.54	19.58
3C1 Emissions from Biomass Burning	0.01	0.01	0.02	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.02	0.01	0.07
3C2 Liming														
3C3 Urea Application														
3C4 Direct N_2O Emissions from Managed Soils	9.67	11.39	12.93	11.84	13.68	14.52	11.55	12.47	12.38	14.61	13.67	14.60	13.62	13.60
3C5 Indirect N_2O Emissions from Managed Soils	3.06	3.55	3.98	3.62	4.20	4.45	3.48	3.67	3.62	4.32	3.98	4.27	3.89	3.88
3C6 Indirect N_2O Emissions from Manure Management	1.57	1.63	1.53	1.55	1.64	1.63	1.64	1.73	1.74	1.85	1.95	2.03	2.03	2.03
3C7 Rice Cultivation	NA	NA	NA	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	NO	NO	NO
3D Other	NO	NO	NO	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	NO	NO	NO

Table B14: Trends of N_2O (Gigagrams) (11 of 14)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
4 WASTE	0.59	0.60	0.65	0.69	0.73	0.77	0.80	0.85	0.86	0.88	0.91	0.93	0.95
4A Solid Waste Disposal	NA	NA	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	NA	NA
4A2 Unmanaged Waste Disposal Sites	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4A3 Uncategorised Waste Disposal Sites	NA	NA	NA	NA	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	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	0.00	0.00	0.00	0.00
4C1 Waste Incineration	NO	NO	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00	0.00	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	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	0.88	0.90	0.92	0.94
4D1 Domestic Wastewater Treatment and Discharge	0.58	0.60	0.64	0.69	0.73	0.77	0.80	0.85	0.86	0.88	0.90	0.92	0.94
4D2 Industrial Wastewater Treatment and Discharge	NA	NA	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	NO	NO
5 OTHER	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
5A Indirect N_2O Emissions from the Atmospheric Deposition of Nitrogen in NOx and NH_3	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
5B Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table B14: Trends of N_2O (Gigagrams) (12 of 14)

Categories	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
4 WASTE	0.96	1.00	0.99	1.07	1.09	1.09	1.11	1.13	1.17	1.18	1.21	1.23	1.25	1.27
4A Solid Waste Disposal	NA	NA	NA	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	NA	NA	NA
4A2 Unmanaged Waste Disposal Sites	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4A3 Uncategorised Waste Disposal Sites	NA	NA	NO	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	0.00	0.00	0.00
4C Incineration and Open Burning of Waste	0.00	0.01	0.01	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	0.00	0.00	0.01	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	0.00	0.00	0.00
4D Wastewater Treatment and Discharge	0.96	0.99	0.99	1.06	1.08	1.09	1.11	1.13	1.16	1.18	1.20	1.22	1.24	1.26
4D1 Domestic Wastewater Treatment and Discharge	0.96	0.99	0.99	1.06	1.08	1.09	1.11	1.13	1.16	1.18	1.20	1.22	1.24	1.26
4D2 Industrial Wastewater Treatment and Discharge	NA	NA	NA	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	NO	NO	NO
5 OTHER	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
5A Indirect N_2O Emissions from the Atmospheric Deposition of Nitrogen in NOx and NH_3	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
5B Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table B14: Trends of N_2O (13 of 14)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Memo items													
International Bunkers	0.05	0.05	0.06	0.06	0.08	0.09	0.10	0.11	0.14	0.13	0.12	0.13	0.12
International Aviation (International Bunkers)	0.04	0.05	0.05	0.06	0.06	0.08	0.09	0.09	0.11	0.09	0.10	0.12	0.12
International Water-borne Transport (International Bunkers)	0.01	0.01	0.01	0.01	0.02	0.01	0.02	0.01	0.04	0.03	0.02	0.01	0.01
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Information items													
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	NO	NO

Table B14: Trends of N_2O (14 of 14)

Categories	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Memo items														
International Bunkers	0.13	0.14	0.14	0.17	0.15	0.15	0.15	0.16	0.18	0.16	0.22	0.24	0.24	0.23
International Aviation (International Bunkers)	0.12	0.13	0.13	0.16	0.14	0.14	0.14	0.15	0.17	0.16	0.20	0.22	0.22	0.21
International Water-borne Transport (International Bunkers)	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.00	0.02	0.00	0.03	0.02	0.02	0.02
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Information items														
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	NO	NO	NO

Table B15: Trends of HFCs (CO2 equivalents Gigagrams) (1 of 4)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Total National Emissions and Removals	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	91.05	142.11	193.17	190.87	411.29	511.39
2 INDUSTRIAL PROCESSES AND PRODUCT USE	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	91.05	142.11	193.17	190.87	411.29	511.39
2A Mineral Industry													
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	NO	NO
2B Chemical Industry	NO	NO	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	NO	NO
2B10 Other (Please specify)	NO	NO	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	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	NO	NO
2C5 Lead Production													
2C6 Zinc Production													
2C7 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table B15: Trends of HFCs (CO2 equivalents Gigagrams) (2 of 4)

Categories	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total National Emissions and Removals	327.71	449.76	518.83	504.49	563.03	642.19	678.73	723.02	688.57	726.51	743.32	764.47	760.40	757.00
2 INDUSTRIAL PROCESSES AND PRODUCT USE	327.71	449.76	518.83	504.49	563.03	642.19	678.73	723.02	688.57	726.51	743.32	764.47	760.40	757.00
2A Mineral Industry														
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	NO	NO	NO
2B Chemical Industry	NO	NO	NO	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	NO	NO	NO
2B10 Other (Please specify)	NO	NO	NO	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	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	NO	NO	NO
2C5 Lead Production														
2C6 Zinc Production														
2C7 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table B15: Trends of HFCs (CO_2 equivalents Gigagrams) (3 of 4)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
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	NO	39.49	39.49	39.49
2E1 Integrated Circuit or Semiconductor	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	39.49	39.49	39.49
2E2 TFT Flat Panel Display	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E3 Photovoltaics	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA	NA	NA
2E4 Heat Transfer Fluid													
2E5 Other (please specify)	NO	NO	NO	NO	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	193.17	151.38	371.80	471.90
2F1 Refrigeration and Air Conditioning	NO	NO	NO	NO	NO	NO	NO	91.05	142.11	193.17	151.38	371.80	471.90
2F2 Foam Blowing Agents	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
2F4 Aerosols	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
2F6 Other Applications	NO	NO	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	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	NO	NO
2H Other													
2H1 Pulp and Paper Industry													
2H2 Food and Beverages Industry													
2H3 Other (please specify)													

Table B15: Trends of HFCs (CO2 equivalents Gigagrams) (4 of 4)

Categories	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
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	39.49	39.49	39.49	39.49	39.49	39.49	38.97	40.48	39.03	39.03	43.75
2E1 Integrated Circuit or Semiconductor	39.49	39.49	39.49	39.49	39.49	39.49	39.49	39.49	39.49	38.97	40.48	39.03	39.03	43.75
2E2 TFT Flat Panel Display	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E3 Photovoltaics	NA	NA	NA	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	NO	NO	NO
2F Product Uses as Substitutes for Ozone Depleting Substances	288.22	410.27	479.34	464.99	523.54	602.70	639.24	683.53	649.08	687.54	702.85	725.44	721.37	713.25
2F1 Refrigeration and Air Conditioning	288.22	410.27	479.34	464.99	523.54	602.70	639.24	683.53	649.08	678.39	702.85	725.44	721.37	713.25
2F2 Foam Blowing Agents	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
2F4 Aerosols	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
2F6 Other Applications	NO	NO	NO	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	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	NO	NO	NO
2H Other														
2H1 Pulp and Paper Industry														
2H2 Food and Beverages Industry														
2H3 Other (please specify)														

Table B16: Trends of PFCs (CO2 equivalents Gigagrams) (1 of 4)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Total National Emissions and Removals	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	140.64	240.45	340.27
2 INDUSTRIAL PROCESSES AND PRODUCT USE	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	140.64	240.45	340.27
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	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	NO	NO
2B10 Other (Please specify)	NO	NO	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	NO	NO
2C1 Iron and Steel Production													
2C2 Ferroalloys Production													
2C3 Aluminium Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C4 Magnesium Production	NO	NO	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	NO	NO

Table B16: Trends of PFCs (CO2 equivalents Gigagrams) (2 of 4)

Categories	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total National Emissions and Removals	440.08	539.90	639.71	739.53	839.34	939.16	1,038.97	1,138.79	1,445.24	2,576.01	2,668.57	3,023.58	4,694.46	4,976.28
2 INDUSTRIAL PROCESSES AND PRODUCT USE	440.08	539.90	639.71	739.53	839.34	939.16	1,038.97	1,138.79	1,445.24	2,576.01	2,668.57	3,023.58	4,694.46	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	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	NO	NO	NO
2B10 Other (Please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C Metal Industry	NO	NO	NO	NO	NO	NO	NO	NO	206.64	1,239.84	1,239.84	1,239.84	2,617.44	2,617.44
2C1 Iron and Steel Production														
2C2 Ferroalloys Production														
2C3 Aluminium Production	NO	NO	NO	NO	NO	NO	NO	NO	206.64	1,239.84	1,239.84	1,239.84	2,617.44	2,617.44
2C4 Magnesium Production	NO	NO	NO	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	NO	NO	NO

Table B16: Trends of PFCs (CO2 equivalents Gigagrams) (3 of 4)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
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	NO	140.64	240.45	340.27
2E1 Integrated Circuit or Semiconductor	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	140.64	240.45	340.27
2E2 TFT Flat Panel Display	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E3 Photovoltaics	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	IE	IE	IE
2E4 Heat Transfer Fluid													
2E5 Other (please specify)	NO	NO	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	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	NA,NE	NA,NE
2F2 Foam Blowing Agents	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
2F4 Aerosols	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
2F6 Other Applications (please specify)	NO	NO	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	NE,NO	NE,NO
2G1 Electrical Equipment	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2G2 SF_6 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	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 B16: Trends of PFCs (CO2 equivalents Gigagrams) (4 of 4)

Categories	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
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	440.08	539.90	639.71	739.53	839.34	939.16	1,038.97	1,138.79	1,238.60	1,336.17	1,428.73	1,783.74	2,077.02	2,358.84
2E1 Integrated Circuit or Semiconductor	440.08	539.90	639.71	739.53	839.34	939.16	1,038.97	1,138.79	1,238.60	1,270.06	1,318.91	1,271.98	1,272.02	1,425.89
2E2 TFT Flat Panel Display	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E3 Photovoltaics	IE	IE	IE	IE	IE	IE	IE	IE	IE	66.11	109.82	511.75	805.00	932.95
2E4 Heat Transfer Fluid														
2E5 Other (please specify)	NO	NO	NO	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	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	NA,NE	NA, NE	NA, NE
2F2 Foam Blowing Agents	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
2F4 Aerosols	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
2F6 Other Applications (please specify)	NO	NO	NO	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	NE,NO	NE, NO	NE, NO
2G1 Electrical Equipment	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2G2 SF_6 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	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 B17: Trends of SF_6 (CO2 equivalents Gigagrams) (1 of 4)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Total National Emissions and Removals	**0.23**	**0.23**	**0.23**	**0.23**	**0.23**	**0.23**	**0.50**	**0.78**	**1.05**	**1.32**	**310.12**	**306.02**	**306.48**
2 INDUSTRIAL PROCESSES AND PRODUCT USE	0.23	0.23	0.23	0.23	0.23	0.23	0.50	0.78	1.05	1.32	310.12	306.02	306.48
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	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	NO	NO
2B10 Other (Please specify)	NO	NO	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	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	NO	NO
2C5 Lead Production													
2C6 Zinc Production													
2C7 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table B17: Trends of SF_6 (CO2 equivalents Gigagrams) (2 of 4)

Categories	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total National Emissions and Removals	**306.48**	**306.93**	**319.02**	**313.27**	**311.48**	**311.47**	**313.85**	**315.42**	**317.42**	**309.54**	**324.41**	**316.45**	**311.02**	**348.17**
2 INDUSTRIAL PROCESSES AND PRODUCT USE	306.48	306.93	319.02	313.27	311.48	311.47	313.85	315.42	317.42	309.54	324.41	316.45	311.02	348.17
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	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	NO	NO	NO
2B10 Other (Please specify)	NO	NO	NO	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	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	NO	NO	NO
2C5 Lead Production														
2C6 Zinc Production														
2C7 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table B17: Trends of SF_6 (CO2 equivalents Gigagrams) (3 of 4)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
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	NO	304.20	304.20	304.20
2E1 Integrated Circuit or Semiconductor	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	304.20	304.20	304.20
2E2 TFT Flat Panel Display	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E3 Photovoltaics	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA	NA	NA
2E4 Heat Transfer Fluid													
2E5 Other (please specify)	NO	NO	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	0.23	0.23	0.23	0.23	0.23	0.23	0.50	0.78	1.05	1.32	5.93	1.82	2.28
2G1 Electrical Equipment	0.23	0.23	0.23	0.23	0.23	0.23	0.50	0.78	1.05	1.32	5.93	1.82	2.28
2G2 SF_6 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	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 B17: Trends of SF_6 (CO2 equivalents Gigagrams) (4 of 4)

Categories	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
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	304.20	304.20	304.20	304.20	304.20	304.20	300.19	311.74	300.50	300.66	337.03
2E1 Integrated Circuit or Semiconductor	304.20	304.20	304.20	304.20	304.20	304.20	304.20	304.20	304.20	300.19	311.74	300.50	300.66	337.03
2E2 TFT Flat Panel Display	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E3 Photovoltaics	NA	NA	NA	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	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	2.28	2.74	14.82	9.07	7.28	7.27	9.65	11.23	13.22	9.35	12.67	15.95	10.36	11.14
2G1 Electrical Equipment	2.28	2.74	14.82	9.07	7.28	7.27	9.65	11.23	13.22	9.35	12.67	15.95	10.36	11.14
2G2 SF_6 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	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 B18: Trends of Other Gases (NF_3) (CO_2 equivalents Gigagrams) (1 of 4)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Total National Emissions and Removals	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**NA,NO**	**45.90**	**45.90**	**45.90**
2 INDUSTRIAL PROCESSES AND PRODUCT USE	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	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	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	NO	NO
2B10 Other (Please specify)	NO	NO	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	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	NO	NO
2C5 Lead Production													
2C6 Zinc Production													
2C7 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table B18: Trends of Other Gases (NF_3) (CO_2 equivalents Gigagrams) (2 of 4)

Categories	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total National Emissions and Removals	**45.90**	**45.90**	**45.90**	**45.90**	**45.90**	**45.90**	**45.90**	**45.90**	**45.90**	**45.29**	**47.03**	**45.36**	**45.36**	**50.85**
2 INDUSTRIAL PROCESSES AND PRODUCT USE	45.90	45.90	45.90	45.90	45.90	45.90	45.90	45.90	45.90	45.29	47.03	45.36	45.36	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	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	NO	NO	NO
2B10 Other (Please specify)	NO	NO	NO	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	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	NO	NO	NO
2C5 Lead Production														
2C6 Zinc Production														
2C7 Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table B18: Trends of Other Gases (NF_3) (CO_2 equivalents Gigagrams) (3 of 4)

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
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	NA, NO	45.90	45.90	45.90
2E1 Integrated Circuit or Semiconductor	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	45.90	45.90	45.90
2E2 TFT Flat Panel Display	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E3 Photovoltaics	NA	NA	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	NO	NO
2E5 Other (please specify)	NO	NO	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	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	NA, NE	NA, NE
2F2 Foam Blowing Agents	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
2F4 Aerosols	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
2F6 Other Applications	NO	NO	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	NE,NO	NE,NO
2G1 Electrical Equipment	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2G2 SF_6 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	NE, NO	NE, NO
2G3 N_2O from Product Uses													
2G4 Other (Please specify)	NO	NO	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 B18: Trends of Other Gases (NF_3) (CO_2 equivalents Gigagrams) (4 of 4)

Categories	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
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	45.90	45.90	45.90	45.90	45.90	45.90	45.29	47.03	45.36	45.36	50.85
2E1 Integrated Circuit or Semiconductor	45.90	45.90	45.90	45.90	45.90	45.90	45.90	45.90	45.90	45.29	47.03	45.36	45.36	50.85
2E2 TFT Flat Panel Display	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E3 Photovoltaics	NA	NA	NA	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	NO	NO	NO
2E5 Other (please specify)	NO	NO	NO	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	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	NA,NE	NA,NE	NA,NE
2F2 Foam Blowing Agents	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
2F4 Aerosols	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
2F6 Other Applications	NO	NO	NO	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	NE,NO	NE,NO	NE,NO
2G1 Electrical Equipment	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2G2 SF_6 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	NE, NO	NE, NO	NE, NO
2G3 N_2O from Product Uses														
2G4 Other (Please specify)	NO	NO	NO	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 B19a: Approach 1 Level Assessment for Greenhouse Gas Inventory Year 2016 - without LULUCF (1 of 5)

Sector	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2016 Year Estimate (Gg CO_2 eq)	Level Assessment (%)	Cumulative (%)
ENERGY	1.A.1	Energy Industries - Solid Fuels	CO_2	68,189.15	21.52%	21.52%
ENERGY	1.A.3.b	Road Transportation	CO_2	55,188.34	17.42%	38.94%
ENERGY	1.A.1	Energy Industries - Gaseous Fuels	CO_2	52,070.82	16.43%	55.38%
ENERGY	1.B.2.b	Fugitive Emissions from Fuels - Natural Gas	CH_4	24,446.89	7.72%	63.09%
WASTE	4.D.2	Industrial Wastewater Treatment and Discharge	CH_4	13,927.93	4.40%	67.49%
WASTE	4.A	Solid Waste Disposal	CH_4	11,214.23	3.54%	71.03%
ENERGY	1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	CO_2	10,896.28	3.44%	74.47%
ENERGY	1.A.1	Energy Industries - Liquid Fuels	CO_2	10,663.81	3.37%	77.83%
IPPU	2.A.1	Cement Production	CO_2	9,125.90	2.88%	80.71%
ENERGY	1.A.2	Manufacturing Industries and Construction - Solid Fuels	CO_2	6,795.19	2.14%	82.86%
ENERGY	1.A.2	Manufacturing Industries and Construction - Liquid Fuels	CO_2	6,164.27	1.95%	84.80%
ENERGY	1.A.3.d	Transport - Water-borne Navigation - Liquid Fuels	CO_2	5,505.04	1.74%	86.54%
ENERGY	1.A.4	Other Sectors - Liquid Fuels	CO_2	5,260.26	1.66%	88.20%
IPPU	2.A.4	Other Process Uses of Carbonates - Limestone and Dolomite	CO_2	4,184.05	1.32%	89.52%
AFOLU-Agriculture	3.C.4	Direct N_2O Emissions from Managed Soils	N_2O	4,052.61	1.28%	90.80%
IPPU	2.B.8	Petrochemical and Carbon Black Production	CO_2	3,583.40	1.13%	91.93%
AFOLU-Agriculture	3.C.7	Rice Cultivations	CH_4	2,265.20	0.71%	92.65%
IPPU	2.C.3	Aluminium Production	PFC-14	2,246.56	0.71%	93.36%
ENERGY	1.B.2.a	Fugitive Emissions from Fuel - Oil	CO_2	1,846.14	0.58%	93.94%
WASTE	4.D.1	Domestic Wastewater Treatment and Discharge	CH_4	1,608.12	0.51%	94.45%
IPPU	2.C.1	Iron and Steel Production	CO_2	1,384.51	0.44%	94.88%
AFOLU-Agriculture	3.A.1	Enteric Fermentation	CH_4	1,370.44	0.43%	95.31%

Table B19a: Approach 1 Level Assessment for Greenhouse Gas Inventory Year 2016 - without LULUCF (2 of 5)

Sector	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2016 Year Estimate (Gg CO_2 eq)	Level Assessment (%)	Cumulative (%)
IPPU	2.C.3	Aluminium Production	CO_2	1,216.00	0.38%	95.70%
IPPU	2.B.1	Ammonia Production	CO_2	1,170.29	0.37%	96.07%
AFOLU-Agriculture	3.C.5	Indirect N_2O Emissions from Managed Soils	N_2O	1,156.86	0.37%	96.43%
ENERGY	1.A.3.a	Civil Aviation	CO_2	1,132.99	0.36%	96.79%
IPPU	2.E.1	Integrated Circuit or Semiconductor	PFC-116	901.69	0.28%	97.08%
IPPU	2.E.3	Photovoltaics	PFC-14	875.16	0.28%	97.35%
ENERGY	1.B.2.a	Fugitive Emissions from Fuels - Oil	CH_4	861.34	0.27%	97.62%
ENERGY	1.A.3.b	Road Transportation	N_2O	794.46	0.25%	97.87%
IPPU	2.F.1.b	Refrigeration and Air Conditioning - Mobile Air Conditioning	HFC-134a	713.28	0.23%	98.10%
AFOLU-Agriculture	3.C.6	Indirect N_2O Emissions from Manure Management	N_2O	605.34	0.19%	98.29%
AFOLU-Agriculture	3.C.3	Urea application	CO_2	527.29	0.17%	98.46%
ENERGY	1.A.5	Non-Specified - Liquid Fuels	CO_2	507.91	0.16%	98.62%
AFOLU-Agriculture	3.A.2	Manure Management	CH_4	505.64	0.16%	98.78%
ENERGY	1.A.3.b	Road Transportation	CH_4	501.41	0.16%	98.93%
IPPU	2.E.1	Integrated Circuit or Semiconductor	PFC-14	491.57	0.16%	99.09%
WASTE	4.D.1	Domestic Wastewater Treatment and Discharge	N_2O	375.96	0.12%	99.21%
IPPU	2.C.3	Aluminium Production	PFC-116	370.88	0.12%	99.33%
IPPU	2.E.1	Integrated Circuit or Semiconductor	SF_6	337.03	0.11%	99.43%
IPPU	2.B.8	Petrochemical and Carbon Black Production	CH_4	321.67	0.10%	99.53%
ENERGY	1.A.1	Energy Industries - Solid Fuels	N_2O	317.18	0.10%	99.63%
AFOLU-Agriculture	3.A.2	Manure Management	N_2O	129.79	0.04%	99.67%
ENERGY	1.B.2.b	Fugitive Emissions from Fuels - Natural Gas	CO_2	96.01	0.03%	99.71%

Table B 19a: Approach 1 Level Assessment for Greenhouse Gas Inventory Year 2016 - without LULUCF (3 of 5)

Sector	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2016 Year Estimate (Gg CO_2 eq)	Level Assessment (%)	Cumulative (%)
ENERGY	1.A.3.c	Railways	CO_2	77.73	0.02%	99.73%
IPPU	2.A.2	Lime Production	CO_2	77.00	0.02%	99.75%
IPPU	2.G.3.b	Other Product Manufacture and Use - N_2O in Medical Applications	N_2O	70.70	0.02%	99.78%
ENERGY	1.A.4	Other Sectors - Gaseous Fuels	CO_2	58.68	0.02%	99.79%
IPPU	2.E.3	Photovoltaics	PFC-116	57.79	0.02%	99.81%
IPPU	2.E.1	Integrated Circuit or Semiconductor	NF3	50.85	0.02%	99.83%
ENERGY	1.A.3.d	Water-borne Navigation - Liquid Fuels	N_2O	44.26	0.01%	99.84%
IPPU	2.E.1	Integrated Circuit or Semiconductor	HFC-23	43.75	0.01%	99.86%
IPPU	2.B.5	Carbide Production	CO_2	38.02	0.01%	99.87%
IPPU	2.E.1	Integrated Circuit or Semiconductor	PFC-218	32.63	0.01%	99.88%
ENERGY	1.A.2	Manufacturing Industries and Construction - Solid Fuels	N_2O	31.61	0.01%	99.89%
WASTE	4.C.1	Waste Incineration	CO_2	30.36	0.01%	99.90%
IPPU	2.A.3	Glass Production	CO_2	28.71	0.01%	99.91%
ENERGY	1.A.1	Energy Industries - Gaseous Fuels	N_2O	27.66	0.01%	99.92%
ENERGY	1.A.1	Energy Industries - Liquid Fuels	N_2O	25.93	0.01%	99.92%
ENERGY	1.A.1	Energy Industries - Gaseous Fuels	CH_4	23.20	0.01%	99.93%
ENERGY	1.B.1	Fugitive Emissions from Fuels - Solid Fuels	CH_4	19.63	0.01%	99.94%
ENERGY	1.A.1	Energy Industries - Solid Fuels	CH_4	17.74	0.01%	99.94%
ENERGY	1.A.2	Manufacturing Industries and Construction - Solid Fuels	CH_4	17.68	0.01%	99.95%
IPPU	2.C.1	Iron and Steel Production	CH_4	16.40	0.01%	99.95%
ENERGY	1.A.2	Manufacturing Industries and Construction - Liquid Fuels	N_2O	14.13	0.00%	99.96%
ENERGY	1.A.3.d	Water-borne Navigation - Liquid Fuels	CH_4	13.00	0.00%	99.96%

Table B19a: Approach 1 Level Assessment for Greenhouse Gas Inventory Year 2016 - without LULUCF (4 of 5)

Sector	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2016 Year Estimate (Gg CO_2 eq)	Level Assessment (%)	Cumulative (%)
ENERGY	1.A.4	Other Sectors - Liquid Fuels	CH_4	12.73	0.00%	99.97%
IPPU	2.G.1	Other Product Manufacture and Use - Electrical Equipment	SF_6	11.14	0.00%	99.97%
ENERGY	1.A.1	Energy Industries - Liquid Fuels	CH_4	10.88	0.00%	99.97%
ENERGY	1.A.1	Energy Industries - Biomass	N_2O	9.90	0.00%	99.98%
ENERGY	1.A.3.a	Civil Aviation	N_2O	9.44	0.00%	99.98%
ENERGY	1.A.3.c	Railways	N_2O	8.94	0.00%	99.98%
AFOLU-Agriculture	3.C.1.b	Emissions from Biomass Burning in Croplands	CH_4	7.65	0.00%	99.99%
ENERGY	1.A.1	Energy Industries - Biomass	CH_4	6.23	0.00%	99.99%
ENERGY	1.A.2	Manufacturing Industries and Construction - Liquid Fuels	CH_4	5.99	0.00%	99.99%
ENERGY	1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	N_2O	5.79	0.00%	99.99%
ENERGY	1.A.4	Other Sectors - Liquid Fuels	N_2O	5.71	0.00%	99.99%
ENERGY	1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	CH_4	4.86	0.00%	99.99%
ENERGY	1.A.5	Non-Specified - Liquid Fuels	N_2O	4.76	0.00%	100.00%
AFOLU-Agriculture	3.C.2	Liming	CO_2	4.54	0.00%	100.00%
AFOLU-Agriculture	3.C.1.b	Emissions from Biomass Burning in Croplands	N_2O	2.37	0.00%	100.00%
WASTE	4.C.2	Open Burning of Waste	CH_4	1.93	0.00%	100.00%
WASTE	4.C.1	Waste Incineration	N_2O	1.79	0.00%	100.00%
WASTE	4.C.2	Open Burning of Waste	CO_2	0.70	0.00%	100.00%
ENERGY	1.A.5	Non-Specified - Liquid Fuels	CH_4	0.59	0.00%	100.00%
WASTE	4.B	Biological Treatment of Solid Waste	CH_4	0.24	0.00%	100.00%
WASTE	4.C.2	Open Burning of Waste	N_2O	0.23	0.00%	100.00%

Table B19a: Approach 1 Level Assessment for Greenhouse Gas Inventory Year 2016 - without LULUCF (5 of 5)

Sector	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2016 Year Estimate (Gg CO_2 eq)	Level Assessment (%)	Cumulative (%)
ENERGY	1.A.3.a	Civil Aviation	CH_4	0.20	0.00%	100.00%
WASTE	4.B	Biological Treatment of Solid Waste	N_2O	0.17	0.00%	100.00%
ENERGY	1.A.4	Other Sectors - Gaseous Fuels	CH_4	0.13	0.00%	100.00%
ENERGY	1.A.3.c	Railways	CH_4	0.11	0.00%	100.00%
ENERGY	1.A.4	Other Sectors - Gaseous Fuels	N_2O	0.03	0.00%	100.00%
					100.00%	

Table B19b: Approach 1 Level Assessment for Greenhouse Gas Inventory Year 2016 - with LULUCF (1 of 5)

Sector	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2016 Year Estimate (Gg CO_2 eq)	Level Assessment (%)	Cumulative (%)
AFOLU	**3.B.1.a**	**Forest Land Remaining Forest Land**	**CO_2**	**-243,831.71**	**41.06%**	**41.06%**
ENERGY	**1.A.1**	**Energy Industries - Solid Fuels**	**CO_2**	**68,189.15**	**11.48%**	**52.55%**
ENERGY	**1.A.3.b**	**Road Transportation**	**CO_2**	**55,188.34**	**9.29%**	**61.84%**
ENERGY	**1.A.1**	**Energy Industries - Gaseous Fuels**	**CO_2**	**52,070.82**	**8.77%**	**70.61%**
ENERGY	**1.B.2.b**	**Fugitive Emissions from Fuels - Natural Gas**	**CH_4**	**24,446.89**	**4.12%**	**74.73%**
AFOLU	**3.B.5.b**	**Land Converted to Settlements**	**CO_2**	**17,753.21**	**2.99%**	**77.72%**
AFOLU	**3.B.2.a**	**Crop Land Remaining Cropland**	**CO_2**	**-15,314.31**	**2.58%**	**80.30%**
WASTE	**4.D.2**	**Industrial Wastewater Treatment and Discharge**	**CH_4**	**13,927.93**	**2.35%**	**82.64%**
WASTE	**4.A**	**Solid Waste Disposal**	**CH_4**	**11,214.23**	**1.89%**	**84.53%**
ENERGY	**1.A.2**	**Manufacturing Industries and Construction - Gaseous Fuels**	**CO_2**	**10,896.28**	**1.84%**	**86.37%**
ENERGY	**1.A.1**	**Energy Industries - Liquid Fuels**	**CO_2**	**10,663.81**	**1.80%**	**88.16%**
IPPU	**2.A.1**	**Cement Production**	**CO_2**	**9,125.90**	**1.54%**	**89.70%**
ENERGY	**1.A.2**	**Manufacturing Industries and Construction - Solid Fuels**	**CO_2**	**6,795.19**	**1.14%**	**90.84%**
ENERGY	**1.A.2**	**Manufacturing Industries and Construction - Liquid Fuels**	**CO_2**	**6,164.27**	**1.04%**	**91.88%**
ENERGY	**1.A.3.d**	**Transport - Water-borne Navigation - Liquid Fuels**	**CO_2**	**5,505.04**	**0.93%**	**92.81%**
ENERGY	**1.A.4**	**Other Sectors - Liquid Fuels**	**CO_2**	**5,260.26**	**0.89%**	**93.70%**
IPPU	**2.A.4**	**Other Process Uses of Carbonates - Limestone and Dolomite**	**CO_2**	**4,184.05**	**0.70%**	**94.40%**
AFOLU	**3.C.4**	**Direct N_2O Emissions from Managed Soils**	**N_2O**	**4,052.61**	**0.68%**	**95.08%**
IPPU	2.B.8	Petrochemical and Carbon Black Production	CO_2	3,583.40	0.60%	95.69%
AFOLU	3.C.7	Rice Cultivations	CH_4	2,265.20	0.38%	96.07%
IPPU	2.C.3	Aluminium Production	PFC-14	2,246.56	0.38%	96.45%
ENERGY	1.B.2.a	Fugitive Emissions from Fuel - Oil	CO_2	1,846.14	0.31%	96.76%

Table B19b: Approach 1 Level Assessment for Greenhouse Gas Inventory Year 2016 - with LULUCF (2 of 5)

Sector	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2016 Year Estimate (Gg CO_2 eq)	Level Assessment (%)	Cumulative (%)
WASTE	4.D.1	Domestic Wastewater Treatment and Discharge	CH_4	1,608.12	0.27%	97.03%
IPPU	2.C.1	Iron and Steel Production	CO_2	1,384.51	0.23%	97.26%
AFOLU	3.A.1	Enteric Fermentation	CH_4	1,370.44	0.23%	97.49%
IPPU	2.C.3	Aluminium Production	CO_2	1,216.00	0.20%	97.70%
IPPU	2.B.1	Ammonia Production	CO_2	1,170.29	0.20%	97.89%
AFOLU	3.C.5	Indirect N_2O Emissions from Managed Soils	N_2O	1,156.86	0.19%	98.09%
ENERGY	1.A.3.a	Civil Aviation	CO_2	1,132.99	0.19%	98.28%
IPPU	2.E.1	Integrated Circuit or Semiconductor	PFC-116	901.69	0.15%	98.43%
IPPU	2.E.3	Photovoltaics	PFC-14	875.16	0.15%	98.58%
ENERGY	1.B.2.a	Fugitive Emissions from Fuels - Oil	CH_4	861.34	0.15%	98.72%
ENERGY	1.A.3.b	Road Transportation	N_2O	794.46	0.13%	98.86%
IPPU	2.F.1.b	Refrigeration and Air Conditioning - Mobile Air Conditioning	HFC-134a	713.28	0.12%	98.98%
AFOLU	3.C.6	Indirect N_2O Emissions from Manure Management	N_2O	605.34	0.10%	99.08%
AFOLU	3.C.3	Urea application	CO_2	527.29	0.09%	99.17%
ENERGY	1.A.5	Non-Specified - Liquid Fuels	CO_2	507.91	0.09%	99.25%
AFOLU	3.A.2	Manure Management	CH_4	505.64	0.09%	99.34%
ENERGY	1.A.3.b	Road Transportation	CH_4	501.41	0.08%	99.42%
IPPU	2.E.1	Integrated Circuit or Semiconductor	PFC-14	491.57	0.08%	99.51%
WASTE	4.D.1	Domestic Wastewater Treatment and Discharge	N_2O	375.96	0.06%	99.57%
IPPU	2.C.3	Aluminium Production	PFC-116	370.88	0.06%	99.63%
IPPU	2.E.1	Integrated Circuit or Semiconductor	SF_6	337.03	0.06%	99.69%
IPPU	2.B.8	Petrochemical and Carbon Black Production	CH_4	321.67	0.05%	99.74%

Table B19b: Approach 1 Level Assessment for Greenhouse Gas Inventory Year 2016 - with LULUCF (3 of 5)

Sector	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2016 Year Estimate (Gg CO_2 eq)	Level Assessment (%)	Cumulative (%)
ENERGY	1.A.1	Energy Industries - Solid Fuels	N_2O	317.18	0.05%	99.80%
AFOLU	3.A.2	Manure Management	N_2O	129.79	0.02%	99.82%
ENERGY	1.B.2.b	Fugitive Emissions from Fuels - Natural Gas	CO_2	96.01	0.02%	99.83%
ENERGY	1.A.3.c	Railways	CO_2	77.73	0.01%	99.85%
IPPU	2.A.2	Lime Production	CO_2	77.00	0.01%	99.86%
IPPU	2.G.3.b	Other Product Manufacture and Use - N_2O in Medical Applications	N_2O	70.70	0.01%	99.87%
ENERGY	1.A.4	Other Sectors - Gaseous Fuels	CO_2	58.68	0.01%	99.88%
IPPU	2.E.3	Photovoltaics	PFC-116	57.79	0.01%	99.89%
IPPU	2.E.1	Integrated Circuit or Semiconductor	NF3	50.85	0.01%	99.90%
ENERGY	1.A.3.d	Water-borne Navigation - Liquid Fuels	N_2O	44.26	0.01%	99.91%
IPPU	2.E.1	Integrated Circuit or Semiconductor	HFC-23	43.75	0.01%	99.92%
IPPU	2.B.5	Carbide Production	CO_2	38.02	0.01%	99.92%
IPPU	2.E.1	Integrated Circuit or Semiconductor	PFC-218	32.63	0.01%	99.93%
ENERGY	1.A.2	Manufacturing Industries and Construction - Solid Fuels	N_2O	31.61	0.01%	99.93%
WASTE	4.C.1	Waste Incineration	CO_2	30.36	0.01%	99.94%
AFOLU	3.C.1.a	Emissions from Biomass Burning in Forest Lands	CH_4	28.93	0.00%	99.94%
IPPU	2.A.3	Glass Production	CO_2	28.71	0.00%	99.95%
ENERGY	1.A.1	Energy Industries - Gaseous Fuels	N_2O	27.66	0.00%	99.95%
ENERGY	1.A.1	Energy Industries - Liquid Fuels	N_2O	25.93	0.00%	99.96%
ENERGY	1.A.1	Energy Industries - Gaseous Fuels	CH_4	23.20	0.00%	99.96%
ENERGY	1.B.1	Fugitive Emissions from Fuels - Solid Fuels	CH_4	19.63	0.00%	99.96%
AFOLU	3.C.1.a	Emissions from Biomass Burning in Forest Lands	N_2O	19.13	0.00%	99.97%

Table B19b: Approach 1 Level Assessment for Greenhouse Gas Inventory Year 2016 - with LULUCF (4 of 5)

Sector	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2016 Year Estimate (Gg CO_2 eq)	Level Assessment (%)	Cumulative (%)
ENERGY	1.A.1	Energy Industries - Solid Fuels	CH_4	17.74	0.00%	99.97%
ENERGY	1.A.2	Manufacturing Industries and Construction - Solid Fuels	CH_4	17.68	0.00%	99.97%
IPPU	2.C.1	Iron and Steel Production	CH_4	16.40	0.00%	99.98%
ENERGY	1.A.2	Manufacturing Industries and Construction - Liquid Fuels	N_2O	14.13	0.00%	99.98%
ENERGY	1.A.3.d	Water-borne Navigation - Liquid Fuels	CH_4	13.00	0.00%	99.98%
ENERGY	1.A.4	Other Sectors - Liquid Fuels	CH_4	12.73	0.00%	99.98%
IPPU	2.G.1	Other Product Manufacture and Use - Electrical Equipment	SF_6	11.14	0.00%	99.98%
ENERGY	1.A.1	Energy Industries - Liquid Fuels	CH_4	10.88	0.00%	99.99%
ENERGY	1.A.1	Energy Industries - Biomass	N_2O	9.90	0.00%	99.99%
ENERGY	1.A.3.a	Civil Aviation	N_2O	9.44	0.00%	99.99%
ENERGY	1.A.3.c	Railways	N_2O	8.94	0.00%	99.99%
AFOLU	3.C.1.b	Emissions from Biomass Burning in Croplands	CH_4	7.65	0.00%	99.99%
ENERGY	1.A.1	Energy Industries - Biomass	CH_4	6.23	0.00%	99.99%
ENERGY	1.A.2	Manufacturing Industries and Construction - Liquid Fuels	CH_4	5.99	0.00%	99.99%
ENERGY	1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	N_2O	5.79	0.00%	100.00%
ENERGY	1.A.4	Other Sectors - Liquid Fuels	N_2O	5.71	0.00%	100.00%
ENERGY	1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	CH_4	4.86	0.00%	100.00%
ENERGY	1.A.5	Non-Specified - Liquid Fuels	N_2O	4.76	0.00%	100.00%
AFOLU	3.C.2	Liming	CO_2	4.54	0.00%	100.00%
AFOLU	3.C.1.b	Emissions from Biomass Burning in Croplands	N_2O	2.37	0.00%	100.00%
WASTE	4.C.2	Open Burning of Waste	CH_4	1.93	0.00%	100.00%

Table B19b: Approach 1 Level Assessment for Greenhouse Gas Inventory Year 2016 - with LULUCF (5 of 5)

Sector	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2016 Year Estimate (Gg CO_2 eq)	Level Assessment (%)	Cumulative (%)
WASTE	4.C.1	Waste Incineration	N_2O	1.79	0.00%	100.00%
WASTE	4.C.2	Open Burning of Waste	CO_2	0.70	0.00%	100.00%
ENERGY	1.A.5	Non-Specified - Liquid Fuels	CH_4	0.59	0.00%	100.00%
WASTE	4.B	Biological Treatment of Solid Waste	CH_4	0.24	0.00%	100.00%
WASTE	4.C.2	Open Burning of Waste	N_2O	0.23	0.00%	100.00%
ENERGY	1.A.3.a	Civil Aviation	CH_4	0.20	0.00%	100.00%
WASTE	4.B	Biological Treatment of Solid Waste	N_2O	0.17	0.00%	100.00%
ENERGY	1.A.4	Other Sectors - Gaseous Fuels	CH_4	0.13	0.00%	100.00%
ENERGY	1.A.3.c	Railways	CH_4	0.11	0.00%	100.00%
ENERGY	1.A.4	Other Sectors - Gaseous Fuels	N_2O	0.03	0.00%	100.00%
				75,488.62	100.00%	

Table B20a: Approach 1 Trend Assessment for Greenhouse Gas Inventory Year 2016 - without LULUCF (1 of 5)

Sector	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2005 Base Year Estimate (Gg CO_2 eq)	2016 Year (Gg CO_2 eq)	Trend Assessment	Contribution to Trend (%)	Cumulative (%)
ENERGY	1.A.1	Energy Industries - Solid Fuels	CO_2	22,279.39	68,189.15	0.16	31.11%	31.11%
ENERGY	1.A.1	Energy Industries - Gaseous Fuels	CO_2	57,713.54	52,070.82	0.09	17.59%	48.70%
ENERGY	1.A.2	Manufacturing Industries and Construction - Liquid Fuels	CO_2	17,297.09	6,164.27	0.07	12.71%	61.41%
ENERGY	1.A.3.b	Road Transportation	CO_2	35,458.78	55,188.34	0.04	7.47%	68.89%
ENERGY	1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	CO_2	12,480.19	10,896.28	0.02	4.09%	72.98%
ENERGY	1.A.1	Energy Industries - Liquid Fuels	CO_2	11,757.33	10,663.81	0.02	3.54%	76.52%
IPPU	2.A.4	Other Process Uses of Carbonates - Limestone and Dolomite	CO_2	178.68	4,184.05	0.02	3.12%	79.63%
WASTE	4.D.2	Industrial Wastewater Treatment and Discharge	CH_4	13,833.55	13,927.93	0.02	3.08%	82.71%
WASTE	4.A	Solid Waste Disposal	CH_4	6,072.29	11,214.23	0.01	2.67%	85.38%
ENERGY	1.B.2.b	Fugitive Emissions from Fuels - Natural Gas	CH_4	21,581.36	24,446.89	0.01	2.66%	88.04%
IPPU	2.C.3	Aluminium Production	PFC-14	-	2,246.56	0.01	1.77%	89.81%
IPPU	2.C.3	Aluminium Production	CO_2	-	1,216.00	0.00	0.96%	90.77%
AFOLU-Agriculture	3.C.4	Direct N_2O Emissions from Managed Soils	N_2O	3,852.49	4,052.61	0.00	0.72%	91.49%
IPPU	2.E.3	Photovoltaics	PFC-14	-	875.16	0.00	0.69%	92.18%
ENERGY	1.B.2.a	Fugitive Emissions from Fuel - Oil	CO_2	2,006.83	1,846.14	0.00	0.58%	92.76%
IPPU	2.A.1	Cement Production	CO_2	7,615.98	9,125.90	0.00	0.54%	93.30%
ENERGY	1.A.4	Other Sectors - Liquid Fuels	CO_2	4,555.67	5,260.26	0.00	0.48%	93.79%
WASTE	4.D.1	Domestic Wastewater Treatment and Discharge	CH_4	1,694.11	1,608.12	0.00	0.45%	94.24%
AFOLU-Agriculture	3.A.1	Enteric Fermentation	CH_4	1,452.12	1,370.44	0.00	0.40%	94.63%
IPPU	2.E.1	Integrated Circuit or Semiconductor	PFC-14	-	491.57	0.00	0.39%	95.02%

Table B20a: Approach 1 Trend Assessment for Greenhouse Gas Inventory Year 2016 - without LULUCF (2 of 5)

Sector	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2005 Base Year Estimate (Gg CO_2 eq)	2016 Year (Gg CO_2 eq)	Trend Assessment	Contribution to Trend (%)	Cumulative (%)
AFOLU-Agriculture	3.C.7	Rice Cultivations	CH_4	2,118.20	2,265.20	0.00	0.37%	95.39%
IPPU	2.E.1	Integrated Circuit or Semiconductor	PFC-116	1,029.30	901.69	0.00	0.34%	95.72%
ENERGY	1.A.3.a	Civil Aviation	CO_2	1,202.61	1,132.99	0.00	0.33%	96.05%
ENERGY	1.A.3.d	Water-borne Navigation - Liquid Fuels	CO_2	3,947.29	5,505.04	0.00	0.33%	96.38%
IPPU	2.C.1	Iron and Steel Production	CO_2	1,367.96	1,384.51	0.00	0.30%	96.68%
AFOLU-Agriculture	3.C.5	Indirect N_2O Emissions from Managed Soils	N_2O	1,185.79	1,156.86	0.00	0.29%	96.97%
IPPU	2.C.3	Aluminium Production	PFC-116	-	370.88	0.00	0.29%	97.26%
ENERGY	1.B.2.a	Fugitive Emissions from Fuels - Oil	CH_4	932.06	861.34	0.00	0.27%	97.53%
IPPU	2.E.1	Integrated Circuit or Semiconductor	SF_6	-	337.03	0.00	0.27%	97.80%
IPPU	2.B.2	Nitric Acid Production	N_2O	217.54	-	0.00	0.22%	98.02%
IPPU	2.A.2	Lime Production	CO_2	239.24	77.00	0.00	0.18%	98.20%
AFOLU-Agriculture	3.C.3	Urea Application	CO_2	575.07	527.29	0.00	0.17%	98.37%
ENERGY	1.A.2	Manufacturing Industries and Construction - Solid Fuels	CO_2	5,420.07	6,795.19	0.00	0.15%	98.52%
IPPU	2.B.8	Petrochemical and Carbon Black Production	CO_2	2,633.90	3,583.40	0.00	0.15%	98.67%
ENERGY	1.A.1	Energy Industries - Solid Fuels	N_2O	103.63	317.18	0.00	0.14%	98.81%
ENERGY	1.A.5	Non-Specified - Liquid Fuels	CO_2	279.22	507.91	0.00	0.12%	98.93%
AFOLU-Agriculture	3.A.2	Manure Management	CH_4	506.79	505.64	0.00	0.12%	99.05%

Table B20a: Approach 1 Trend Assessment for Greenhouse Gas Inventory Year 2016 - without LULUCF (3 of 5)

Sector	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2005 Base Year Estimate (Gg CO_2 eq)	2016 Year (Gg CO_2 eq)	Trend Assessment	Contribution to Trend (%)	Cumulative (%)
ENERGY	1.A.3.b	Road Transportation	N_2O	510.57	794.46	0.00	0.11%	99.15%
ENERGY	1.A.3.c	Railways	CO_2	158.12	77.73	0.00	0.10%	99.25%
ENERGY	1.A.3.b	Road Transportation	CH_4	306.68	501.41	0.00	0.08%	99.34%
IPPU	2.B.1	Ammonia Production	CO_2	988.52	1,170.29	0.00	0.08%	99.42%
IPPU	2.F.1.b	Refrigeration and Air Conditioning - Mobile Air Conditioning	HFC-134a	479.34	713.28	0.00	0.08%	99.49%
IPPU	2.B.8	Petrochemical and Carbon Black Production	CH_4	202.75	321.67	0.00	0.05%	99.54%
IPPU	2.E.3	Photovoltaics	PFC-116	-	57.79	0.00	0.05%	99.59%
IPPU	2.E.1	Integrated Circuit or Semiconductor	NF3	-	50.85	0.00	0.04%	99.63%
IPPU	2.E.1	Integrated Circuit or Semiconductor	HFC-23	-	43.75	0.00	0.03%	99.66%
IPPU	2.G.3.b	Other Product Manufacture and Use - N_2O in Medical Applications	N_2O	22.34	70.70	0.00	0.03%	99.70%
ENERGY	1.A.2	Manufacturing Industries and Construction - Liquid Fuels	N_2O	40.06	14.13	0.00	0.03%	99.73%
IPPU	2.E.1	Integrated Circuit or Semiconductor	PFC-218	-	32.63	0.00	0.03%	99.75%
IPPU	2.C.1	Iron and Steel Production	CH_4	33.75	16.40	0.00	0.02%	99.77%
ENERGY	1.A.4	Other Sectors - Gaseous Fuels	CO_2	65.72	58.68	0.00	0.02%	99.79%
ENERGY	1.A.1	Energy Industries - Biomass	N_2O	27.71	9.90	0.00	0.02%	99.81%
IPPU	2.B.5	Carbide Production	CO_2	49.49	38.02	0.00	0.02%	99.83%
ENERGY	1.B.2.b	Fugitive Emissions from Fuels - Natural Gas	CO_2	87.89	96.01	0.00	0.01%	99.85%
AFOLU-Agriculture	3.C.6	Indirect N_2O Emissions from Manure Management	N_2O	456.57	605.34	0.00	0.01%	99.86%
ENERGY	1.A.1	Energy Industries - Biomass	CH_4	17.43	6.23	0.00	0.01%	99.87%
ENERGY	1.A.2	Manufacturing Industries and Construction - Liquid Fuels	CH_4	16.92	5.99	0.00	0.01%	99.89%
ENERGY	1.A.3.c	Railways	N_2O	18.19	8.94	0.00	0.01%	99.90%
ENERGY	1.B.1	Fugitive Emissions from Fuels - Solid Fuels	CH_4	24.73	19.63	0.00	0.01%	99.91%
ENERGY	1.A.1	Energy Industries - Gaseous Fuels	N_2O	30.66	27.66	0.00	0.01%	99.92%

Table B20a: Approach 1 Trend Assessment for Greenhouse Gas Inventory Year 2016 - without LULUCF (4 of 5)

Sector	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2005 Base Year Estimate (Gg CO_2 eq)	2016 Year (Gg CO_2 eq)	Trend Assessment	Contribution to Trend (%)	Cumulative (%)
ENERGY	1.A.1	Energy Industries - Liquid Fuels	N_2O	28.54	25.93	0.00	0.01%	99.92%
ENERGY	1.A.1	Energy Industries - Solid Fuels	CH_4	5.80	17.74	0.00	0.01%	99.93%
ENERGY	1.A.1	Energy Industries - Gaseous Fuels	CH_4	25.72	23.20	0.00	0.01%	99.94%
ENERGY	1.A.4	Other Sectors - Liquid Fuels	N_2O	10.78	5.71	0.00	0.01%	99.95%
IPPU	2.G.1	Other Product Manufacture and Use - Electrical Equipment	SF_6	14.82	11.14	0.00	0.01%	99.95%
IPPU	2.A.3	Glass Production	CO_2	28.34	28.71	0.00	0.01%	99.96%
WASTE	4.C.1	Waste Incineration	CO_2	29.61	30.36	0.00	0.01%	99.97%
ENERGY	1.A.4	Other Sectors - Liquid Fuels	CH_4	4.66	12.73	0.00	0.01%	99.97%
AFOLU-Agriculture	3.A.2	Manure Management	N_2O	96.78	129.79	0.00	0.00%	99.97%
ENERGY	1.A.1	Energy Industries - Liquid Fuels	CH_4	11.97	10.88	0.00	0.00%	99.98%
AFOLU-Agriculture	3.C.2	Liming	CO_2	-	4.54	0.00	0.00%	99.98%
ENERGY	1.A.3.a	Civil Aviation	N_2O	10.02	9.44	0.00	0.00%	99.98%
ENERGY	1.A.3.d	Water-borne Navigation - Liquid Fuels	N_2O	31.74	44.26	0.00	0.00%	99.99%
WASTE	4.D.1	Domestic Wastewater Treatment and Discharge	N_2O	293.84	375.96	0.00	0.00%	99.99%
ENERGY	1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	N_2O	6.63	5.79	0.00	0.00%	99.99%
ENERGY	1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	CH_4	5.56	4.86	0.00	0.00%	99.99%
AFOLU-Agriculture	3.C.1.b	Emissions from Biomass Burning in Croplands	CH_4	7.13	7.65	0.00	0.00%	99.99%
ENERGY	1.A.5	Non-Specified - Liquid Fuels	N_2O	2.87	4.76	0.00	0.00%	100.00%
ENERGY	1.A.3.d	Water-borne Navigation - Liquid Fuels	CH_4	9.32	13.00	0.00	0.00%	100.00%
ENERGY	1.A.2	Manufacturing Industries and Construction - Solid Fuels	N_2O	25.21	31.61	0.00	0.00%	100.00%

Table B20a: Approach 1 Trend Assessment for Greenhouse Gas Inventory Year 2016 - without LULUCF (5 of 5)

Sector	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2005 Base Year Estimate (Gg CO_2 eq)	2016 Year (Gg CO_2 eq)	Trend Assessment	Contribution to Trend (%)	Cumulative (%)
WASTE	4.C.2	Open Burning of Waste	CH_4	2.11	1.93	0.00	0.00%	100.00%
ENERGY	1.A.2	Manufacturing Industries and Construction - Solid Fuels	CH_4	14.10	17.68	0.00	0.00%	100.00%
AFOLU-Agriculture	3.C.1.b	Emissions from Biomass Burning in Croplands	N_2O	2.20	2.37	0.00	0.00%	100.00%
WASTE	4.C.1	Waste Incineration	N_2O	1.74	1.79	0.00	0.00%	100.00%
ENERGY	1.A.5	Non-Specified - Liquid Fuels	CH_4	0.73	0.59	0.00	0.00%	100.00%
WASTE	4.C.2	Open Burning of Waste	CO_2	0.77	0.70	0.00	0.00%	100.00%
WASTE	4.B	Biological Treatment of Solid Waste	CH_4	0.01	0.24	0.00	0.00%	100.00%
ENERGY	1.A.3.c	Railways	CH_4	0.22	0.11	0.00	0.00%	100.00%
WASTE	4.B	Biological Treatment of Solid Waste	N_2O	0.01	0.17	0.00	0.00%	100.00%
WASTE	4.C.2	Open Burning of Waste	N_2O	0.25	0.23	0.00	0.00%	100.00%
ENERGY	1.A.3.a	Civil Aviation	CH_4	0.21	0.20	0.00	0.00%	100.00%
ENERGY	1.A.4	Other Sectors - Gaseous Fuels	CH_4	0.15	0.13	0.00	0.00%	100.00%
ENERGY	1.A.4	Other Sectors - Gaseous Fuels	N_2O	0.03	0.03	0.00	0.00%	100.00%
				245,797.39	316,833.37	0.52	**100.00%**	

Table B20b: Approach 1 Trend Assessment for Greenhouse Gas Inventory Year 2016 - with LULUCF (1 of 5)

Sector	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2005 Base Year Estimate (Gg CO_2 eq)	2016 Year (Gg CO_2 eq)	Trend Assessment	Contribution to Trend (%)	Cumulative (%)
AFOLU	3.B.1.a	Forest Land Remaining Forest Land	CO_2	-215,305.31	-243,831.71	0.30	42.53%	42.53%
AFOLU	3.B.5.b	Land Converted to Settlements	CO_2	35,969.41	17,753.21	0.08	10.85%	53.38%
ENERGY	1.A.1	Energy Industries - Gaseous Fuels	CO_2	57,713.54	52,070.82	0.08	10.84%	64.22%
ENERGY	1.A.1	Energy Industries - Solid Fuels	CO_2	22,279.39	68,189.15	0.06	9.20%	73.42%
ENERGY	1.A.2	Manufacturing Industries and Construction - Liquid Fuels	CO_2	17,297.09	6,164.27	0.04	5.88%	79.29%
ENERGY	1.B.2.b	Fugitive Emissions from Fuels - Natural Gas	CH_4	21,581.36	24,446.89	0.02	2.67%	81.96%
ENERGY	1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	CO_2	12,480.19	10,896.28	0.02	2.45%	84.41%
WASTE	4.D.2	Industrial Wastewater Treatment and Discharge	CH_4	13,833.55	13,927.93	0.02	2.20%	86.61%
ENERGY	1.A.1	Energy Industries - Liquid Fuels	CO_2	11,757.33	10,663.81	0.02	2.19%	88.80%
AFOLU	3.B.2.a	Crop Land Remaining Cropland	CO_2	-18,612.73	-15,314.31	0.01	2.07%	90.87%
IPPU	2.A.4	Other Process Uses of Carbonates - Limestone and Dolomite	CO_2	178.68	4,184.05	0.01	1.09%	91.96%
IPPU	2.A.1	Cement Production	CO_2	7,615.98	9,125.90	0.01	0.80%	92.76%
IPPU	2.C.3	Aluminium Production	PFC-14	-	2,246.56	0.00	0.63%	93.39%
AFOLU	3.C.4	Direct N_2O Emissions from Managed Soils	N_2O	3,852.49	4,052.61	0.00	0.56%	93.95%
ENERGY	1.A.4	Other Sectors - Liquid Fuels	CO_2	4,555.67	5,260.26	0.00	0.54%	94.48%
ENERGY	1.A.2	Manufacturing Industries and Construction - Solid Fuels	CO_2	5,420.07	6,795.19	0.00	0.49%	94.97%
WASTE	4.A	Solid Waste Disposal	CH_4	6,072.29	11,214.23	0.00	0.46%	95.43%

Table B20b: Approach 1 Trend Assessment for Greenhouse Gas Inventory Year 2016 - with LULUCF (2 of 5)

Sector	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2005 Base Year Estimate (Gg CO_2 eq)	2016 Year (Gg CO_2 eq)	Trend Assessment	Contribution to Trend (%)	Cumulative (%)
ENERGY	1.B.2.a	Fugitive Emissions from Fuel - Oil	CO_2	2,006.83	1,846.14	0.00	0.37%	95.79%
IPPU	2.C.3	Aluminium Production	CO_2	-	1,216.00	0.00	0.34%	96.13%
AFOLU	3.C.7	Rice Cultivations	CH_4	2,118.20	2,265.20	0.00	0.30%	96.43%
WASTE	4.D.1	Domestic Wastewater Treatment and Discharge	CH_4	1,694.11	1,608.12	0.00	0.30%	96.73%
AFOLU	3.A.1	Enteric Fermentation	CH_4	1,452.12	1,370.44	0.00	0.26%	96.98%
IPPU	2.E.3	Photovoltaics	PFC-14	-	875.16	0.00	0.24%	97.23%
IPPU	2.C.1	Iron and Steel Production	CO_2	1,367.96	1,384.51	0.00	0.22%	97.44%
ENERGY	1.A.3.a	Civil Aviation	CO_2	1,202.61	1,132.99	0.00	0.21%	97.66%
ENERGY	1.A.3.b	Road Transportation	CO_2	35,458.78	55,188.34	0.00	0.20%	97.86%
IPPU	2.E.1	Integrated Circuit or Semiconductor	PFC-116	1,029.30	901.69	0.00	0.20%	98.06%
ENERGY	1.A.3.d	Water-borne Navigation - Liquid Fuels	CO_2	3,947.29	5,505.04	0.00	0.20%	98.26%
AFOLU	3.C.5	Indirect N_2O Emissions from Managed Soils	N_2O	1,185.79	1,156.86	0.00	0.20%	98.46%
ENERGY	1.B.2.a	Fugitive Emissions from Fuels - Oil	CH_4	932.06	861.34	0.00	0.17%	98.63%
IPPU	2.B.8	Petrochemical and Carbon Black Production	CO_2	2,633.90	3,583.40	0.00	0.16%	98.79%
IPPU	2.E.1	Integrated Circuit or Semiconductor	PFC-14	-	491.57	0.00	0.14%	98.93%
IPPU	2.B.1	Ammonia Production	CO_2	988.52	1,170.29	0.00	0.11%	99.03%
AFOLU	3.C.3	Urea Application	CO_2	575.07	527.29	0.00	0.11%	99.14%
IPPU	2.C.3	Aluminium Production	PFC-116	-	370.88	0.00	0.10%	99.24%

Table B20b: Approach 1 Trend Assessment for Greenhouse Gas Inventory Year 2016 - with LULUCF (3 of 5)

Sector	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2005 Base Year Estimate (Gg CO_2 eq)	2016 Year (Gg CO_2 eq)	Trend Assessment	Contribution to Trend (%)	Cumulative (%)
IPPU	2.B.2	Nitric Acid Production	N_2O	217.54	-	0.00	0.10%	99.34%
IPPU	2.E.1	Integrated Circuit or Semiconductor	SF_6	-	337.03	0.00	0.09%	99.43%
IPPU	2.A.2	Lime Production	CO_2	239.24	77.00	0.00	0.08%	99.52%
AFOLU	3.A.2	Manure Management	CH_4	506.79	505.64	0.00	0.08%	99.60%
ENERGY	1.A.3.c	Railways	CO_2	158.12	77.73	0.00	0.05%	99.64%
ENERGY	1.A.1	Energy Industries - Solid Fuels	N_2O	103.63	317.18	0.00	0.04%	99.69%
AFOLU	3.C.6	Indirect N_2O Emissions from Manure Management	N_2O	456.57	605.34	0.00	0.03%	99.72%
WASTE	4.D.1	Domestic Wastewater Treatment and Discharge	N_2O	293.84	375.96	0.00	0.02%	99.74%
ENERGY	1.A.5	Non-Specified - Liquid Fuels	CO_2	279.22	507.91	0.00	0.02%	99.76%
IPPU	2.E.3	Photovoltaics	PFC-116	-	57.79	0.00	0.02%	99.78%
IPPU	2.E.1	Integrated Circuit or Semiconductor	NF3	-	50.85	0.00	0.01%	99.79%
ENERGY	1.A.2	Manufacturing Industries and Construction - Liquid Fuels	N_2O	40.06	14.13	0.00	0.01%	99.81%
ENERGY	1.A.4	Other Sectors - Gaseous Fuels	CO_2	65.72	58.68	0.00	0.01%	99.82%
IPPU	2.E.1	Integrated Circuit or Semiconductor	HFC-23	-	43.75	0.00	0.01%	99.83%
IPPU	2.F.1.b	Refrigeration and Air Conditioning - Mobile Air Conditioning	HFC-134a	479.34	713.28	0.00	0.01%	99.84%
ENERGY	1.B.2.b	Fugitive Emissions from Fuels - Natural Gas	CO_2	87.89	96.01	0.00	0.01%	99.86%
IPPU	2.B.5	Carbide Production	CO_2	49.49	38.02	0.00	0.01%	99.87%
IPPU	2.C.1	Iron and Steel Production	CH_4	33.75	16.40	0.00	0.01%	99.88%
IPPU	2.G.3.b	Other Product Manufacture and Use - N_2O in Medical Applications	N_2O	22.34	70.70	0.00	0.01%	99.89%
ENERGY	1.A.1	Energy Industries - Biomass	N_2O	27.71	9.90	0.00	0.01%	99.90%

Table B20b: Approach 1 Trend Assessment for Greenhouse Gas Inventory Year 2016 - with LULUCF (4 of 5)

Sector	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2005 Base Year Estimate (Gg CO_2 eq)	2016 Year (Gg CO_2 eq)	Trend Assessment	Contribution to Trend (%)	Cumulative (%)
IPPU	2.E.1	Integrated Circuit or Semiconductor	PFC-218	-	32.63	0.00	0.01%	99.90%
AFOLU	3.A.2	Manure Management	N_2O	96.78	129.79	0.00	0.01%	99.91%
ENERGY	1.A.1	Energy Industries - Biomass	CH_4	17.43	6.23	0.00	0.01%	99.92%
ENERGY	1.A.2	Manufacturing Industries and Construction - Liquid Fuels	CH_4	16.92	5.99	0.00	0.01%	99.92%
ENERGY	1.A.1	Energy Industries - Gaseous Fuels	N_2O	30.66	27.66	0.00	0.01%	99.93%
ENERGY	1.A.3.c	Railways	N_2O	18.19	8.94	0.00	0.01%	99.93%
ENERGY	1.B.1	Fugitive Emissions from Fuels - Solid Fuels	CH_4	24.73	19.63	0.00	0.01%	99.94%
ENERGY	1.A.1	Energy Industries - Liquid Fuels	N_2O	28.54	25.93	0.00	0.01%	99.94%
ENERGY	1.A.3.b	Road Transportation	CH_4	306.68	501.41	0.00	0.00%	99.95%
ENERGY	1.A.1	Energy Industries - Gaseous Fuels	CH_4	25.72	23.20	0.00	0.00%	99.95%
WASTE	4.C.1	Waste Incineration	CO_2	29.61	30.36	0.00	0.00%	99.96%
IPPU	2.A.3	Glass Production	CO_2	28.34	28.71	0.00	0.00%	99.96%
AFOLU	3.C.1.a	Emissions from Biomass Burning in Forest Lands	N2O	4.10	19.13	0.00	0.00%	99.97%
IPPU	2.G.1	Other Product Manufacture and Use - Electrical Equipment	SF_6	14.82	11.14	0.00	0.00%	99.97%
ENERGY	1.A.4	Other Sectors - Liquid Fuels	N_2O	10.78	5.71	0.00	0.00%	99.97%
ENERGY	1.A.3.b	Road Transportation	N_2O	510.57	794.46	0.00	0.00%	99.98%
AFOLU	3.C.1.a	Emissions from Biomass Burning in Forest Lands	CH_4	11.68	28.93	0.00	0.00%	99.98%
ENERGY	1.A.1	Energy Industries - Solid Fuels	CH_4	5.80	17.74	0.00	0.00%	99.98%
ENERGY	1.A.2	Manufacturing Industries and Construction - Solid Fuels	N_2O	25.21	31.61	0.00	0.00%	99.98%

Table B20b: Approach 1 Trend Assessment for Greenhouse Gas Inventory Year 2016 - with LULUCF (5 of 5)

Sector	IPCC Category Code	IPCC Category Name	Greenhouse Gas	2005 Base Year Estimate (Gg CO_2 eq)	2016 Year (Gg CO_2 eq)	Trend Assessment	Contribution to Trend (%)	Cumulative (%)
ENERGY	1.A.1	Energy Industries - Liquid Fuels	CH_4	11.97	10.88	0.00	0.00%	99.99%
ENERGY	1.A.3.a	Civil Aviation	N_2O	10.02	9.44	0.00	0.00%	99.99%
ENERGY	1.A.3.d	Water-borne Navigation - Liquid Fuels	N_2O	31.74	44.26	0.00	0.00%	99.99%
ENERGY	1.A.4	Other Sectors - Liquid Fuels	CH_4	4.66	12.73	0.00	0.00%	99.99%
ENERGY	1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	N_2O	6.63	5.79	0.00	0.00%	99.99%
ENERGY	1.A.2	Manufacturing Industries and Construction - Solid Fuels	CH_4	14.10	17.68	0.00	0.00%	99.99%
AFOLU	3.C.2	Liming	CO_2	-	4.54	0.00	0.00%	100.00%
ENERGY	1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	CH_4	5.56	4.86	0.00	0.00%	100.00%
AFOLU	3.C.1.b	Emissions from Biomass Burning in Croplands	CH_4	7.13	7.65	0.00	0.00%	100.00%
IPPU	2.B.8	Petrochemical and Carbon Black Production	CH_4	202.75	321.67	0.00	0.00%	100.00%
ENERGY	1.A.3.d	Water-borne Navigation - Liquid Fuels	CH_4	9.32	13.00	0.00	0.00%	100.00%
WASTE	4.C.2	Open Burning of Waste	CH_4	2.11	1.93	0.00	0.00%	100.00%
AFOLU	3.C.1.b	Emissions from Biomass Burning in Croplands	N_2O	2.20	2.37	0.00	0.00%	100.00%
WASTE	4.C.1	Waste Incineration	N_2O	1.74	1.79	0.00	0.00%	100.00%
ENERGY	1.A.5	Non-Specified - Liquid Fuels	CH_4	0.73	0.59	0.00	0.00%	100.00%
WASTE	4.C.2	Open Burning of Waste	CO_2	0.77	0.70	0.00	0.00%	100.00%
ENERGY	1.A.3.c	Railways	CH_4	0.22	0.11	0.00	0.00%	100.00%
ENERGY	1.A.5	Non-Specified - Liquid Fuels	N_2O	2.87	4.76	0.00	0.00%	100.00%
WASTE	4.B	Biological Treatment of Solid Waste	CH_4	0.01	0.24	0.00	0.00%	100.00%
WASTE	4.C.2	Open Burning of Waste	N_2O	0.25	0.23	0.00	0.00%	100.00%
WASTE	4.B	Biological Treatment of Solid Waste	N_2O	0.01	0.17	0.00	0.00%	100.00%
ENERGY	1.A.3.a	Civil Aviation	CH_4	0.21	0.20	0.00	0.00%	100.00%
ENERGY	1.A.4	Other Sectors - Gaseous Fuels	CH_4	0.15	0.13	0.00	0.00%	100.00%
ENERGY	1.A.4	Other Sectors - Gaseous Fuels	N_2O	0.03	0.03	0.00	0.00%	100.00%
				47,864.54	**75,488.62**	**0.70**	**100.00%**	

Table B21a: Approach 1 Uncertainty Analysis for Greenhouse Gas Inventory Year 2016 - without LULUCF (1 of 7)

Sector	IPCC category		Gas	Base year (2005) emissions or removals	Year t (2016) emissions or removals	Activity data uncer-tainty	Emission factor uncertainty/ estimation parameter uncertainty	Combined uncertainty	Contribu-tion 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
				($Gg\ CO_2$ eq.)	($Gg\ CO_2$ eq.)	%	%	%		%	%	%	%	%
ENERGY	**1A Fuel Combustion Activities**													
	1A1 Energy Industries													
	1A1a Main Activity Electricity and Heat Production	Liquids	CO_2	1,820.67	1,165.70	0.71%	1.56%	1.72%	0.0000	0.0048	0.0047	0.01%	0.00%	0.00%
			CH_4	1.80	1.16	0.71%	166.81%	166.81%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
			N_2O	4.30	2.76	0.71%	162.36%	162.36%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
		Solids	CO_2	22,279.39	68,189.15	1.00%	4.06%	4.18%	0.0001	0.1604	0.2774	0.65%	0.39%	0.01%
			CH_4	5.80	17.74	1.00%	200.00%	200.00%	0.0000	0.0000	0.0001	0.01%	0.00%	0.00%
			N_2O	103.63	317.18	1.00%	233.33%	233.33%	0.0000	0.0007	0.0013	0.17%	0.00%	0.00%
		Gas	CO_2	30,969.27	33,692.05	1.00%	3.90%	4.03%	0.0000	0.0253	0.1371	0.10%	0.19%	0.00%
			CH_4	13.80	15.01	1.00%	200.00%	200.00%	0.0000	0.0000	0.0001	0.00%	0.00%	0.00%
			N_2O	16.45	17.90	1.00%	275.00%	275.00%	0.0000	0.0000	0.0001	0.00%	0.00%	0.00%
		Bio-mass	CH_4	17.43	6.21	1.00%	233.33%	233.33%	0.0000	0.0001	0.0000	0.02%	0.00%	0.00%
			N_2O	27.71	9.87	1.00%	275.00%	275.00%	0.0000	0.0001	0.0000	0.03%	0.00%	0.00%
		Biogas	CH_4	0.00	0.02	1.00%	233.33%	233.33%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
			N_2O	0.00	0.03	1.00%	200.00%	200.00%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
	1A1b Petroleum Refining	Liquids	CO_2	9,936.67	9,498.10	1.00%	3.00%	3.16%	0.0000	0.0135	0.0386	0.04%	0.05%	0.00%
			CH_4	10.17	9.72	1.00%	200.00%	200.00%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
			N_2O	24.24	23.17	1.00%	233.33%	233.33%	0.0000	0.0000	0.0001	0.01%	0.00%	0.00%

Table B21a: Approach 1 Uncertainty Analysis for Greenhouse Gas Inventory Year 2016 - without LULUCF (2 of 7)

Sector	IPCC category		Gas	Base year (2005) emissions or removals	Year t (2016) emissions or removals	Activity data uncer-tainty	Emission factor uncertainty/ estimation parameter uncertainty	Combined uncertainty	Contribu-tion 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
				($Gg\ CO_2$ eq.)	($Gg\ CO_2$ eq.)	%	%	%		%	%	%	%	%
ENERGY	1A1c Manufacture of Solid Fuels and Other Energy Industries	Gas	CO_2	26,744.27	18,378.76	1.00%	3.92%	4.05%	0.0000	0.0654	0.0748	0.26%	0.11%	0.00%
			CH_4	11.92	8.19	1.00%	200.00%	200.00%	0.0000	0.0000	0.0000	0.01%	0.00%	0.00%
			N_2O	14.21	9.76	1.00%	200.00%	200.00%	0.0000	0.0000	0.0000	0.01%	0.00%	0.00%
	1A2 Manufacturing Industries and Construction	Liquids	CO_2	17,297.09	6,164.27	2.10%	1.48%	2.57%	0.0000	0.0656	0.0251	0.10%	0.07%	0.00%
			CH_4	16.92	5.99	2.17%	144.51%	144.52%	0.0000	0.0001	0.0000	0.01%	0.00%	0.00%
			N_2O	40.06	14.13	2.19%	170.37%	170.39%	0.0000	0.0002	0.0001	0.03%	0.00%	0.00%
		Solids	CO_2	5,420.07	6,795.19	3.00%	4.06%	5.05%	0.0000	0.0008	0.0276	0.00%	0.12%	0.00%
			CH_4	14.10	17.68	3.00%	200.00%	200.02%	0.0000	0.0000	0.0001	0.00%	0.00%	0.00%
			N_2O	25.21	31.61	3.00%	233.33%	233.35%	0.0000	0.0000	0.0001	0.00%	0.00%	0.00%
		Gas	CO_2	12,480.19	10,896.28	3.00%	3.92%	4.94%	0.0000	0.0211	0.0443	0.08%	0.19%	0.00%
			CH_4	5.56	4.86	3.00%	200.00%	200.02%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
			N_2O	6.63	5.79	3.00%	233.33%	233.35%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
	1A3a Civil Aviation	Liquids	CO_2	1,202.61	1,132.99	5.00%	4.06%	6.44%	0.0000	0.0017	0.0046	0.01%	0.03%	0.00%
			CH_4	0.21	0.20	5.00%	233.33%	233.38%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
			N_2O	10.02	9.44	5.00%	233.33%	233.38%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
	1A3b Road Transportation	Liquids	CO_2	35,235.80	54,700.12	17.66%	3.81%	18.07%	0.0010	0.0377	0.2225	0.14%	5.56%	0.31%
			CH_4	297.53	481.39	18.28%	191.38%	192.25%	0.0000	0.0004	0.0020	0.08%	0.05%	0.00%
			N_2O	507.01	786.68	12.81%	157.33%	157.85%	0.0000	0.0005	0.0032	0.09%	0.06%	0.00%

Table B21a: Approach 1 Uncertainty Analysis for Greenhouse Gas Inventory Year 2016 - without LULUCF (3 of 7)

Sector	IPCC category		Gas	Base year (2005) emissions or removals	Year t (2016) emissions or removals	Activity data uncer-tainty	Emission factor uncertainty/ estimation parameter uncertainty	Combined uncertainty	Contribu-tion 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
				($Gg\ CO_2$ eq.)	($Gg\ CO_2$ eq.)	%	%	%		%	%	%	%	%
ENERGY		Gas	CO_2	222.99	488.22	1.00%	3.92%	4.05%	0.0000	0.0008	0.0020	0.00%	0.00%	0.00%
			CH_4	9.14	20.02	1.00%	200.00%	200.00%	0.0000	0.0000	0.0001	0.01%	0.00%	0.00%
			N_2O	3.55	7.78	1.00%	233.33%	233.33%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
	1A3c Railway	Liquids	CO_2	158.12	77.73	5.00%	2.02%	5.39%	0.0000	0.0005	0.0003	0.00%	0.00%	0.00%
			CH_4	0.22	0.11	5.00%	233.33%	233.38%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
			N_2O	18.19	8.94	5.00%	233.33%	233.38%	0.0000	0.0001	0.0000	0.01%	0.00%	0.00%
	1A3d Water-Borne Navigation	Liquids	CO_2	3947.29	5505.04	4.96%	2.02%	5.35%	0.0000	0.0017	0.0224	0.00%	0.16%	0.00%
			CH_4	9.32	13.00	5.00%	233.33%	233.38%	0.0000	0.0000	0.0001	0.00%	0.00%	0.00%
			N_2O	31.74	44.26	5.00%	233.33%	233.38%	0.0000	0.0000	0.0002	0.00%	0.00%	0.00%
	1A4a Commercial & Institutional	Liquids	CO_2	2,156.27	2,519.97	4.09%	3.18%	5.18%	0.0000	0.0011	0.0103	0.00%	0.06%	0.00%
			CH_4	5.36	5.70	3.75%	150%	150.19%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
			N_2O	2.61	2.18	3.39%	149%	149.24%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
		Gas	CO_2	53.99	56.33	5.00%	3.92%	6.35%	0.0000	0.0001	0.0002	0.00%	0.00%	0.00%
			CH_4	0.12	0.13	5.00%	200.00%	200.06%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
			N_2O	0.03	0.03	5.00%	200.00%	200.06%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
	1A4b Residential	Liquids	CO_2	2,085.98	1,598.37	4.97%	3.94%	6.34%	0.0000	0.0044	0.0065	0.02%	0.05%	0.00%
			CH_4	4.36	3.18	4.95%	198.04%	198.10%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
			N_2O	1.29	0.77	4.86%	194.31%	194.37%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%

Table B21a: Approach 1 Uncertainty Analysis for Greenhouse Gas Inventory Year 2016 - without LULUCF (4 of 7)

Sector	IPCC category		Gas	Base year (2005) emissions or removals	Year t (2016) emissions or removals	Activity data uncer-tainty	Emission factor uncertainty/ estimation parameter uncertainty	Combined uncertainty	Contribu-tion 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
				($Gg\ CO_2$ eq.)	($Gg\ CO_2$ eq.)	%	%	%		%	%	%	%	%
ENERGY	1A4b Residential	Gas	CO_2	11.74	2.35	5.00%	3.92%	6.35%	0.0000	0.0001	0.0000	0.00%	0.00%	0.00%
			CH_4	0.03	0.01	5.00%	200.00%	200.06%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
			N_2O	0.01	0.00	5.00%	200.00%	200.06%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
	1A4c Agriculture	Liquids	CO_2	313.42	1,141.93	4.07%	1.92%	4.50%	0.0000	0.0030	0.0046	0.01%	0.03%	0.00%
			CH_4	1.06	3.85	4.03%	161.16%	161.21%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
			N_2O	0.76	2.75	4.03%	188.02%	188.06%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
	1A5 Non Specified	Liquids	CO_2	279.22	507.91	3.64%	2.77%	4.58%	0.0000	0.0006	0.0021	0.00%	0.01%	0.00%
			CH_4	0.732	0.591	3.24%	129.47%	129.51%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
			N_2O	2.874	4.759	3.45%	160.94%	160.98%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
	1B Fugitive Emissions from Fuels													
	1B1 Solid Fuel	Solids	CH_4	24.73	19.63	5.00%	200.00%	200.06%	0.0000	0.0000	0.0001	0.01%	0.00%	0.00%
	1B2 Oil and Natural Gas	Liquids	CO_2	2,006.83	1,846.14	5.00%	3.00%	5.83%	0.0000	0.0030	0.0075	0.01%	0.05%	0.00%
			CH_4	932.06	861.34	5.00%	233.33%	233.38%	0.0000	0.0014	0.0035	0.32%	0.02%	0.00%
		Gas	CO_2	87.89	96.01	5.00%	3.92%	6.35%	0.0000	0.0001	0.0004	0.00%	0.00%	0.00%
			CH_4	21,581.36	24,446.89	5.00%	66.67%	66.86%	0.0027	0.0137	0.0995	0.91%	0.70%	0.01%

Table B21a: Approach 1 Uncertainty Analysis for Greenhouse Gas Inventory Year 2016 - without LULUCF (5 of 7)

Sector	IPCC category		Gas	Base year (2005) emissions or removals	Year t (2016) emissions or removals	Activity data uncer-tainty	Emission factor uncertainty/ estimation parameter uncertainty	Combined uncertainty	Contribu-tion 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
				($Gg\ CO_2$ eq.)	($Gg\ CO_2$ eq.)	%	%	%		%	%	%	%	%
2 Industrial Processes and Product Use														
IPPU	2A Mineral Industry	2A1 Cement production	CO_2	7,615.98	9,125.90	2.00%	8.00%	8.25%	0.0000	0.0028	0.0371	0.02%	0.11%	0.00%
		2A2 Lime production	CO_2	239.24	77.00	8.00%	2.00%	8.25%	0.0000	0.0009	0.0003	0.00%	0.00%	0.00%
		2A3 Glass production	CO_2	28.34	28.71	5.00%	10.00%	11.18%	0.0000	0.0000	0.0001	0.00%	0.00%	0.00%
		2A4d Limestone and dolomite	CO_2	178.68	4,184.05	3.00%	5.00%	5.83%	0.0000	0.0161	0.0170	0.08%	0.07%	0.00%
	2B Chemical Industry	2B1 Ammonia production	CO_2	988.52	1,170.29	5.00%	6.00%	7.81%	0.0000	0.0004	0.0048	0.00%	0.03%	0.00%
		2B2 Nitric acid production	N_2O	217.54	0.00	2.00%	40.00%	40.05%	0.0000	0.0011	0.0000	0.05%	0.00%	0.00%
		2B5 Carbide production	CO_2	49.49	38.02	5.00%	10.00%	11.18%	0.0000	0.0001	0.0002	0.00%	0.00%	0.00%
		2B8 Petrochemicals and Carbon Black	CO_2	2,633.90	3,583.40	5.00%	30.00%	30.41%	0.0000	0.0008	0.0146	0.02%	0.10%	0.00%
			CH_4	202.75	321.67	5.00%	60.00%	60.21%	0.0000	0.0002	0.0013	0.01%	0.01%	0.00%
	2C Metal Industry	2C1 Iron and Steel production	CO_2	1,367.96	1,384.51	10.00%	25.00%	26.93%	0.0000	0.0015	0.0056	0.04%	0.08%	0.00%
			CH_4	33.75	16.40	10.00%	25.00%	26.93%	0.0000	0.0001	0.0001	0.00%	0.00%	0.00%
		2C3 Aluminium production	CO_2	0.00	1,216.00	1.00%	10.00%	10.05%	0.0000	0.0049	0.0049	0.05%	0.01%	0.00%
			PFC	0.00	2,617.44	1.00%	10.00%	10.05%	0.0000	0.0106	0.0106	0.11%	0.02%	0.00%
	2E Electronics Industry	2E1 Integrated Circuit or Semiconductor	PFC, HFC, SF_6, NH_3	1,029.30	1,857.51	10.00%	10.00%	14.14%	0.0000	0.0022	0.0076	0.02%	0.11%	0.00%
		2E3 Photovoltaics	PFC	0.00	932.95	10.00%	10.00%	14.14%	0.0000	0.0038	0.0038	0.04%	0.05%	0.00%

Table B21a: Approach 1 Uncertainty Analysis for Greenhouse Gas Inventory Year 2016 - without LULUCF (6 of 7)

Sector	IPCC category		Gas	Base year (2005) emissions or removals	Year t (2016) emissions or removals	Activity data uncer-tainty	Emission factor uncertainty/ estimation parameter uncertainty	Combined uncertainty	Contribu-tion 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
				($Gg\ CO_2$ eq.)	($Gg\ CO_2$ eq.)	%	%	%		%	%	%	%	%
IPPU	2F Product Uses as Substitutes for Ozone Depleting Substances	2F1b Mobile Air-Conditioning	HFC134a	479.34	713.28	10.00%	10.00%	14.14%	0.0000	0.0004	0.0029	0.00%	0.04%	0.00%
	2G Other Product Manufacture and Use	2G1 Electrical Equipment	SF_6	14.82	11.14	10.00%	10.00%	14.14%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
		2G3b N_2O in Medical Applications	N_2O	22.34	70.70	10.00%	1.00%	10.05%	0.0000	0.0002	0.0003	0.00%	0.00%	0.00%
3 AFOLU - Agriculture														
AFOLU - Agriculture	3A Livestock	3A1 Enteric Fermentation	CH_4	1,452.12	1,370.44	13.23%	97.47%	98.36%	0.0000	0.0020	0.0056	0.20%	0.10%	0.00%
		3A2 Manure Management	CH_4	506.79	505.64	14.14%	93.81%	94.87%	0.0000	0.0006	0.0021	0.06%	0.04%	0.00%
			N_2O	96.78	129.79	14.14%	141.42%	142.13%	0.0000	0.0000	0.0005	0.00%	0.01%	0.00%
	3C Aggregate Sources and Non-CO2 Emissions Sources on Land	3C1b Biomass Burning In Croplands	CH_4	7.13	7.65	10.00%	0.00%	10.00%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
			N_2O	2.20	2.37	10.00%	0.00%	10.00%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
		3C2 Liming	CO_2	0.00	4.54	50.00%	50.00%	70.71%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
		3C3 Urea application	CO_2	575.07	527.29	50.00%	50.00%	70.71%	0.0000	0.0009	0.0021	0.04%	0.15%	0.00%
		3C4 Direct N2O Emissions from managed soils	N_2O	3,852.49	4,052.61	113.58%	112.85%	160.11%	0.0004	0.0037	0.0165	0.42%	2.65%	0.07%
		3C5 Indirect N2O Emissions from managed soils	N_2O	1,185.79	1,156.86	90.880%	21.08%	93.29%	0.0000	0.0015	0.0047	0.03%	0.60%	0.00%

Table B21a: Approach 1 Uncertainty Analysis for Greenhouse Gas Inventory Year 2016 - without LULUCF (7 of 7)

Sector	IPCC category		Gas	Base year (2005) emissions or removals	Year t (2016) emissions or removals	Activity data uncer-tainty	Emission factor uncertainty/ estimation parameter uncertainty	Combined uncertainty	Contribu-tion 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
				($Gg\ CO_2$ eq.)	($Gg\ CO_2$ eq.)	%	%	%		%	%	%	%	%
		3C6 Indirect N2O Emissions from manure management	N_2O	456.57	605.34	16.58%	20.00%	25.98%	0.0000	0.0001	0.0025	0.00%	0.06%	0.00%
		3C7 Rice cultivations	CH_4	2,118.20	2,265.20	10.00%	62.50%	63.29%	0.0000	0.0019	0.0092	0.12%	0.13%	0.00%
WASTE														
WASTE	4A Solid Waste Disposal Sites		CH_4	6,072.29	11,214.23	51.96%	35.00%	62.65%	0.0005	0.0138	0.0456	0.48%	3.35%	0.11%
	4B Biological Treatment of Solid Waste		CH_4	0.01	0.24	154.00%	100.00%	183.62%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
			N_2O	0.01	0.17	154.00%	150.00%	214.98%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
	4 C Incineration and Open Burning of Waste	4C1 Waste Incineration	CO_2	29.61	30.36	10.00%	70.00%	70.71%	0.0000	0.0000	0.0001	0.00%	0.00%	0.00%
			CH_4	0.00	0.00	10.00%	100.00%	100.50%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
			N_2O	1.74	1.79	10.00%	100.00%	100.50%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
		4C2 Open Burning of Waste	CO_2	0.77	0.70	54.77%	65.57%	85.44%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
			CH_4	2.11	1.93	54.77%	112.69%	125.30%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
			N_2O	0.25	0.23	54.77%	100.00%	114.02%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
	4 D Wastewater Treatment and Discharge	4D1 Domestic Wastewater	CH_4	1,694.11	1,608.12	60.00%	58.31%	83.67%	0.0000	0.0023	0.0065	0.14%	0.56%	0.00%
			N_2O	293.84	375.96	15.48%	50.00%	52.34%	0.0000	0.0000	0.0015	0.00%	0.03%	0.00%
		4D2 Industrial Wastewater	CH_4	13,833.55	13,927.93	28.72%	39.05%	48.48%	0.0005	0.0159	0.0567	0.62%	2.30%	0.06%
Total				**245,797.38**	**316,833.38**				**0.0053**					**0.0058**
							Percentage uncertainty in total inventory		**7.3%**				**Trend Uncertainty**	**7.6%**

Table B21b: Approach 1 Uncertainty Analysis for Greenhouse Gas Inventory Year 2016 - with LULUCF (1 of 9)

Sector	IPCC category		Gas	Base year (2005) emissions or removals	Year t (2016) 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
				($Gg\ CO_2$ eq.)	($Gg\ CO_2$ eq.)	%	%	%		%	%	%	%	%
ENERGY	**1A Fuel Combustion Activities**													
	1A1 Energy Industries													
	1A1a Main Activity Electricity and Heat Production	Liquids	CO_2	1,820.67	1,165.70	0.71%	1.56%	1.72%	0.0000	0.0356	0.0244	0.06%	0.02%	0.00%
			CH_4	1.80	1.16	0.71%	166.81%	166.81%	0.0000	0.0000	0.0000	0.01%	0.00%	0.00%
			N_2O	4.30	2.76	0.71%	162.36%	162.36%	0.0000	0.0001	0.0001	0.01%	0.00%	0.00%
		Solids	CO_2	22,279.39	68,189.15	1.00%	4.06%	4.18%	0.0014	0.6873	1.4246	2.79%	2.01%	0.12%
			CH_4	5.80	17.74	1.00%	200.00%	200.00%	0.0000	0.0002	0.0004	0.04%	0.00%	0.00%
			N_2O	103.63	317.18	1.00%	233.33%	233.33%	0.0001	0.0032	0.0066	0.75%	0.01%	0.01%
		Gas	CO_2	30,969.27	33,692.05	1.00%	3.90%	4.03%	0.0003	0.3145	0.7039	1.23%	1.00%	0.02%
			CH_4	13.80	15.01	1.00%	200.00%	200.00%	0.0000	0.0001	0.0003	0.03%	0.00%	0.00%
			N_2O	16.45	17.90	1.00%	275.00%	275.00%	0.0000	0.0002	0.0004	0.05%	0.00%	0.00%
		Biomass	CH_4	17.43	6.21	1.00%	233.33%	233.33%	0.0000	0.0004	0.0001	0.10%	0.00%	0.00%
			N_2O	27.71	9.87	1.00%	275.00%	275.00%	0.0000	0.0007	0.0002	0.19%	0.00%	0.00%
		Biogas	CH_4	0.00	0.02	1.00%	233.33%	233.33%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
			N_2O	0.00	0.03	1.00%	200.00%	200.00%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
	1A1b Petroleum Refining	Liquids	CO_2	9,936.67	9,498.10	1.00%	3.00%	3.16%	0.0000	0.1287	0.1984	0.39%	0.28%	0.00%
			CH_4	10.17	9.72	1.00%	200.00%	200.00%	0.0000	0.0001	0.0002	0.03%	0.00%	0.00%
			N_2O	24.24	23.17	1.00%	233.33%	233.33%	0.0000	0.0003	0.0005	0.07%	0.00%	0.00%

Table B21b: Approach 1 Uncertainty Analysis for Greenhouse Gas Inventory Year 2016 - with LULUCF (2 of 9)

Sector	IPCC category		Gas	Base year (2005) emissions or removals	Year t (2016) emissions or removals	Activity data uncertainty	Emission factor uncer-tainty/ estimation parameter uncertainty	Combi-ned uncer-tainty	Contri-bution to variance by source/ sink category in year *t*	Type A sensiti-vity	Type B sensiti-vity	Uncer-tainty in trend in national emissions introduced by emission factor / estimation parameter uncer-tainty	Uncer-tainty in trend in national emissions introduced by activity data uncer-tainty	Uncertainty introduced into the trend in total national emissions
				(Gg CO_2 eq.)	(Gg CO_2 eq.)	%	%	%		%	%	%	%	%
ENERGY	1A1c Manufacture of Solid Fuels and Other Energy Industries	Gas	CO_2	26,744.27	18,378.76	1.00%	3.92%	4.05%	0.0001	0.4945	0.3840	1.94%	0.54%	0.04%
			CH_4	11.92	8.19	1.00%	200.00%	200.00%	0.0000	0.0002	0.0002	0.04%	0.00%	0.00%
			N_2O	14.21	9.76	1.00%	200.00%	200.00%	0.0000	0.0003	0.0002	0.05%	0.00%	0.00%
	1A2 Manufaturing Industries and Construction	Liquids	CO_2	17,297.09	6,164.27	2.10%	1.48%	2.57%	0.0000	0.4396	0.1288	0.65%	0.38%	0.01%
			CH_4	16.92	5.99	2.17%	144.51%	144.52%	0.0000	0.0004	0.0001	0.06%	0.00%	0.00%
			N_2O	40.06	14.13	2.19%	170.37%	170.39%	0.0000	0.0010	0.0003	0.17%	0.00%	0.00%
		Solids	CO_2	5,420.07	6,795.19	3.00%	4.06%	5.05%	0.0000	0.0366	0.1420	0.15%	0.60%	0.00%
			CH_4	14.10	17.68	3.00%	200.00%	200.02%	0.0000	0.0001	0.0004	0.02%	0.00%	0.00%
			N_2O	25.21	31.61	3.00%	233.33%	233.35%	0.0000	0.0002	0.0007	0.04%	0.00%	0.00%
		Gas	CO_2	12,480.19	10,896.28	3.00%	3.92%	4.94%	0.0001	0.1831	0.2276	0.72%	0.97%	0.01%
			CH_4	5.56	4.86	3.00%	200.00%	200.02%	0.0000	0.0001	0.0001	0.02%	0.00%	0.00%
			N_2O	6.63	5.79	3.00%	233.33%	233.35%	0.0000	0.0001	0.0001	0.02%	0.00%	0.00%
	1A3a Civil Aviation	Liquids	CO_2	1,202.61	1,132.99	5.00%	4.06%	6.44%	0.0000	0.0160	0.0237	0.06%	0.17%	0.00%
			CH_4	0.21	0.20	5.00%	233.33%	233.38%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
			N_2O	10.02	9.44	5.00%	233.33%	233.38%	0.0000	0.0001	0.0002	0.03%	0.00%	0.00%
	1A3b Road Transporta-tion	Liquids	CO_2	35,235.80	54,700.12	17.66%	3.81%	18.07%	0.0171	0.0181	1.1428	0.07%	28.54%	8.15%
			CH_4	297.53	481.39	18.28%	191.38%	192.25%	0.0002	0.0003	0.0101	0.05%	0.26%	0.00%
			N_2O	507.01	786.68	12.81%	157.33%	157.85%	0.0003	0.0003	0.0164	0.04%	0.30%	0.00%

Table B21b: Approach 1 Uncertainty Analysis for Greenhouse Gas Inventory Year 2016 - with LULUCF (3 of 9)

Sector	IPCC category		Gas	Base year (2005) emissions or removals	Year t (2016) emissions or removals	Activity data uncertainty	Emission factor uncer-tainty/ estimation parameter uncertainty	Combi-ned uncer-tainty	Contri-bution to variance by source/ sink category in year *t*	Type A sensiti-vity	Type B sensiti-vity	Uncer-tainty in trend in national emissions introduced by emission factor / estimation parameter uncer-tainty	Uncer-tainty in trend in national emissions introduced by activity data uncer-tainty	Uncertainty introduced into the trend in total national emissions
				(Gg CO_2 eq.)	(Gg CO_2 eq.)	%	%	%		%	%	%	%	%
ENERGY		Gas	CO_2	222.99	488.22	1.00%	3.92%	4.05%	0.0000	0.0029	0.0102	0.01%	0.01%	0.00%
			CH_4	9.14	20.02	1.00%	200.00%	200.00%	0.0000	0.0001	0.0004	0.02%	0.00%	0.00%
			N_2O	3.55	7.78	1.00%	233.33%	233.33%	0.0000	0.0000	0.0002	0.01%	0.00%	0.00%
	1A3c Railway	Liquids	CO_2	158.12	77.73	5.00%	2.02%	5.39%	0.0000	0.0036	0.0016	0.01%	0.01%	0.00%
			CH_4	0.22	0.11	5.00%	233.33%	233.38%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
			N_2O	18.19	8.94	5.00%	233.33%	233.38%	0.0000	0.0004	0.0002	0.10%	0.00%	0.00%
	1A3d Water-Borne Navigation	Liquids	CO_2	3,947.29	5,505.04	4.96%	2.02%	5.35%	0.0000	0.0150	0.1150	0.03%	0.81%	0.01%
			CH_4	9.32	13.00	5.00%	233.33%	233.38%	0.0000	0.0000	0.0003	0.01%	0.00%	0.00%
			N_2O	31.74	44.26	5.00%	233.33%	233.38%	0.0000	0.0001	0.0009	0.03%	0.01%	0.00%
	1A4a Commercial & Institutional	Liquids	CO_2	2,156.27	2,519.97	4.09%	3.18%	5.18%	0.0000	0.0184	0.0526	0.06%	0.30%	0.00%
			CH_4	5.36	5.70	3.75%	150%	150.19%	0.0000	0.0001	0.0001	0.01%	0.00%	0.00%
			N_2O	2.61	2.18	3.39%	149%	149.24%	0.0000	0.0000	0.0000	0.01%	0.00%	0.00%
		Gas	CO_2	53.99	56.33	5.00%	3.92%	6.35%	0.0000	0.0006	0.0012	0.00%	0.01%	0.00%
			CH_4	0.12	0.13	5.00%	200.00%	200.06%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
			N_2O	0.03	0.03	5.00%	200.00%	200.06%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
	1A4b Residential	Liquids	CO_2	2,085.98	1,598.37	4.97%	3.94%	6.34%	0.0000	0.0353	0.0334	0.14%	0.23%	0.00%
			CH_4	4.36	3.18	4.95%	198.04%	198.10%	0.0000	0.0001	0.0001	0.02%	0.00%	0.00%
			N_2O	1.29	0.77	4.86%	194.31%	194.37%	0.0000	0.0000	0.0000	0.01%	0.00%	0.00%

Table B21b: Approach 1 Uncertainty Analysis for Greenhouse Gas Inventory Year 2016 - with LULUCF (4 of 9)

Sector	IPCC category		Gas	Base year (2005) emissions or removals	Year t (2016) emissions or removals	Activity data uncertainty	Emission factor uncer-tainty/ estimation parameter uncertainty	Combi-ned uncer-tainty	Contri-bution to variance by source/ sink category in year *t*	Type A sensiti-vity	Type B sensiti-vity	Uncer-tainty in trend in national emissions introduced by emission factor / estimation parameter uncer-tainty	Uncer-tainty in trend in national emissions introduced by activity data uncer-tainty	Uncertainty introduced into the trend in total national emissions
				(Gg CO_2 eq.)	(Gg CO_2 eq.)	%	%	%		%	%	%	%	%
		Gas	CO_2	11.74	2.35	5.00%	3.92%	6.35%	0.0000	0.0003	0.0000	0.00%	0.00%	0.00%
			CH_4	0.03	0.01	5.00%	200.00%	200.06%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
			N_2O	0.01	0.00	5.00%	200.00%	200.06%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
	1A4c Agriculture	Liquids	CO_2	313.42	1,141.93	4.07%	1.92%	4.50%	0.0000	0.0135	0.0239	0.03%	0.14%	0.00%
			CH_4	1.06	3.85	4.03%	161.16%	161.21%	0.0000	0.0000	0.0001	0.01%	0.00%	0.00%
			N_2O	0.76	2.75	4.03%	188.02%	188.06%	0.0000	0.0000	0.0001	0.01%	0.00%	0.00%
	1A5 Non Specified	Liquids	CO_2	279.22	507.91	3.64%	2.77%	4.58%	0.0000	0.0014	0.0106	0.00%	0.05%	0.00%
			CH_4	0.732	0.591	3.24%	129.47%	129.51%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
			N_2O	2.874	4.759	3.45%	160.94%	160.98%	0.0000	0.0000	0.0001	0.00%	0.00%	0.00%
	1B Fugitive Emissions from Fuels													
	1B1 Solid Fuel	Solids	CH_4	24.73	19.63	5.00%	200.00%	200.06%	0.0000	0.0004	0.0004	0.08%	0.00%	0.00%
	1B2 Oil and Natural Gas	Liquids	CO_2	2,006.83	1,846.14	5.00%	3.00%	5.83%	0.0000	0.0275	0.0386	0.08%	0.27%	0.00%
			CH_4	932.06	861.34	5.00%	233.33%	233.38%	0.0007	0.0127	0.0180	2.97%	0.13%	0.09%
		Gas	CO_2	87.89	96.01	5.00%	3.92%	6.35%	0.0000	0.0009	0.0020	0.00%	0.01%	0.00%
			CH_4	21,581.36	24,446.89	5.00%	66.67%	66.86%	0.0469	0.1995	0.5108	13.30%	3.61%	1.90%

Table B21b: Approach 1 Uncertainty Analysis for Greenhouse Gas Inventory Year 2016 - with LULUCF (5 of 9)

Sector	IPCC category		Gas	Base year (2005) emissions or removals	Year t (2016) emissions or removals	Activity data uncertainty	Emission factor uncer-tainty/ estimation parameter uncertainty	Combi-ned uncer-tainty	Contri-bution to variance by source/ sink category in year *t*	Type A sensiti-vity	Type B sensiti-vity	Uncer-tainty in trend in national emissions introduced by emission factor / estimation parameter uncer-tainty	Uncer-tainty in trend in national emissions introduced by activity data uncer-tainty	Uncertainty introduced into the trend in total national emissions
				(Gg CO_2 eq.)	(Gg CO_2 eq.)	%	%	%		%	%	%	%	%
2 Industrial Processes and Product Use														
IPPU	2A Mineral Industry	2A1 Cement production	CO_2	7,615.98	9,125.90	2.00%	8.00%	8.25%	0.0001	0.0602	0.1907	0.48%	0.54%	0.01%
		2A2 Lime production	CO_2	239.24	77.00	8.00%	2.00%	8.25%	0.0000	0.0063	0.0016	0.01%	0.02%	0.00%
		2A3 Glass production	CO_2	28.34	28.71	5.00%	10.00%	11.18%	0.0000	0.0003	0.0006	0.00%	0.00%	0.00%
		2A4d Limestone and dolomite	CO_2	178.68	4,184.05	3.00%	5.00%	5.83%	0.0000	0.0815	0.0874	0.41%	0.37%	0.00%
	2B Chemical Industry	2B1 Ammonia production	CO_2	988.52	1,170.29	5.00%	6.00%	7.81%	0.0000	0.0081	0.0244	0.05%	0.17%	0.00%
		2B2 Nitric acid production	N_2O	217.54	0.00	2.00%	40.00%	40.05%	0.0000	0.0072	0.0000	0.29%	0.00%	0.00%
		2B5 Carbide production	CO_2	49.49	38.02	5.00%	10.00%	11.18%	0.0000	0.0008	0.0008	0.01%	0.01%	0.00%
		2B8 Petrochemicals and Carbon Black	CO_2	2,633.90	3,583.40	5.00%	30.00%	30.41%	0.0002	0.0119	0.0749	0.36%	0.53%	0.00%
			CH_4	202.75	321.67	5.00%	60.00%	60.21%	0.0000	0.0000	0.0067	0.00%	0.05%	0.00%
	2C Metal Industry	2C1 Iron and Steel production	CO_2	1,367.96	1,384.51	10.00%	25.00%	26.93%	0.0000	0.0161	0.0289	0.40%	0.41%	0.00%
			CH_4	33.75	16.40	10.00%	25.00%	26.93%	0.0000	0.0008	0.0003	0.02%	0.00%	0.00%
		2C3 Aluminium production	CO_2	0.00	1,216.00	1.00%	10.00%	10.05%	0.0000	0.0254	0.0254	0.25%	0.04%	0.00%
			PFC	0.00	2,617.44	1.00%	10.00%	10.05%	0.0000	0.0547	0.0547	0.55%	0.08%	0.00%

Table B21b: Approach 1 Uncertainty Analysis for Greenhouse Gas Inventory Year 2016 - with LULUCF (6 of 9)

Sector	IPCC category		Gas	Base year (2005) emissions or removals	Year t (2016) emissions or removals	Activity data uncertainty	Emission factor uncer-tainty/ estimation parameter uncertainty	Combi-ned uncer-tainty	Contri-bution to variance by source/ sink category in year *t*	Type A sensiti-vity	Type B sensiti-vity	Uncer-tainty in trend in national emissions introduced by emission factor / estimation parameter uncer-tainty	Uncer-tainty in trend in national emissions introduced by activity data uncer-tainty	Uncertainty introduced into the trend in total national emissions
				(Gg CO_2 eq.)	(Gg CO_2 eq.)	%	%	%		%	%	%	%	%
IPPU	2E Electronics Industry	2E1 Integrated Circuit or Semiconductor	PFC, HFC, SF_6, NH_3	1,029.30	1,857.51	10.00%	10.00%	14.14%	0.0000	0.0049	0.0388	0.05%	0.55%	0.00%
		2E3 Photovoltaics	PFC	0.00	932.95	10.00%	10.00%	14.14%	0.0000	0.0195	0.0195	0.19%	0.28%	0.00%
	2F Product Uses as Substitutes for Ozone Depleting Substances	2F1b Mobile Air-Conditioning	HFC134a	479.34	713.28	10.00%	10.00%	14.14%	0.0000	0.0009	0.0149	0.01%	0.21%	0.00%
	2G Other Product Manufacture and Use	2G1 Electrical Equipment	SF_6	14.82	11.14	10.00%	10.00%	14.14%	0.0000	0.0003	0.0002	0.00%	0.00%	0.00%
		2G3b N_2O in Medical Applications	N_2O	22.34	70.70	10.00%	1.00%	10.05%	0.0000	0.0007	0.0015	0.00%	0.02%	0.00%
3 AFOLU														
AFOLU	3A Livestock	3A1 Enteric Fermentation	CH_4	1,452.12	1,370.44	13.23%	97.47%	98.36%	0.0003	0.0192	0.0286	1.87%	0.54%	0.04%
		3A2 Manure Management	CH_4	506.79	505.64	14.14%	93.81%	94.87%	0.0000	0.0061	0.0106	0.58%	0.21%	0.00%
			N_2O	96.78	129.79	14.14%	141.42%	142.13%	0.0000	0.0005	0.0027	0.07%	0.05%	0.00%

Table B21b: Approach 1 Uncertainty Analysis for Greenhouse Gas Inventory Year 2016 - with LULUCF (7 of 9)

Sector	IPCC category		Gas	Base year (2005) emissions or removals	Year t (2016) 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
				($Gg\ CO_2$ eq.)	($Gg\ CO_2$ eq.)	%	%	%		%	%	%	%	%
AFOLU	**3B Land**													
	3B1 Forest Land	3B1a Forest Land Remaining Forest Land	CO_2	-215,305.31	-243,831.71	15.00%	10.00%	18.03%	0.3391	2.0943	5.0942	20.94%	108.06%	121.17%
	3B2 Cropland	3B2a Cropland Remaining Cropland	CO_2	-18,612.73	-15,314.31	20.00%	10.00%	22.36%	0.0021	0.2945	0.3200	2.94%	9.05%	0.91%
	3B5 Settlements	3B5b Land Converted to Settlements	CO2	35,969.41	17,753.21	20.00%	20.00%	28.28%	0.0044	0.8082	0.3709	16.16%	10.49%	3.71%
	3C Aggregate Sources and Non-CO2 Emissions Sources on Land													
	3C Aggregate Sources and Non-CO2 Emissions Sources on Land	3C1a Biomass Burning in Forest Lands	CH_4	11.68	28.93	15.00%	10.00%	18.03%	0.0000	0.0002	0.0006	0.00%	0.01%	0.00%
			N_2O	4.10	19.13	15.00%	10.00%	18.03%	0.0000	0.0003	0.0004	0.00%	0.01%	0.00%
		3C1b Biomass Burning In Croplands	CH_4	7.13	7.65	10.00%	0.00%	10.00%	0.0000	0.0001	0.0002	0.00%	0.00%	0.00%
			N_2O	2.20	2.37	10.00%	0.00%	10.00%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%

Table B21b: Approach 1 Uncertainty Analysis for Greenhouse Gas Inventory Year 2016 - with LULUCF (8 of 9)

Sector	IPCC category		Gas	Base year (2005) emissions or removals	Year t (2016) emissions or removals	Activity data uncertainty	Emission factor uncer-tainty/ estimation parameter uncertainty	Combi-ned uncer-tainty	Contri-bution to variance by source/ sink category in year *t*	Type A sensiti-vity	Type B sensiti-vity	Uncer-tainty in trend in national emissions introduced by emission factor / estimation parameter uncer-tainty	Uncer-tainty in trend in national emissions introduced by activity data uncer-tainty	Uncertainty introduced into the trend in total national emissions
				($Gg\ CO_2$ eq.)	($Gg\ CO_2$ eq.)	%	%	%		%	%	%	%	%
AFOLU	3C Aggregate Sources and Non-CO2 Emissions Sources on Land	3C2 Liming	CO_2	0.00	4.54	50.00%	50.00%	70.71%	0.0000	0.0001	0.0001	0.00%	0.01%	0.00%
		3C3 Urea application	CO_2	575.07	527.29	50.00%	50.00%	70.71%	0.0000	0.0079	0.0110	0.40%	0.78%	0.01%
		3C4 Direct N2O Emissions from managed soils	N_2O	3,852.49	4,052.61	113.58%	112.85%	160.11%	0.0074	0.0422	0.0847	4.77%	13.60%	2.08%
		3C5 Indirect N2O Emissions from managed soils	N_2O	1,185.79	1,156.86	90.880%	21.08%	93.29%	0.0002	0.0149	0.0242	0.31%	3.11%	0.10%
		3C6 Indirect N2O Emissions from manure management	N_2O	456.57	605.34	16.58%	20.00%	25.98%	0.0000	0.0024	0.0126	0.05%	0.30%	0.00%
		3C7 Rice cultivations	CH_4	2,118.20	2,265.20	10.00%	62.50%	63.29%	0.0004	0.0225	0.0473	1.40%	0.67%	0.02%

Table B21b: Approach 1 Uncertainty Analysis for Greenhouse Gas Inventory Year 2016 - with LULUCF (9 of 9)

Sector	IPCC category		Gas	Base year (2005) emissions or removals	Year t (2016) emissions or removals	Activity data uncertainty	Emission factor uncer-tainty/ estimation parameter uncertainty	Combi-ned uncer-tainty	Contri-bution to variance by source/ sink category in year *t*	Type A sensiti-vity	Type B sensiti-vity	Uncer-tainty in trend in national emissions introduced by emission factor / estimation parameter uncer-tainty	Uncer-tainty in trend in national emissions introduced by activity data uncer-tainty	Uncertainty introduced into the trend in total national emissions
				($Gg\ CO_2$ eq.)	($Gg\ CO_2$ eq.)	%	%	%		%	%	%	%	%
WASTE														
WASTE	4A Solid Waste Disposal Sites		CH_4	6,072.29	11,214.23	51.96%	35.00%	62.65%	0.0087	0.0342	0.2343	1.20%	17.22%	2.98%
	4B Biological Treatment of Solid Waste		CH_4	0.01	0.24	154.00%	100.00%	183.62%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
			N_2O	0.01	0.17	154.00%	150.00%	214.98%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
	4 C Incineration and Open Burning of Waste	4C1 Waste Incineration	CO_2	29.61	30.36	10.00%	70.00%	70.71%	0.0000	0.0003	0.0006	0.02%	0.01%	0.00%
			CH_4	0.00	0.00	10.00%	100.00%	100.50%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
			N_2O	1.74	1.79	10.00%	100.00%	100.50%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
		4C2 Open Burning of Waste	CO_2	0.77	0.70	54.77%	65.57%	85.44%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
			CH_4	2.11	1.93	54.77%	112.69%	125.30%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
			N_2O	0.25	0.23	54.77%	100.00%	114.02%	0.0000	0.0000	0.0000	0.00%	0.00%	0.00%
	4 D Wastewater Treatment and Discharge	4D1 Domestic Wastewater	CH_4	1,694.11	1,608.12	60.00%	58.31%	83.67%	0.0003	0.0222	0.0336	1.30%	2.85%	0.10%
			N_2O	293.84	375.96	15.48%	50.00%	52.34%	0.0000	0.0018	0.0079	0.09%	0.17%	0.00%
		4D2 Industrial Wastewater	CH_4	13,833.55	13,927.93	28.72%	39.05%	48.48%	0.0080	0.1644	0.2910	6.42%	11.82%	1.81%
Total				**47,864.53**	**75,488.63**				**0.4385**					**1.4331**
							Percentage uncertainty in total inventory		**66.22%**				**Trend Uncertainty**	**119.71%**

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