Federal Republic of Nigeria

First Biennial Update Report (BUR1) of the Federal Republic of Nigeria

under the

United Nations Framework Convention on Climate Change (UNFCCC)

March, 2018

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Produced by Department of Climate Change
Federal Ministry of Environment Nigeria.

Foreword

Nigeria has been actively engaged in international climate policy negotiations since it became a Party to the United Nations Framework Convention on Climate Change (UNFCCC) in 1994 and ratifying its Kyoto Protocol in 2004. Nigeria submitted its First National Communication in 2003, Second National Communication in February 2014 to honour its reporting obligations and its Intended Nationally Determined Contributions in 2015 within the framework of the Paris Agreement.

The unwavering decision of the Federal Government of Nigeria to fully comply with commitments to the UNFCCC informed the submission of the country's First Biennial Update Report (BUR1). During the preparation of the BUR1, the country adopted a participatory process at the national level. This included rigorous consultations, various technical studies, collaborative activities and workshops at various stages of the preparation process. To enhance transparency, the BUR1 was also subjected to intensive peer review in accordance with best standard practice.

This document holistically looks at Nigeria's National Circumstances, National Greenhouse Gas Inventory which covers the Energy, Industrial Process and Product use (IPPU), Agriculture, Forest and Other Land Use (AFOLU) and Waste sectors, information on Mitigation actions and their effects, the Monitoring, Reporting and Verification System, Constraints and Gaps as well as Support received and needed.

The Government of Nigeria, with its ambitious reduction target, is poised towards implementing an all-inclusive national response to Climate Change through emission reduction, adaptation to the changing climate, and contributing to global discussions on optimal solutions to climate change response. Within this context, the Federal Republic of Nigeria adopted the National Climate Change Policy Response and Strategy (NCCPRS) in 2012.

The Federal Ministry of Environment is delighted to submit its BUR1 to the United Nations Framework Convention on Climate Change, with the intent that the information contained therein will prove useful towards achieving the set environmental goals and objectives of the country as well as the objectives of the Convention.

Ibrahim Usman Jibril
Honourable Minister of State for Environment

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Abbreviations and Acronyms

Acronym	Definition
AD	activity data
AFOLU	Agriculture, Forest and Other Land Use
AGO	automotive gas oil
Al_2O_3	alumina (aluminium oxide)
AP	ammonia production
ASB	annual statistical bulletin
ATK	aviation turbine kerosene
Bbls	Billion barrels
BOF	basic oxygen furnace
BRT	Bus Rapid Transit
BUR	biennial update report
$CaCO_3$	calcium carbonate
CaO	calcium oxide
CBN	Central Bank of Nigeria
CBO	community based organization
CCF	carbon content factor
CH_4	Methane
CDM	clean development mechanism
CEMAN	Cement Manufacturers Association of Nigeria
CEO	Chief Executive Officer
CER	certified emission reduction
CFE	Carbon Fund for Europe
CFL	compact fluorescent lamp
CGE	Consultative Group of Experts
CHP	Combined Heat and Power Generation
CMAN	Cement Manufacturers Association of Nigeria
CMS	Content Management System
CO	carbon monoxide
CO_2	carbon dioxide
CO_2-eq	carbon dioxide equivalent
COP	Conference of Parties
CPEIR	Climate Public Expenditure and Institutional Review
CRAFF	Commercial, Residential and Agriculture/Forestry/Fish farms
CSO	Civil Society Organization
DARE	Nigeria Developmental Association for Renewable Energies

Acronym	Definition
DCC	Department of Climate Change
DFID	Department for International Development -UK
DNA	Designated National Authority
DPR	Department of Petroleum Resources
EA&O	education, awareness and outreach
ECN	Energy Commission of Nigeria
ECO_2	emission of CO_2
EEA	European Environment Agency
EF	emission factor
EMEP	European Monitoring and Evaluation Program
EPCL	Eleme Petrochemicals Company Limited
ER	emission reduction
EU	European Union
EE	Executing entity
FAO	Food and Agricultural Organization
FAOSTAT	Food and Agricultural Organization Statistics
FBO	Faith Based Organization
FCCC	Framework Convention on Climate Change
Fe_2O_3	iron oxide
FEC	Nigerian Federal Executive Council
FMARD	Federal Ministry of Agriculture and Rural Development
FMC	Federal Ministry of Commerce
FMEnv	Federal Ministry of Environment
FMJ	Federal Ministry of Justice
FMPWH	Federal Ministry of Power, Works and Housing
FMWR	Federal Ministry of Water Resources
FNC	First National Communication
FOLU	Forest and Other Land Use
FORMECU	Forestry Management, Evaluation and Coordination Unit
FR	fuel requirement
FO	Fuel Oil
G	gram (1 g = 0.001 kg)
GCF	Green Climate Fund
GDP	gross domestic product
GEF	Global Environment Facility
Gg	Gigagram
GHG	greenhouse gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH or GIZ - a German Agency for international development cooperation

Acronym	Definition
GL	Guidelines
GPG	Good Practice Guidance/Guidelines
GWP	global warming potential
Ha	Hectare
HFCs	Hydrofluorocarbons
HHK	household kerosene
HNO_3	nitric acid
HWP	harvested wood product
IA	institutional arrangements
ICA	international consultation and analysis
ICCC	Inter-ministerial Committee on Climate Change
ICEED	International Centre for Energy Environment and Development
ICREEE	Inter-ministerial Committee on Renewable Energy and Energy Efficiency
ICT	Information and Communications Technology
IEA	International Energy Agency
IMB	International Marine Bunkers
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
IWMF	Integrated Waste Disposal & Management Facility
J	Joule
KCA	key category analysis
Kg	Kilogram
kg/hr.	kilogram per hour
kg hr^{-1}	kilogram per hour
Km	Kilometer
LAMATA	Lagos Metropolitan Area Transport Authority
LAWMA	Lagos Waste Management Authority
LED	light-emitting diode
LFG	Liquefied flammable gas
LNG	liquefied natural gas
LPG	liquefied petroleum gas
LSMenv	Lagos State Ministry of Environment
LSWMO	Lagos State Waste Management Organization
LULUCF	Land Use, Land-Use Change and Forestry
LUTH	Lagos University Teaching Hospital
M	Meter
m^2	square meter

Acronym	Definition
m^3	cubic metre
MAN	Manufacturers Association of Nigeria
MDAs	Ministries, Departments and Agencies
MDGs	Millennium Development Goals
Mg	megagram (1Mg = 1 t = 1000 kg)
Mg	milligram (1mg = 0.000001 kg = 0.001 g)
M J	Mega Joule (1000 000 J)
Mm	Millimeter
MMS	manure management system
MoU/MOU	memorandum of understanding
MRV	Measurement, Reporting and Verification
Mscm	million standard cubic meters
MSW	municipal solid waste
Mt	megatonne (1 Mt = 1 Gg = 1000000 t = 1000000000 kg)
Mt	metric tonnes (1 mt = 1 t = 1000kg)
MW	mega Watt
N_2O	nitrous oxide
NAMA	nationally appropriate mitigation action
NASRDA	National Space Research & Development Agency
NASPA	National Adaptation Strategy and Plan of Action
NASPA-CCN	National Adaptation Strategy and Plan of Action for Climate Change Nigeria
NBET	Nigerian Bulk Electricity Trading Company
NBS	National Bureau of Statistics
NC	national communication
NCCPRS	National Climate Change Policy Response and Strategy
NCV	net calorific value
NDC	nationally determined contribution
NE	not estimated
NEEAP	National Energy Efficiency Action Plans
NEMA	National Emergency Management Agency
NEP	National Energy Policy
NERC	National Electricity Regulatory Commission
NESI	Nigerian Electricity Supply Industry
NG	natural gas
NGL	natural gas liquids
NGO	non-governmental organizations
NH_3	Ammonia
NIAF	Nigeria Infrastructure Advisory Facility
NIE	NAMA Implementing Entity

Acronym	Definition
NIMET	Nigeria Meteorological Agency
NIMS	National (GHG) Inventory Management System
NIR	national inventory report
NMVOC	non-methane volatile organic compound
NNPC	Nigerian National Petroleum Corporation
NO_X	nitrogen oxides
NPC	National Population Commission
NREAP	National Renewable Energy Action Plan
NREEEP	National Renewable Energy and Energy Efficiency Policy
NSHDP	National Strategic Health Development Plan
OGPP	Open Government partnership principles
OHF	open hearth furnace
OML	Oil Mining License
OPEC	Organization of Petroleum Exporting Countries
PC & EH	Pollution Control and Environmental Health"
PDNA	Post Disaster Needs Assessment
PFCs	Perfluorocarbons
PIC	Presidential Implementation Committee
PMS	premium motor spirit
POA	program of activities
QA	quality assurance
QC	quality control
RCO_2	recovered carbon dioxide
RA	Reference approach
RE	renewable energy
REDD	reducing emissions from deforestation and degradation
REMP	The Renewable Energy Master Plan
RFO	residual fuel oil
RUWES	Rural Women Energy Security
R&D	Research and Development
SAR	second assessment report
SCCU	Special Climate Change Unit
Scm	standard cubic meter (1 Scm = 1 m^3)
SA	Sectoral approach
SDG	Sustainable Development Goal
SE4ALL	Sustainable Energy for All
SF_6	Sulphur hexafluoride
SHP	Small Hydro Power

Acronym	Definition
SiO_2	Silica
SNC	Second National Communication
SO_2	Sulphur dioxide
T	tonne (1t = 1Mg = 1000kg)
TACCC	transparent, accurate, consistent, complete and comparable
TJ	terajoule (1 trillion joule) x
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
V&A	vulnerability and adaptation
WB	World Bank
WEC	World Energy Council

Executive Summary

National circumstances and institutional arrangements

Introduction

The Federal Republic of Nigeria, commonly referred to as Nigeria, is located at the extreme inner corner of the Gulf of Guinea on the west coast of Africa between latitudes 3°15' to 13°30' N and longitudes 2°59' to 15°00' E. It is the 14th largest country in Africa with a land area of 923 768 km2 and a total boundary length of 4900 km, including 853 km of coastline.

Nigeria comprises 36 states and the Federal Capital Territory (FCT), Abuja . It is officially a democratic secular country. The States and FCT are further sub-divided into 774 Local Government Areas/Area Councils for grassroot administration. The 36 States are grouped into six geopolitical zones for political and development purposes. These are shown in Figure 1.2. The Constitution of the country provides for a presidential system of government in which there is an Executive, a Legislature and a Judiciary. The Constitution further provides for the operation of three tiers of government, at the Federal, State and Local levels.

Convention Obligations

As a Non-Annex 1 Party signatory to the United Nations Framework Convention on Climate Change (UNFCCC), and more specifically as directed by Paragraph 60 (c) of decision 1/CP.16 of the 16th Session of the Conference of Parties to the UNFCCC, Nigeria is obliged to report certain elements of information as follows:

> *Developing countries, consistent with their capabilities and the level of support provided for reporting, should also submit biennial update reports containing updates of national greenhouse gas inventories, including a national inventory report and information on mitigation actions, needs and support received*;

Since the inception of joint global actions on climate change arising from the Rio Conventions of 1992, Nigeria has been active on many fronts. It has submitted the First National Communication (FNC) in 2003 and the Second National Communication (SNC) in 2014 to meet the country's obligations to the UNFCCC. The Intended Nationally Determined Contributions was submitted in 2015 within the framework of the Paris Agreement.

Institutional arrangements

The establishment of the Department of Climate Change (DCC) of the Federal Ministry of Environment is evidence of the Nigerian Government's *"commitment to introducing and implementing adaptation and mitigation measures necessary to reduce vulnerability to climate change"*. DCC is Nigeria's focal point to the UNFCCC and comprises the Green House Gas (GHG) Division, the Vulnerability and Adaptation Division, the Education, Awareness and Outreach Division and the Mitigation Division. In addition to the operations carried out by these divisions, DCC is also the convener and chair of the Inter-Ministerial Committee on Climate Change (ICCC). A description of the institutional arrangements is provided in this report.

Climate

Nigeria is located primarily within the lowland humid tropics. The country is generally characterized by a high temperature regime almost through the year. In the far south, mean maximum temperature is 32 ^{o}C while in the north it is 41^{o}C. The mean temperature for the country is 27^{o}C, in the absence of altitudinal modifications. Over the last few decades, there has been a general increase in temperature throughout Nigeria. The climate of the country varies from a very wet coastal area with annual rainfall greater than 3,500 mm to the Sahel region in the northwest and north-eastern parts, with annual rainfall less than 600 mm.

Demography

Even if there exists no precise statistics on the Nigerian population, various sources tend to agree that it is the most populated country in Africa and ranked 7th at world level in 2015. According to the Director General of the Nigerian National Population Commission (NPC) NPC, the country's population had reached 182 million by late 2016. Two important demographic aspects need to be considered for the sustainable socio-economic development of Nigeria namely, the growing youth bulge, with those under 14 years accounting for more than 40% of the population and the rapid urbanisation of the Nigerian society. According to the 2006 census, around 39% of the population lived in urban regions and World Bank statistics estimates that urban dwellers, representing 50.2% of total population, will surpass their rural counterparts by 2018.

Economic profile

Nigeria is a lower middle-income country. According to World Bank statistics, since 2012, the year during which it overtook South Africa, it has become the largest economy in Africa. In 2016, at current US$, the Nigerian GDP was 405.083 billion and the GDP per capita was 2178. **Error! Reference source not found.** illustrates the evolution of Nigeria's GDP during the period 2000 to 2016 (source: World Bank).

Between 2005 and 2014, the economy grew steadily by over 7% per annum, but exhibited a marked contraction from 2015 when GDP growth rate fell to 2.79% from the previous 5 years (2010 - 2014) average growth of 5.7% The situation worsened in 2016 when a negative growth of -1.5% was recorded. A sectoral analysis shows that within the whole economy, it was the oil sector which regressed most. Nigeria remains heavily dependent on oil revenues. In recent years, oil and gas have accounted for more than 90% of the country's exports and more than 70% of consolidated budgetary revenue. On the other hand, the other sectors of the economy have exhibited relatively more resilience. Hence, over the last five years ending 2016, the agriculture sector grew on average by 4.3% and the services sector grew on average by 6.0% from 2012 to 2015 to regress only in 2016 by -0.8%. In 2016, the real contributions of the agriculture, industry and services sectors to national GDP were 24.4, 22.0 and 53.6% respectively. Trade, information and communications technology, and real estate together accounted for around 70% of the output of the services sector.

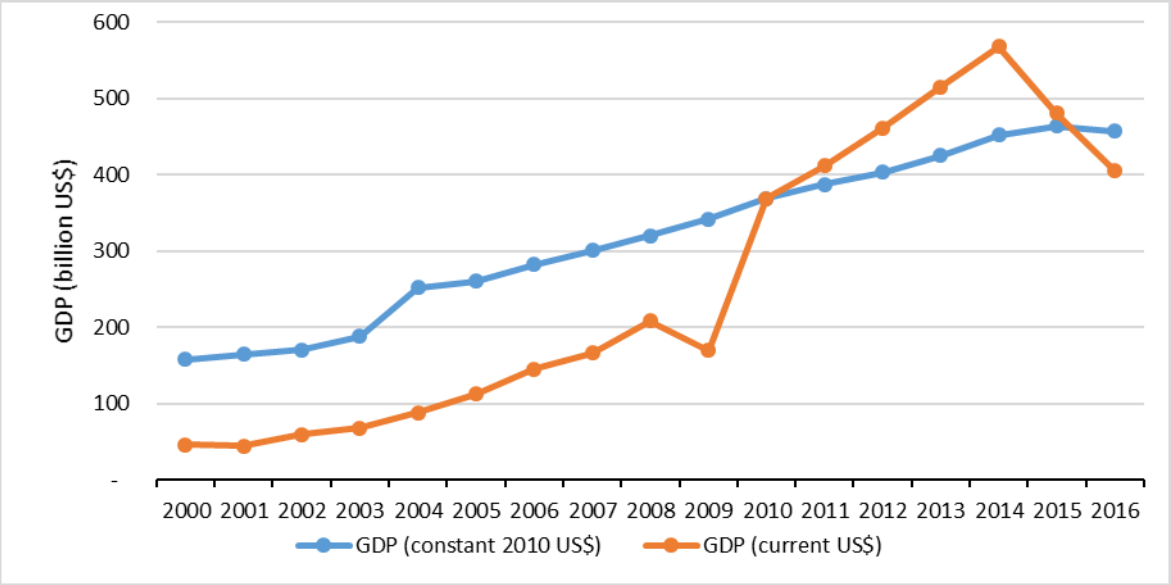

Figure 1.1 GDP of Nigeria in constant 2010 US$ and current US$

Energy

Oil and natural gas, and biomass constitute the main sources of energy for Nigeria. Other energy sources include coal, wind, nuclear, geothermal, solar and hydro. Nigeria has the second largest proven crude oil reserves of Africa and according to Abstract of Statistics 2016 (NBS, 2017) of the Nigerian National Bureau of Statistics, the reserves stood at 37,448.25 million barrels in 2014. During the same period, the country produced 699,486 barrels of crude oil whereas it exported 773,833 barrels.

Nigeria is one of the main gas producers in Africa and production is expected to double between now and 2030, increasing to about 400 billion m^3 per annum. Proved recoverable reserves of natural gas in Nigeria at the end of 2011 were 5,110 billion m^3. Current production, at 29 billion m^3, is estimated to last more than 100 years (WEC, 2013). A significant amount of Nigeria's gross natural gas production is flared (burned off) because some of Nigeria's oil fields lack the infrastructure needed to capture the natural gas produced with oil, known as associated gas. In 2014, Nigeria flared 10.73 billion m^3 of its associated gas production, or 12% of its gross production and ranked as the world's fifth-largest gas flaring country, accounting for 8% of the total amount flared globally in 2014 (EIA, 2016).

Nigeria is the third world's largest producer of bioenergy, after China and India, respectively. The biomass resources of Nigeria can be identified as crop residues, forage grasses and shrubs, animal wastes and waste arising from forestry, municipal and industrial activities, as well as, aquatic biomass. In 2010, the share of bioenergy of total primary energy supply was over 80% (WEC, 2013). In 2011, Nigeria was among the largest fuel wood producers, along with India, China, Brazil and Ethiopia.

Agriculture

Almost 78% of the total land mass of the country, representing 708,000km^2, are under agriculture. Of these, 48.0% constitute arable lands, 42.8% are under permanent meadows and pastures and the remaining 9.2% are under permanent crops.The sector is also the largest employer of the country and accounted for 24.4% of GDP in 2016. Crop production is by far the most important component of the agriculture sector, contributing 89.7% to the total GDP of the sector. Climate change poses a threat to Nigerian agriculture - the World Bank recently predicted an up to 30% drop in the country's crop output due to erratic rainfall and higher temperatures.

Human Health

Nigeria shoulders 10% of the global disease burden and is making slow progress towards achieving the 2015 Millennium Development Goals (MDGs) targets health targets. The health indicators in Nigeria have largely remained below country targets and internationally-set benchmarks due to weaknesses inherent in its health system. Nonetheless, Nigeria is making some progress in the achievement of the health-related MDGs. The prevalence of infectious and parasitic diseases like malaria (141 in 100,000), tuberculosis (282 in 100,000), HIV/AIDS (3.9% of the population) and Schistosomiasis among others, remains very high. Furthermore, illnesses such as diabetes and cardio-vascular diseases, often associated with increasing socio-economic wellbeing, are becoming significant health problems in the country (Babatimehin, 2003).

Transportation

Air, rail, pipelines, road and water transportation facilities are available in the country. The total length of Federal Government highways is about 34,340 km. States also make complementary investments on high grade road development. The total rail length is about 4,000 km while water and air transportation are the least developed. The country has close to 8,600 km of water ways, the longest being on River Niger and the Benue system. Governments, at both the state and federal levels, are investing on airports to increase access to air travel.

Manufacturing

The manufacturing sector has the potential to boost economic growth and stimulate employment generation, wealth creation and poverty eradication but has been handicapped by low capacity utilization. It started to take off as from 2010 and eventually peaked with a GDP contribution of almost 10% in value added terms in 2014. However, it regressed in 2015 and 2016, amidst, admittedly, a general contraction of the economy. The stated focus of increasing annual growth in the manufacturing sector from 8% in 2005 to a minimum of 35.9% on the average annually (Vision 2020 Technical Report on Manufacturing) would no doubt have serious implications for energy use and climate change in the very near future.

The Power sector

Power supply in Nigeria is a big challenge to the economy of the nation. Despite efforts by various governments and huge sums of money invested in the sector, the power supply is still inefficient and this hampers industrial development of the nation. At present, less than half of Nigeria's population has access to grid-connected electricity. The per capita power consumption of 151 KWh per year in Nigeria is among the lower end of the spectrum in the African continent.

The 23 grid-connected generating plants in operation in the Nigerian Electricity Supply Industry (NESI) has a total installed capacity of only 11.165 MW and available capacity of 7,139.6 MW as at June 2016. Equally, most of the generation are thermal based with an installed capacity of 9,044 MW (81% of the total) and available capacity of 6,079.6 MW (83% of the total). Hydropower from three major plants accounts for 1,938.4 MW of total installed capacity (an available capacity of 1,060 MW, 77.8%) with limited contributions by non-hydropower renewable sources making up the remainder. The Electric Power Sector Reform Act was passed in 2005 to reposition the sector by changing its structure, and privatizing generation and distribution while retaining transmission under Government control. Today, Nigeria has 12.5 GW of installed capacity, but less than one third is operational (average of 3.9 GW in 2015; 3.0 GW in November 2016). Overall, only about 15 % of installed capacity is eventually distributed to end users, resulting in a huge shortage of electricity supply across the country.

Environmental Challenges

The main environmental challenges in Nigeria are land degradation, environmental pollution, floods and erosion. Land degradation is stemming from many factors, including pressure on the land resources, which lead to deforestation or de-vegetation and unproductive land. Environmental pollution is a serious challenge, especially around the major urban areas.

Climate Change

Accelerated climatic changes are expected to lead to potentially large impacts across Africa, including Nigeria, in the future. Temperatures in West Africa, and particularly the Sahel, have increased more sharply than the global trend, and the average predicted rise in temperature between 1980/99 and 2080/99 is between 3 °C and 4 °C, which is more than 1.5 times the average global trend. For Nigeria, sea level rise of 1 m could result in loss of 75% of the Niger Delta (IPCC, 2007).

Deforestation

Deforestation is a significant environmental issue in Nigeria because of the direct impacts of growing demand for land for various other uses, including settlement development, logging, fuel wood extraction, transport facility development and mining. According to the Food and Agricultural Organization (FAO), the remaining forest areas in Nigeria will likely disappear by 2020 if the current rate of forest depletion continues unabated. To protect natural areas for ecological purposes, efforts need to be made to intensify forest preservation, encourage the use of alternatives to wood and continue to sensitize the communities on the need to protect the forests. Desertification is also a key environmental challenge in the northern parts of the country. According to Obioha (2009), Nigeria has been losing about 351,000 Km^2 of landmass to the desert, which is advancing southward at the rate of 0.6 Km^2 annually. Other authors have reported desert encroachment at the rate of 1 km per year towards the same general southward trend.

Floods

Floods in the last two decades have become more frequent in every part of the country. Inadequate watershed management, unplanned rapid urbanization, blockage of river/drainage channels through careless waste disposal, poor land use practices, land clearing for agricultural purposes, sub-standard dam construction and deforestation among other factors influence the occurrence and severity of flooding in the country.

Waste

The burden of waste management is growing everywhere, more particularly in the urban areas. The total amount of domestic waste per annum in Nigeria is estimated at about 63 million tonnes (0.45 kg/capital/annum) and is increasing. The problem is largely with collection and disposal. Waste is indiscriminately disposed of in many areas, and solid waste dumps dot the urban landscape in many parts of the country. Usually, only about 30- 50 % of waste in Nigeria is collected (Osibanjo, 2008).

Economic challenges

The Nigerian economy continues to be dominated by the oil sector which fetches more than 90% of the foreign exchange for the country. The impact of the sector is however little felt by the vast majority of the people. The agricultural sector, which once occupied a dominant position, has been relegated to a poor second place and Nigeria now imports a substantial proportion of its food. For instance, more than 50 % of rice consumed is imported from Thailand (Ezedinma, 2004). Linkages between various sectors of the economy are weak and unemployment and underemployment are high. Most people are consequently poor with two-thirds of the population living on USD 2 or less per day. For example, the

poor development of the nations' energy sector is keeping large industrial establishments in the Lagos, Kaduna and Kano axis out of business. The critical economic issues concern the need to foster sustainable rapid economic growth that will cater for the needs of over 180 million people and the imperative for proper integration of its domestic economy with the world economy.

National Greenhouse Gas Inventory

Introduction

In line with articles 4 and 12 of the UNFCCC, which state that non-Annex I Parties should include information on a national inventory of anthropogenic emissions by source and absorption by sinks of all GHG not controlled by the Protocol of Montreal, within the limits of their possibilities, using in its preparation the comparable methodologies promoted and approved by the Conference of Parties, Nigeria has prepared and submitted two GHG inventories for the years 1994 and 2000. Decision 1/CP.16 paragraphs 60(a-c) introduced an enhanced reporting regime for Non-Annex I Parties, requiring them to submit Biennial Update Reports, including a National Inventory of GHGs in accordance with the UNFCCC guidelines for the preparation of national communications from non-Annex I Parties (decision 17/CP.8) and the UNFCCC biennial update reporting guidelines for Parties not included in Annex I to the convention (decision 2/CP.17, and its annex III).

Institutional arrangements

The Department of Climate Change (DCC) of the Federal Ministry of Environment has the responsibility of Climate Change activities in the country. DCC is one of six technical departments in Nigeria's Federal Ministry of Environment. It has four divisions, each responsible for a major thematic area of climate change. One of these division is the GHG Division with which rests also the responsibility of producing the GHG inventories for reporting to the Convention. The institutional arrangements and GHG inventory management system is more fully described in the chapter on MRV.

The compilation and production of a national GHG inventory requires the successful implementation of well-defined steps. Nigeria lacked a fully-fledged GHG inventory management system (IMS) and perfect institutional arrangements (IA) when producing the inventory for the BUR1. This is because previous inventories were prepared on an ad-Hoc basis with the support of international consultants. Nonetheless, as per existing IMS and IA, the country implemented the steps for the compilation of this GHG inventory and intends to further improve in future compilations.

Coverage

This GHG inventory covers the whole territory of the Federal Republic of Nigeria and estimates are computed at the national scale. It includes estimates from the four IPCC sectors, Energy; Industrial Processes and Product Use (IPPU); Agriculture, Forestry and Other Land Use (AFOLU) and Waste. However, the categories and subcategories have not been exhausted due to lack of activity data in some cases. The level of details is provided under completeness in this report. The GHG inventory addressed emissions of the direct GHGs carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Additionally, estimates of the GHG precursors NO_X, CO, NMVOCs, and SO2 have been compiled whenever activity data were available.

Estimates have been made for the year 2015 as needed under the BUR requirements to be at most 4 years prior to the date of submission. In line with the recommendation to provide a trend of estimates, the period 2001 to 2015 have been adopted. For consistent reporting, estimates for the year 2000 have been recalculated using the same methodology and data source as for the period under review.

Global Warming Potentials (GWPs) adopted for uniformizing emissions of all GHGs in CO_2 equivalent are those from the IPCC Second Assessment Report. The GWPs used in this report for the direct GHGs are 1 for CO_2, 21 for CH_4 and 310 for N_2O.

Methods

Estimates of GHG emissions have been compiled using the IPCC 2006 Guidelines for National GHG Inventories (IPCC, 2007) and the IPCC Good Practice Guidance and Uncertainty Management (IPCC, 2000) to ensure that the estimates are Transparent, Accurate, Complete, Consistent and Comparable (TACCC). Selection of the Tier level for all sectors was determined by the availability of relevant activity data and national emission factors. In all cases, the tier 1 level was adopted with IPCC default emission factors (EFs).

Completeness

Results of the GHG inventory of the SNC, availability of resources, existing capacity, availability of activity data and national emission factors dictated the choice of source categories to be included for compilation. A prioritization exercise was conducted and the highest emitting source categories emerged.

Data Sources

Activity data used in the compilation of this inventory were sourced from a combination of national and international institutions. During data collection, priority was given to data generated within the country. However, in cases where the required data was not available in the country, data from credible international organizations such as IEA, United Nations databases, World Bank and FAO were used.

QA/QC procedures

Quality Assurance/Quality Control (QA/QC) procedures were developed and implemented in line with the *IPCC 2006 Guidelines for National GHG inventories.* The inventory compilers were responsible for the implementation of the QA/QC activities. In addition, the DCC provided support in coordinating QA/QC and verification activities, especially in the areas of data collection, documentation and archiving, reviewing progress reports for completeness and compliance with standards, follow up to ensure that the required QA/QC and verification procedures were followed, ensuring a synergistic effort among the different teams working on the Inventory, Mitigation and MRV components. DCC also facilitated technical reviews and capacity building with regard to the project. Personnel not directly involved in the inventory compilation process conducted QA review procedures.

Uncertainty Assessment

Due to the fact that most of the activity data were primarily from secondary sources that hardly reported uncertainty ranges in their data, a qualitative approach, backed by experts' judgement, were used in a consistent and transparent manner to assign uncertainty ranges based on the data sources. In addition, the uncertainty ranges associated with the IPCC emission factors were also adopted. Based on the IPCC recommended minimum uncertainty range of ±5% for peer reviewed literature and activity data generated through research, uncertainty ranges were assigned in accordance with the source of the activity data. Uncertainty ranges were assumed to increase according to the level of verifiability and reliability of the data source.

National emissions

Total net national emissions (Table 2.51), including removals, amounted to 712,638 Gg CO_2-eq from the 4 IPCC sectors. AFOLU headed the sectors with 476,949 Gg CO_2-eq (66.9%) of total aggregated emissions followed by Energy with 28.2%, Waste 3.0% and the remaining 1.9% from IPPU. Regarding the direct GHGs, CO_2 was responsible for 82.3% of the emissions, CH_4 for 12.4% and N_2O for 5.3%.

On an individual gas basis, AFOLU was the major contributor for CO_2 and N_2O with 71.4% and 62.1% respectively while Energy emitted most of the CH_4 with 44.6% and more than 99.9% for NO_X, CO and NMVOCs. More than 99% of SO_2 also came from the Energy sector.

Table 1. National emissions for the year 2015

Categories	Net CO_2 (Gg)	CH_4 (Gg)	N_2O (Gg)	Total (Gg CO_2-eq)	NO_X (Gg)	CO (Gg)	NMVOCs (Gg)	SO2 (Gg)
Total National Emissions and Removals	586807	4205	121	712638	738	19516	3069	88
1 - Energy	154671	1874.61	23.49	201319	738.2	19515	3068	87.66
2 - IPPU	13255	0.58	0	13267	0.00052	0.00005	0.87	0
3 - AFOLU	418811	1659.84	75.10	476949	0.06	1.38	0	0
4 - Waste	70	670.37	22.44	21103	0.00006	0.0008	0	0.00001
5 - Other	0	0	0	0	0	0	0	0
Memo Items (5)								
International Bunkers	993	0.01	0.03	1002	0.00	0.00	0	0
1.A.5.c - Multilateral Operations	0	0	0	0	0	0	0	0

Key Category Analysis

The tier 1 level and trend assessments were conducted to identify key categories. The key sources are those that cumulatively contribute to 95% of the total emissions or trend of the inventory in absolute terms. The level assessment was conducted for the years 2000 and 2015, and trend assessment for 2015 with respect to the 2000 base year. For the level assessment, Forest Land Remaining Forest Land was identified as the most significant of the key categories (contributing about 58.7%) of national emissions in 2015. When considering the trend assessment, Forest Land Remaining Forest Land remained the highest key emitting sector but with only 41.0% of national emissions under the trend compared to the 58.7% of the level assessment. Considering the fully disaggregated results of both types of assessment, the number of key categories regressed from 15 to 13 when changing from level to trend assessment. The trend assessment is a good indicator of categories gaining importance over time following development as opposed to the level assessment that considers absolute emissions of one year only.

Constraints and Gaps

Several constraints and gaps were encountered during the preparation of this inventory, especially during data collection and estimation of GHG for the various sectors. These gaps and constraints consisted repeatedly of lack of reliable good quality activity data, inexistence of country specific emission factors, inadequate institutional arrangements and the lack of a fully operational inventory management system to cater for the steps of compilation. In addition to these, there is still need for substantial capacity building of the national experts.

National GHG Inventory Improvement Plan

The salient features that are prioritized for improvement when compiling the next GHG inventory are:

- Establishment and implementation of a GHG inventory management system.
- The present institutional arrangement should be further strengthened.
- A network for collecting appropriate activity data must be established.
- A QA/QC system must be set up to collect and archive quality reliable activity data.
- Capacity building should be imparted to national experts for all inventory compilation steps.
- Nigeria must develop national emission factors, namely for the key categories.
- The country needs to develop land use cover and change maps and overlay them with the climate and soil maps to enable proper estimation in the Forestry and Other Land Use category.
- Biomass stocks must be assessed for use in the AFOLU emissions assessment.
- Information on technologies used in manufacturing processes and in other emitting activity areas must be collected along with the appropriate activity data.

Energy sector

Emissions

Total emissions from the energy sector increased from 84,815 Gg CO_2-eq in 2000 to 201,320 Gg CO_2-eq in 2015. Of the two source categories, Fuel Combustion Activities recorded an increase of 198% compared to 26% for Fugitive Emissions. Out of the 201,320 Gg CO_2-eq emissions of 2015, Fuel Combustion Activities contributed 81.5% while 18.5% came from fugitive processes.

On a subcategory basis in 2015 within the Fuel Combustion Category, Energy Industries is the highest contributor with 34.1% of emissions followed by Other Sectors (29.5%), Transport (22.0%) and Manufacturing Industries & Construction (14.5%). From the year 2000 to 2015, emissions increased by 459% for Energy Industries, 827% for Manufacturing Industries and Construction, 132% for Transport and 79% for Other Sectors.

Carbon dioxide was the dominant gas in the energy sector emissions with approximately 76.8% of total emissions in 2015. For the same year, CO_2 is followed by CH_4 (19.6%) and N_2O (3.6%). In general, there is a steady increase in CO_2 emissions from 54276 Gg in the year 2000 to 154671 Gg in 2015 with dips in a few years, namely 2006, 2007 and 2009. The increase is of the order of 185% from the year 2000 to 2015. CH_4 emissions increased on the same pattern as CO_2 over the time from 26178 Gg CO_2-eq in 2000 to 39367 Gg CO_2-eq in 2015 which represented a 50% progression in emissions. N_2O emissions increased by 67% from 4361 Gg CO_2-eq in 2000 to reach 7283 Gg CO_2-eq in 2015.

All three precursors increased during the period 2000 to 2015, NO_X by 89% from 390 Gg to 738 Gg, CO from 12,409 Gg to 19,515 Gg (57%) and NMVOCs by 56% from 1,969 Gg to 3,068 Gg. SO_2 also increased, from 61 Gg to 88 Gg, representing 44% more emissions in 2015 compared to the year 2000.

Memo items

Emissions from fuels used for international aviation and international marine bunkers (IMB) are excluded from the national totals and reported as memo items. Emissions of CO_2, CH_4 and N_2O from the international bunkers (marine and aviation bunkers) increased from 641.89 Gg CO_2-eq in 2000 to 1,001.88 Gg CO_2-eq in 2015. In 2000, IMB emissions contributed 32.9% to total emissions from International Bunkers, while the balance came from international aviation. In 2015, international aviation contributed 100% of the emissions from international bunkering as no sales of IMB fuels was recorded for that year. Total aggregated emissions were 1001.88 Gg CO_2-eq with CO_2 contributing 99.13%, CH_4 0.01% and N_2O 0.86% in the year 2015.

To avoid double counting, CO_2 emissions from biomass combustion for energy production are also reported under memo items and not included in the Energy sector emissions. This includes CO_2 emissions from transformation of fuel wood to charcoal in energy industries, as well as CO_2 emissions from the use of biomass for energy in the residential and commercial/institutional sectors. In the year 2000, CO_2 emissions from this activity amounted to 354,345 Gg CO_2, while in 2015, total CO_2 emissions from this activity was 583,464 Gg CO_2.

Comparison of the IPCC Tier 1 reference and sectoral approaches

The Reference Approach (RA) is a top-down approach which used Nigeria's total energy supply to calculate CO_2 emissions from fuel combustion but does not distinguish between IPCC source categories as obtained when adopting the Sectoral Approach (SA) (bottom-up approach). The differences in energy consumption between the RA and SA approaches ranged from -6.4% in 2000 to 11.4% in 2001 when the mass of all fuels is considered. The differences in CO_2 emissions between RA and SA ranged from -1.5% in 2000 to 15.1% in 2001.

Industrial Processes and Product Use

The IPPU sector comprises GHG emitted as by-products during industrial processes for the manufacture of new products. The categories considered are Mineral Industry (Cement Production), Chemical Industry (Ammonia Production) and Metal Industry (Iron and Steel Production).

Emissions

Total aggregated emissions for the IPPU sector, ranged between 1553.98 Gg CO_2-eq and 13267.14 Gg CO_2-eq during the period 2000 to 2015 with an annual average of 6932 Gg CO_2-eq . CO_2 emissions increased by nearly 6 times from 2325 Gg in the year 2000 to 13255 in 2015 and CH_4 increased 4 times from 3.19 Gg CO_2-eq to 12.22 Gg CO_2-eq over the same time period. Otherwise, CO_2 represents 99.99 % of all GHG emissions of the IPPU sector in 2015 with the remaining 0.01 % contributed by CH_4.

In 2015, the cement industry was responsible for 53.4% of the aggregated emissions followed by the iron and steel industry with 46.6%. The contribution of the ammonia industry was marginal. With regards to the GHG precursors CO, NO_X and NMVOCs, the emissions were insignificant during the period under review for the IPPU sector. NMVOC attained a value of 0.87 Gg in 2015.

Agriculture, Forestry and Other Land Use (AFOLU)

Activities in the AFOLU sector are among the main contributors to emission of GHGs in Nigeria which makes it a key category. For this inventory, livestock (3.A), and Aggregated sources and non-CO_2 emissions from land (3.C) subcategories were fully covered. For land (3.B), emissions from changes within Forestland only was estimated. Under Other (3.D) removals for harvested wood products (HWP) only was estimated.

Emissions

In 2015, total AFOLU emissions attained 479,571 Gg CO_2-eq with CO_2 contributing 421,434 Gg CO_2-eq, CH_4 for 34,857 Gg CO_2-eq and N_2O for 23,280 Gg CO_2-eq. CO_2 stayed as the main gas emitted over the full period 2000-2015 with about 90% of total annual emissions followed by CH_4 with about 6% and N_2O with about 4%. In the same year and after discounting for removals, net emissions from the AFOLU sector were 476, 948 Gg CO_2-eq, the highest for the entire period under consideration. Compared to the 2000 emissions (376861 Gg CO_2-eq), those of 2015 represented an increase of about 27%. This increase was attributed to (a) the increase in livestock populations, (b) increased consumption of nitrogen based synthetic fertilizers and (c) forest biomass loss. Emissions from Forestland Remaining Forestland

represented 88% of 2015 emissions. The next contributors were Livestock and Aggregated sources and non-CO_2 emissions source on land with 6% each. Harvested Wood Products removed 0.5% of emissions.

Waste

Emissions

Total aggregated emissions for the Waste sector was 21,103 Gg CO_2-eq in 2015 compared with an estimated 12,553 Gg CO_2-eq in 2000. This represents 68.1% increase over the emissions of the year 2000. In 2015, emissions from Wastewater Handling represented 89.8% (18,951 Gg CO_2-eq) of total Waste sector emissions followed by the SWDS category with 6.4% (1,348 Gg CO_2-eq) and the remaining 3.8% (805 Gg CO_2-eq) came from Open Burning. In 2015, the emissions were 69.94 Gg of CO_2, 670.38 Gg of CH_4 and 22.44 Gg of N_2O compared with 48.64 Gg, 609.63 Gg and 12.59 Gg respectively for these three GHGs in 2000. N_2O recorded the highest increase of 78.2% when comparing emissions of 2015 over those of the year 2000. CH_4 emissions increased by 63.7% and CO_2 by 43.8% over the same period.

When taking into consideration the GWP of CH_4 and N_2O, the aggregated emissions of 2015 were 14,078 Gg CO_2-eq and 6,955 Gg CO_2-eq respectively. In 2015 and on the same basis of equivalence, CH_4 topped the emissions with 64.44%, followed by N_2O with 35.21% and CO_2 with 0.35% of total aggregated emissions.

Mitigation actions and their effects

Nigeria's key emission categories include the Energy and AFOLU sectors amongst others. Significant scope exists for mitigation actions in these areas, namely reducing flaring in the oil and gas industry and the use of biomass from forestland. The latter needs to integrate the socio-economic status of the population, particularly the poorer segments. Furthermore, these actions should encompass the needs of a growing urban population.

Nigeria, as per its capabilities as a developing country and also making the most of market mechanisms, has been proactive in implementing mitigation actions. Enhanced commitment is earmarked in the INDC of Nigeria, around which mitigation activities will revolve for the country to meet the targets given the conditional components are supported. Key measures include:

- Work towards ending gas flaring by 2030
- Work towards Off-grid solar PV of 13GW (13,000MW)
- Efficient gas generators
- 2% per year energy efficiency (30% by 2030)
- Transport shift car to bus
- Improve electricity grid
- Climate smart agriculture and reforestation.

The actions to be implemented unconditionally using national resources are expected to reduce emissions by 20 % from the Business As Usual (BAU) scenario. This reduction may further be increased with external support to 45% of the BAU scenario. With these measures, the country will be able to keep emissions at the current rate of 2 tonnes CO_2 eq per capita in 2030 with an annual economic growth of 5%. Without these measures, the per capita emissions are expected to reach 3 tonnes CO_2 eq per capita. The estimated emissions avoided upon full implementation of the NDC by activity area are given in Table 2.

Table 2. Estimated emission reduction by activity area

Measure	Potential GHG reduction (million tonnes per year in 2030)
Economy-wide energy efficiency	179
Work toward ending of gas flaring	64
Climate smart agriculture	74
Reduce transmission losses	26
Efficient gas power stations	102
Renewable energy	31

Nigeria has already implemented various mitigation actions using its own resources, through the Clean Development Mechanism (CDM) and the Program of Activities (POA). For the year 2015 under review, it is estimated that the CDM projects have resulted in an emission reduction of the order of 6,967 Gg annually, the POA projects to a reduction of 215 Gg. Emissions avoided by the locally funded projects have not been estimated. The mitigation actions implemented by Nigeria have significant sustainable development benefits, in addition to their obvious climate change mitigation effect. A brief description of the specific mitigation actions is provided below.

The National Climate Change Policy Response and Strategy (NCCPRS) has been developed for fostering a low-carbon, high growth economic development path and building a climate-resilient society.

The Nigerian National Biofuels Programme aims to reduce the nation's dependence on imported gasoline, while reducing environmental pollution.

The draft revised National Energy Policy of 2013 provides the framework for sustainable energy development in Nigeria with the overall objective of providing clean, affordable, adequate and reliable energy to the nation with the active participation of the private sector

The key objectives of the Sustainable Energy for All (SE4ALL) Action Agenda initiative globally are to ensure universal access to modern energy services; doubling the global rate of improvement in energy efficiency; and doubling the share of renewable energy in global energy mix by 2030 compared to 2010.

The overall thrust of the National Renewable Energy and Energy Efficiency Policy (NREEP) is the optimal utilization of the nation's energy resources for sustainable development.

The overall objective of the Renewable Energy Master Plan (REMP) is to articulate a roadmap for national development through the accelerated exploitation and penetration of renewable energy. REMP seeks to increase the share of renewable electricity from 13% of total electricity generation in 2015 to 23% in 2025 and 36% in 2030.

The Renewable Energy Programmes of the Federal Ministry of Power and Federal Ministry of Environment aims at the development of 6 large scale hydro power stations for the generation of 4220MW of electricity.

The Federal Ministry of Water Resources is engaged in the construction and rehabilitation of 33 dams and construction of 27 small earth dams. Seven other major dams with a combined storage capacity of 2,269 million cubic meters have been completed. Water from these dams will be tapped for hydropower generation.

Under the Renewable Energy Programme of the Federal Ministry of Environment NV, Global Biofuels Ltd is developing a biofuel production complex. The Renewable Energy Programme Office, Adamawa State Government and Green Carbon Africa are developing two sugarcane based biofuel plants. Working in conjunction with Carbon Quest and Adamawa State, the Renewable Energy Programme Office is establishing an integrated Rice Processing and Power Generating Facilitator.

The NAIJA LIGHT Solar Electrification Programme is tasked with sourcing and deploying alternative and sustainable renewable energy sources to create sustainable livelihood for the rural poor and those most affected by the scarcity of electricity and energy supply in the country.

The Energy Efficient Housing Scheme by the Federal Ministry of Environment in collaboration with Aso Savings and Loans Plc is designed to incorporate micro generation of electricity from renewable sources, mainly solar and bio-energy.

The Federal Ministry of Environment, Federal Ministry of Women Affairs and International Centre for Energy Environment and Development (ICEED) through the Alliance for Clean Stoves initiated a sensitization campaign to effectively change the mind-set of the average Nigerian about firewood and introduce them to the healthier and cheaper option of clean cooking stoves.

The Nigeria Feed-in Tariff for Renewable Energy Sourced Electricity aims to utilize Nigeria`s potential for renewable energy, by stimulating investment in the sector to reach 2000MW by 2020.

The goal of the Rural Women Energy Security (RUWES) project is to ensure a safe, affordable and sustainable clean energy access for all, especially the rural poor while reducing emission of short-lived climate pollutants. It is intended to provide 20 million clean cooking stoves across the six-geopolitical zones in the country by the year 2020.

The Reducing Emissions from Deforestation and Forest Degradation (REDD+) program aims at generating financial value for the carbon stored in forests. The Federal Government of Nigeria, backed by pioneering efforts made by Cross River State, started to engage in REDD+ in 2009 and became a Partner Country of the UN-REDD Programme in February 2010.

Nigeria intends to establish a nationally championed Integrated Waste Management System comprising the construction of Integrated Waste Management Facilities in 12 states and the construction of Integrated Waste Disposal & Management Facility in 2 states. The establishment of a Waste Recycling Facility in one State is planned. The Federal Ministry of Environment intends to develop several projects across the country within a solid and medical waste disposal system.

Lagos Waste Management Authority (LAWMA) is responsible for most mitigation efforts being carried out in the waste sector in Nigeria. As an agency, its objective is to keep Lagos clean and this is achieved through various infrastructure development projects being executed. Many of these projects are either being built or upgraded to enhance the development of infrastructure and increase the efficiency and effectiveness of the operational activities of the Authority. Nine (9) projects have been completed, five (5) are ongoing and four (4) proposed. Environmental and social impact assessment of all solid waste landfills and two transfer and loading stations are under way. Projects implemented by the Federal Ministry of Agriculture and Rural Development are intended to mitigate or address GHG emission sources in the agricultural sector through improved management of farm run-off, better agricultural infrastructure, aquaculture, agroforestry, improved agricultural practices and conservation agriculture.

The overall objective of the Lagos Bus Rapid Transit (BRT) system is 'to improve mobility and transport affordability in the city of Lagos through regulatory reform and facilitation of person movement on major corridors through a combination of traffic management and implementation of a high quality, high performance BRT system.

CDM projects

Although only a few CDM projects have been approved and implemented in Nigeria, high potentials for emission reduction still exist in several sectors. To date, the Energy Industry dominates the number of registered CDM projects in Nigeria. As depicted in Table 3, out of the eleven (11) registered CDM projects in Nigeria, eight (8) are energy related falling under subsectors such as oil and gas, energy generation, energy efficiency and renewable energy. The waste sector has two registered projects, and one is registered under Manufacturing Industries.

Table 3. Distribution of CDM projects by sector with estimated emission reduction potential

Type of Project by Sector	No. of CDM Project(s)	Estimated emission reduction (t CO_2-eq)	% Emission Reduction
Energy (Oil and Gas)	4	4,668,609	67.00%
Waste (Waste Handling and Disposal)	2	411,713	6.00%
Energy (Renewable Sources)	2	1,423,708	20.40%
Manufacturing Industries	1	166,557	2.40%
Energy industries (Energy Generation)	1	264,994	3.80%
Energy (Energy Efficiency)	1	31,309	0.40%
Total	11	6,966,890	100.00%

Programme of Activities (POA)

Six national/regional projects are registered under the Programme Of Activities (POA). These projects are:

- Cable Propelled Mass Transit Projects in Nigeria
- Distribution of improved cooking stoves in Sub-Saharan Africa
- Energy efficiency of Nigeria's residential lighting stock through the distribution of up to 40million compact fluorescent lamps (CFLs) to households connected to the grid
- African improved cooking stoves programme of activities
- POA for the reduction of emissions from non-renewable fuel for cooking at household level
- Distribution of fuel-efficient improved cooking stoves in Nigeria
- POA for improved cooking stoves for Nigeria.

Information on domestic Measurement Reporting and Verification

Introduction

The Bali Action Plan introduced the principle of measurement, reporting and verification (MRV) for both developed and developing country Parties towards enhancing action at the international and national levels to mitigate climate change. Paragraphs 61 and 62 of decision 1/CP.16 make it mandatory for non-Annex I Parties to also Measure, Report and Verify domestically and internationally supported mitigation actions with the latter also subject to international MRV.

Development of the MRV system of Nigeria

MRV calls for the measurement and reporting of countries' climate mitigation actions. The development and establishment of a domestic MRV system represents a serious challenge to non-Annex I countries as it is a new and additional responsibility within the framework of the preparation of BURs. Nigeria has some initiatives and existing capabilities within its present monitoring and evaluation system that can serve as basis for the development of the domestic MRV system after appropriate improvements and modifications. Institutionalization of the MRV will ensure that all resource requirements are considered and accounted for in advance and the necessary mechanisms are put in place to address all issues that may arise on a continuous and systematic way rather than on an ad-hoc basis.

A preliminary analysis, performed in view of the development of the domestic MRV system for tracking emissions, mitigation activities, and support needed and received, revealed the need for completion of the following steps:

- Establishment of baselines or references based on current practices and available information;
- Identification and description of existing institutional arrangements, monitoring and evaluation systems, and current capacity to address the MRV indicators and areas;
- Identification and assessment of the gaps, barriers, and challenges in the development of the MRV system to enable their correction; and
- Identification of existing opportunities that could enhance the MRV capabilities while proposing interlinkages and synergies for the preparation of national reports.

Proposed Institutional Framework

The MRV system reflects Nigeria's national circumstances with the underpinning legal framework spanning over different administration/government levels. It contains both mandatory and voluntary components. The Federal Ministry of Environment will spearhead the domestic MRV system in collaboration with other line Ministries, Departments and Agencies (MDAs) and State government representatives in the Inter-Ministerial Committee. The Department of Climate Change of the Federal Ministry of Environment is the focal entity to coordinate and supervise the institutional arrangements through its technical departments overseeing the more detailed activities of the working groups. The latter will comprise representatives from various line ministries, state and local governments, private sector, civil society organizations, educational and research organizations as appropriate according to specificity of activities. The Inter-Ministerial Committee" provides a common coordination platform to harness the many relevant climate datasets that are available in different government departments and in private organizations. The committee is to meet regularly to receive reports from all line Ministries, Departments and Agencies. The role of the Inter-Ministerial Committee will be to collate and integrate information on implementation of the Climate Convention from all concerned stakeholders, including on emissions, mitigation and support needed and received.

GHG Inventory Management System

Preparation of the GHG inventory for the First and Second National Communications of Nigeria were mostly led by individuals who worked with government, consultancy firms or freelance consultants. There was no management system to oversee and coordinate the different steps of the inventory cycle for the compilation of a quality inventory. This arrangement suited the ad-hoc preparation of inventories for reporting in the past but no longer fits the present situation for enhanced reporting as per Decision 1/CP16. It is considered not sustainable. Hence, there is need to put in place a National

Inventory Management System (NIMS) that guarantees sustainability and quality through effective institutional arrangements to produce good quality inventories.

Nigeria has already started developing the NIMS with the creation of a GHG Inventory Division" within the DCC of the Federal Ministry of Environment. This division has the responsibility for producing good quality GHG inventories that are compliant and of the standard required by IPCC. This division operates with two sections responsible respectively for GHG inventory reporting and databasing components.

It should however be highlighted that this is a major challenge for the country and it will take time to develop and implement the NIMS, make it fully operational and sustainable over time. Hence, capacity building will be an integral part when developing the NIMS including the Institutional Arrangements. Nigeria relies on the support of bilateral and multilateral partners to fully implement its sustainable NIMS.

MRV of emissions

MRV of emissions seeks to measure, report and verify quantifiable emissions data at national, regional and plant levels for activities falling under the four IPCC sectors. DCC, as focal Department, will be tasked with collating and integrating information on climate change implementation across government departments. Consequently, the GHG Division of the DCC will oversee all activities of the system for MRV of emissions through the two sections described under the Institutional Arrangements for compilation of inventories. The National Bureau of Statistics will be responsible for collecting activity data from public institutions and private sector companies, the various line ministries, State and local governments and the civil society. Research organizations and universities will support in the assessment of the appropriateness of IPCC default emission factors and their improvement to better suit national circumstances where possible. DCC will take charge of preparation of the report, its review by stakeholders, approval and submission to the COP. There will be continuous assessment and enhancement of institutional arrangements to ensure methodologies and activity data collection, particularly for GHG inventories are up to date for making best estimates of emissions and removals. The MRV of emissions will incorporate best practices from other countries. The major challenges regarding the implementation of the MRV of emissions in Nigeria include inadequate capacity, absence of a legal framework and inadequate understanding of GHG emissions across stakeholders.

MRV mitigation actions including NAMAs

Nationally Appropriate Mitigation Actions (NAMAs) constitute a central instrument to support developing countries' efforts in achieving their GHG emission reduction targets towards a low carbon economy. MRV of mitigation actions, including NAMAs are essential to track progress and allow for backstopping of mitigation activities. In addition, MRV cycles help to inform, understand and correct deviations between projected and real performance, therefore triggering the necessary learning process.

The overall responsibility of the MRV system for mitigation will rest with the Federal Ministry of Environment through the Mitigation Division of the DCC supported by the GHG Inventory Division. The Mitigation Division will track and follow the different steps of the MRV system while estimation of emission reductions stemming from the mitigation activity will be computed by the inventory team of the GHG inventory Division. The Measurement component will be under the responsibility of the Executing Entity (EE) which will also prepare regular monitoring reports and submit to the NAMA Implementing Entity for follow-up. The latter will then submit to the NAMA Coordinating Agency,

namely the Mitigation Division of the DCC for verification and approval for further transmission to the appropriate authority for verification. Once the latter process is satisfactorily completed, the final report will be commissioned and submitted to the NAMA Donor or other collaborating/supporting partner depending on the type of NAMA. Other mitigation activities will follow a similar process. The implementation details, support received, emission estimates and other benefits derived from the activity will then be included in the next BUR for submission to the UNFCCC. Implementation of the MRV for NAMAs in Nigeria faces many gaps and barriers in capacities, technical skills and data availability in all sectors. These gaps and barriers must be taken into consideration when developing and implementing the MRV process.

MRV of support

Direct support from bilateral and multi-lateral partners for climate change activities can be of financial, technical and technological nature notwithstanding capacity building of national experts on various thematic areas. The present situation is the absence of a dedicated system to track support received. The Federal Government of Nigeria will develop and implement an MRV system to correct for this. The Federal Ministry of Environment has provided for the establishment of a Climate Public Expenditure and Institutional Review (CPEIR) in its 2017 budget. The purpose of which is to develop a framework that would identify, report, monitor, evaluate and account for all climate related financial resources.

The proposal is for existing institutional arrangements aimed at monitoring climate change activities to be strengthened after appropriate improvements to meet the challenges for MRV of support. The Inter-Ministerial Committee on Climate Change can act as the platform for collating all information pertaining to support for climate change related activities from all Federal Ministries. The latter can itself collect the same information from the State Governments and the private sector. The information provided as per an agreed template can then be processed, documented and archived by the DCC of the Federal Ministry of Environment for retrieval when preparing the Biennial Update Reports.

Constraints and gaps, and related financial, technical and capacity needs, including a description of support needed and received

Introduction

As a signatory of the Convention, Nigeria has delivered to the extent it has been capable within the context of its development priorities to meet its obligations to the UNFCCC. While the country recognizes the support received from bilateral and multilateral partners to tackle climate change, it is obvious that the level of support received to-date has not been to the tune to enable Nigeria to actively play its role as required and as it would have wanted. The country is highly vulnerable and the priority has been to invest national resources available for adaptation rather than mitigation to guarantee the minimum well-being of the poorest segments of the population, including the more vulnerable groups and women.

Nigeria still faces numerous constraints and gaps of financial, technical and technological nature that the country will have to address in addition to capacity building to be able to cope with the threats posed by climate change. These constraints, gaps and needs relate to its obligations for reporting and implementation of the Convention. In this regard, Nigeria seriously hopes that the Paris Agreement will be fully implemented within the shortest possible time to enable all developing countries implement their NDCs and contribute fully in the achievement of the objectives of the Convention.

GHG inventory

Informing the COP of the best status on country's emissions regularly and sustainably is the backbone for decision-making on curbing GHG emissions towards stabilizing GHG level in the atmosphere to limit global warming and its impacts. Nigeria has set up a GHG inventory Division in the DCC but is still struggling to compute good GHG inventories for reporting to the Convention and to also support the development of its low carbon development strategy. A recurring constraint in the estimation of GHGs for the four IPCC sectors is the lack of good quality activity data. Available activity data are relatively inconsistent in all IPCC sectors. This increases the uncertainty level and prevents the adoption of the more precise higher tier levels as there exist no national emission factors more appropriate to suit national circumstances compared to the default IPCC emission factors. Nigeria also lacks a proper GHG inventory management system with robust institutional arrangements and a pool of national experts for sustainable production of inventories. It is planned to further strengthen the GHG Division of DCC to collect and archive all information pertaining to GHG inventories. This unit will also be liaising with GHG compilers to ensure inventories are consistent, credible and reliable.

Mitigation

Nigeria is geared to continue on the path of mitigation in all areas of its development to meet the objectives of the low carbon strategy it has developed. Already, the country participated in implementing CDM projects and identified and reported clear mitigation opportunities in its NDC. Nigeria is yet to develop its first NAMA due to lack of capacity, a well-computed inventory at facility level with proper baselines due to constraints and gaps reported under GHG inventory. Thus, apart from the CDM projects, mitigation is in its infancy. It is noted that in preparing the section on 'Mitigation Action and Their Effects' for this first BUR, several gaps and constraints were identified. Overall, information on mitigation actions and their effects is very scarce and limited. While there is tremendous effort to mitigate the effects of climate change, this information is either unavailable or in most cases non-existent, as there is no centralized system of reporting or data collection on mitigation in the country. Information on climate change policies and larger national actions are usually available. However, this information only contains the basic details like program name, implementation agency, and objective, with little to no information outlining the effects of the mitigation actions and emissions avoided. Conscious of the need to improve on reporting and implementation of the Convention, Nigeria has established a Mitigation Division within the DCC but the latter lacks the capabilities and resources to make it fully operational to deliver at the required level. Additionally, there is need to impart sufficient knowledge to a higher number of national experts at facility and State levels to develop and implement mitigation actions widely enough to tap all existing possibilities of the development framework.

Measurement, Reporting and Verification

Nigeria as most of the developing countries, will have to build on existing systems to meet the MRV requirement. It is proposed to institutionalize MRV for good quality reporting in the future. Usually, measurements and reporting are done on an ad-hoc basis for projects but this is not necessarily suitable for MRV for BURs which should be systematic and sustainable. The most lacking feature of the present monitoring and evaluation systems practiced is the absence of regular documentation and archiving. The development and implementation of the domestic MRV system will need to integrate various ministries, other government institutions, the private sector organizations and the civil society. DCC will have the responsibility to develop and establish the domestic MRV system. Additionally, there will be the need to allocate enough human, technical and technological resources required to make the process a success. Nigeria on its own may meet difficulties to successfully develop and implement the domestic

MRV and counts on the support of the international community to accomplish this task. In this regard, it will be important to address existing constraints and gaps, and make good for them when developing and implementing the system. Capacity building of sufficient national experts will be first and foremost in the development and implementation of the domestic MRV system.

Technology transfer

Successful technology transfer is primordial when tackling climate change issues. Nigeria is yet to conduct an in-depth technology needs assessment and technology transfer to address climate change. Additionally, constraints and gaps relating to technology transfer in the context of Nigeria's need to mitigate and adapt to climate change exist and will have to be corrected. The main features are lack of awareness of the available technologies; limited human and financial capabilities to domesticate new technologies; poor organizational skills and capacities to coordinate transfer and adoption of new technologies; intellectual property rights which often act as both incentives and obstacles to the transfer of technology; tariffs and taxes are often problematic when import duties on items needed for specific technological development are too high, relevant transfer are inhibited . Technology transfer, in the framework of Clean Development Mechanism (CDM) projects, is most successful when a subsidiary of a company from a developed country is involved; and studies of CDM projects also show that technology transfer is more prevalent in some sectors than in others, depends on the domestic availability of certain technologies, and occurs more frequently in large-scale projects than in smaller ones.

Support received and needed

According to the BUR guidelines, countries are required to also provide information:

- To enable enhanced reporting on mitigation actions and their effects, needs and support received, in accordance with their national circumstances, capacities and respective capabilities, and the availability of support;
- To provide policy guidance to an operating entity of the financial mechanism for the timely provision of financial support needed by developing country Parties to meet the agreed full costs of preparing their biennial update reports (to the Global Environment Facility (GEF) in the case of first BUR).

Nigeria lacks systematic documentation in most areas including support received. Additionally, no exhaustive assessments of support needed to implement fully all identified mitigation actions have been made. Most of the available information relates specifically to financial inflows going to the Federal Government. This data was collected from information available in the public domain and the main recipient like the DCC. Projects with insufficient details and or inadequate information and those less than $50,000 have been excluded, benchmarking it on the limit set by the GEF Small Grant Projects and the information presented covering the period 2012 to 2016.

According to the Department of Climate Change, cumulatively, so far, Nigeria has leveraged over $800million of multilateral funds for climate change projects. Historically, billions of Naira have also been allocated through the budgetary allocations made on an annual basis to Federal Ministries, Departments and Agencies (MDAs) and in some cases, as counter-part funding of bilateral or multilateral financing are presented in the main report. The Nigerian private sector also has started investments to support actions on mitigation and a few of the actions that have been tracked are provided.

Details of a comprehensive Nigerian needs assessment with respect to finance, technical assistance, technology transfer and capacity building have not been made and properly documented. Where such related support has been received, the information is hardly available in the public domain. The difficulty in locating such information is because most of the support is non-monetary and little weight is attached to it for national accounting purposes, resulting in insufficient motivation to record, report and account for them. There exists no efficient system for tracking such support presently. The absence of a duly completed technology needs assessment and financial and capacity building needs assessments also compounds the difficulty in a precise determination of support needed qualitatively and quantitatively. The extent of financial assistance required is not provided and it is planned to start work on this aspect and provide the information as far as possible in the next BUR.

Information on the level of support received to enable the preparation and submission of biennial update reports

The Global Environment Facility (GEF), through the UNDP Country Office acting as the implementing agency, provided funds to the level of USD352,000 to support Nigeria prepare its first Biennial Update Reports (BUR1) for the fulfilment of its obligations under the United Nations Framework Convention on Climate Change (UNFCCC). The Federal Government of Nigeria through the DCC of the Federal Ministry of Environment provided in kind support to the value of USD50,000 to successfully complete the preparation of the BUR1.

Capacity to prepare the BUR is low in most Non-Annex I Parties including Nigeria since the BUR is a new requirement and the guidelines on its preparation are not very explicit. There was therefore a need for capacity building. Although some initiatives have partially addressed this shortcoming through national experts attending workshops on the preparation of the BUR, there is still a need for further capacity building intervention.

Any other information relevant to the achievement of the objective of the Convention and suitable for inclusion in its Biennial Update Report

National climate change development strategy and planning

Nigeria's development process has been guided by two strategic documents in the recent past, Vision 2020 and the Transformation Agenda 2011-2015. Vision 2020 recognizes the changing climate as a threat to sustainable growth in the next decade. It affirms it as a critical challenge globally; and in Nigeria, as a potential driver of damaging and irrecoverable effects on infrastructure, food production and water supplies, as well as precipitating natural resource conflicts. However, the policy and implementation framework have not addressed climate change issues adequately to-date. To correct this anomaly and integrate the increasing importance of climate change issues in the development agenda of the country, the Federal Executive Council adopted the Nigeria Climate Change Policy Response and Strategy in 2012.

Impacts and Vulnerability

Climate change and its impacts vary in extent, severity and intensity across the country. This has been clearly spelt out in the Second National Communication. However, consistent in-depth studies to estimate the costs of the impacts on the economy have not been conducted and only approximate evaluations were made. A summary of the estimates of financial impact on the economy adopted from the INDC is presented in the report. This confirms the high vulnerability of Nigeria to climate change.

The 2014 World Climate Change Vulnerability Index, published by the global risk analytics company Verisk Maplecroft, classified Nigeria as one of the ten most vulnerable countries in the world.

Adaptation Policy Framework

Nigeria's response to climate change impacts has focused on increasing resilience and managing the unavoidable impacts. The National Adaptation Strategy and Plan of Action for Climate Change Nigeria (NASPA-CCN), which was developed in 2011 describes our adaptation priorities, bringing together existing initiatives and priorities for future action. The NASPA-CCN Vision is a Nigeria in which climate change adaptation is an integrated component of sustainable development, reducing the vulnerability and enhancing the resilience and adaptive capacity of all economic sectors and of all people, particularly women, children, and resource-poor men, to the adverse impacts of climate change, while also capturing the opportunities that arise as a result of climate change.

To achieve the objectives of the NASPA-CCN, a set of thirteen sector-specific strategies, policies, programmes and measures have been prepared. The main strategies are:

1. Improve awareness and preparedness for climate change impacts.
2. Mobilize communities for climate change adaptation actions.
3. Reduce the impacts of climate change on key sectors and vulnerable communities
4. Integrate climate change adaptation into national, sectoral, State and Local Government planning and into the plans of universities, research and educational organizations, civil society organizations, the private sector and the media.

1. National Circumstances and Institutional Arrangements

1.1. Introduction

The Federal Republic of Nigeria, commonly referred to as Nigeria, is located at the extreme inner corner of the Gulf of Guinea on the west coast of Africa between latitudes 3°15' to 13°30' N and longitudes 2°59' to 15°00' E. It borders Benin in the west, Niger in the north, Chad and Cameroon in the east, and its coast in the south lies on the Gulf of Guinea in the Atlantic Ocean (Figure 1.1).

Nigeria is the 14th largest country in Africa with a land area of 923,768km^2 of which land comprises 910768km^2 and water accounts for 13,000km^2 It has a total boundary length of 4900 km, including 853km of coastline (Nigeria, 2017).

Figure 1.1 Location map of Nigeria

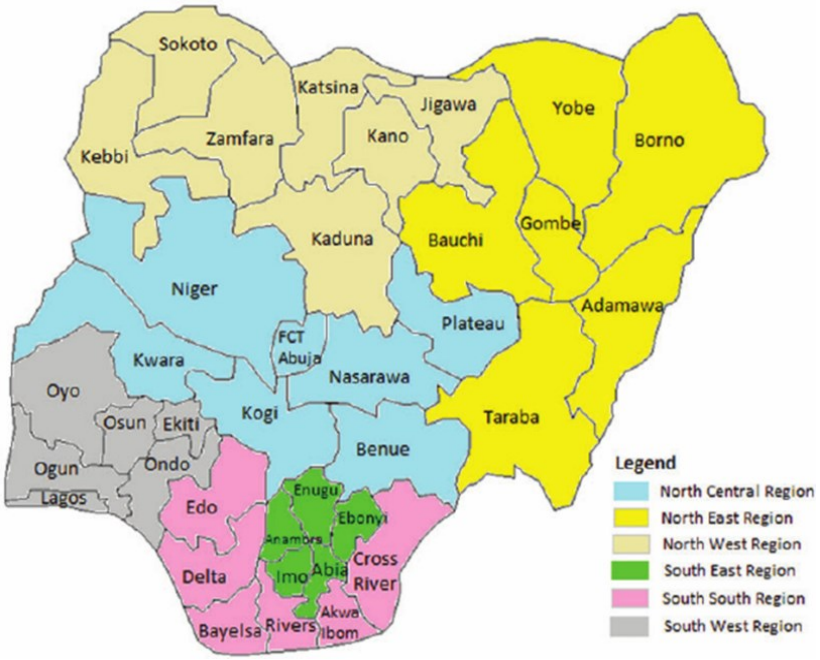

Figure 1.2 Geopolitical zones of Nigeria

It comprises 36 states and the Federal Capital Territory (FCT), where the capital, Abuja is located. Nigeria is officially a democratic secular country. The States and FCT are further sub-divided into 774 Local Government Areas or Area Councils for grassroot administration. The 36 States are grouped into six geopolitical zones for political and development purposes. These are shown in Figure 1.2. The Constitution of the country provides for a presidential system of government in which there is an Executive, a Legislature and a Judiciary. The legislative structure is bicameral with upper and lower chambers at the Federal level while State governments and Local Councils operate a single legislative chamber. A judicial structure erected in all three tiers of government completes the operational framework for checks and balances and separation of powers in governance as enshrined in the Constitution. The Constitution further provides for the operation of three tiers of government, at the Federal, State and Local levels (Nigeria, 2014).

1.2. Convention Obligations

As a Non-Annex 1 Party signatory to the United Nations Framework Convention on Climate Change (UNFCCC), and more specifically as directed by Paragraph 60 (c) of decision 1/CP.16 Nigeria is obliged to report certain elements of information as follows:

> *Developing countries, consistent with their capabilities and the level of support provided for reporting, should also submit biennial update reports containing updates of national greenhouse gas inventories, including a national inventory report and information on mitigation actions, needs and support received*;

Since the inception of joint global actions on climate change arising from the Rio Conventions of 1992, Nigeria has been active on many fronts. In 2003, it submitted the First National Communication (FNC). It had prepared other major documents including the National Adaptation Strategy and Plan of Action (NASPA) to guide its adaptation efforts. A National Climate Change Policy and Response Strategy have been submitted to the National Assembly for passing into law. There have also been efforts to strengthen the institutional arrangements for climate change response in the country. One major aspect of this is the upgrading of the Special Climate Change Unit (SCCU) to a Department of Climate Change (DCC) in the Federal Ministry of Environment. The Second National Communication (SNC) was submitted in February 2014, thus furthering the country's obligations to the UNFCCC and enabling the latter to capture progress in implementing the Convention. The latest document submitted to the UNFCCC was the Intended Nationally Determined Contributions of Nigeria within the framework of the Paris Agreement in 2015.

1.3. Institutional Arrangements

The DCC of the Federal Ministry of Environment was set up to demonstrate the Nigerian Government's *"commitment to introducing and implementing adaptation and mitigation measures necessary to reduce vulnerability to climate change"*. The mandate of the Department is:

> *"To co-ordinate national implementation of the United Nations Framework Convention on Climate Change, its protocol and any other legally binding agreement for implementing climate change activities"* (Department of Climate Change, 2017).

DCC is Nigeria's focal point to the UNFCCC and as such its mission is:

> *"To regularly update information regarding national inventory of the Green House Gas emission and mitigation options, vulnerability assessment and adaptation measures and to satisfactorily provide a sustainable policy framework and enabling environment for the implementation of the UNFCCC and Kyoto Protocol and any other climate change guidelines, laws and control in Nigeria"* (Department of Climate Change, 2017).

DCC comprises the following four divisions:

- Green House Gas (GHG) Division
- Vulnerability and Adaptation Division
- Education, Awareness and Outreach Division
- Mitigation Division

In addition to the operations carried out by these divisions, DCC is also the convener and chair of the Inter-Ministerial Committee on Climate Change (ICCC).

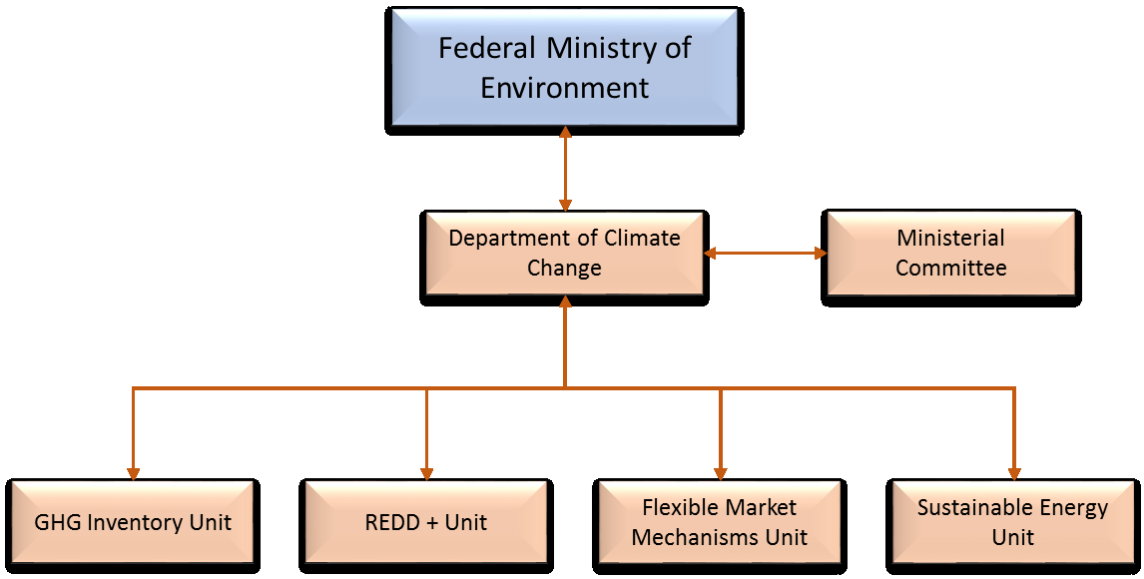

Figure 1.3 Institutional arrangements: Department of Climate Change

1.4. Climate

Nigeria is located primarily within the lowland humid tropics. The climate of Nigeria is mainly influenced by three major air masses: the tropical maritime (mT), the tropical continental (cT) and the equatorial easterlies (Ojo, 1977; Iloeje, 1981).

Nigeria is generally characterized by a high temperature regime almost through the year. In the far south, mean maximum temperature is 32°C while in the north it is 41°C. However, the mean minimum temperature is 21°C in the south and under 13°C in the north which has a much higher annual range. The mean temperature for the country is 27°C, in the absence of altitudinal modifications. Over the last few decades, there has been a general increase in temperature throughout Nigeria.

The climate of the country varies from a very wet coastal area with annual rainfall greater than 3500mm to the Sahel region in the northwest and north-eastern parts, with annual rainfall less than 600mm. The annual variation of rainfall, particularly in the northern parts, is large. This often results in climatic hazards, especially floods and droughts, which bring in their wake much suffering with devastating effects on food production and the nation's economy. Recent studies have revealed declining trends in rainfall. Often, substantial parts of Nigeria receive less than 75% of their annual rainfall and this is particularly worrisome in the north.

1.5. Relief and Drainage

Nigeria has two main relief regions: the high plateaux ranging between 300 and more than 900m above sea level, and the lowlands, which are generally less than 300 m (Iloeje, 1981; Jeje and Adesina,1995). The high plateaux include the North Central Plateau, the Eastern and North Eastern Highlands and the Western Uplands.The lowlands comprise the Sokoto Plains, the Niger-Benue Trough, the Chad Basin, the interior coastal lowlands of western Nigeria, the lowlands and scarplands of south eastern Nigeria and coastlands.

The Niger Delta is a low-lying region, cut up by a complicated system of natural channels through which the River Niger finds its way to the sea. It is made up of three distinct sub-regions. These are: (a) the freshwater zone, (b) the mangrove swamps, and (c) the zone of coastal sands and beach ridges. The freshwater zone, which starts from the apex of the delta, just below the town of Aboh, is essentially an extension of the Lower Niger Floodplains. The numerous water channels in this zone are bordered by natural levees, which provide the sites for most of the settlements and farmlands in the zone. The mangrove swamps, covering about 10 10 360km^2 and located to the south of the freshwater swamps, are sparsely settled. Strips of sandy beaches and ridges, which vary from a few meters to 16km, separate the mangrove swamps from the open sea. In addition to natural levees, ox-bow lakes are common landforms in the Niger Delta. The high rainfall in the region, coupled with the abundance of surface water and the flat terrain, create a serious drainage problem and makes road construction very difficult.

Most of the country's rivers take their sources from four main hydrological basins: the North Central Plateau (Sokoto-Rima, Hadejia, Gongola, and Kaduna rivers etc.), the Western Uplands (Moshi, Awun, Ogun, Osun, Osse rivers etc.), the Eastern Highlands (Katsina-Ala, Donga rivers, etc.) and the Uri Plateau (Anambra, Imo and Cross rivers etc.). These drainage and relief features of the country have impacts on water resources and land use potentials of the country, particularly for agriculture. According to the 2008 State of the Environment Report (Federal Ministry of Environment, 2008), the total surface water resources potential for Nigeria is estimated at 267.3 billion m^3 while the groundwater potential is evaluated at 51.9 billion m^3, giving a total of 319.2 billion m^3. In addition, the number of relatively large dams completed or under construction is about 160 with a total active storage of 30.7 billion m^3.

1.6. Demography

Even if there exists no precise statistics on the Nigerian population, various sources tend to agree that it is the most populated country in Africa and ranked 7th at world level in 2015. According to the Director General of the Nigerian National Population Commission (NPC) the country's population had reached 182 million by late 2016 (Vanguard, 2016; Nigeria, NPC, 2017). This estimate was based on the last Population and Housing Census done in 2006, using an annual growth rate of 3.5% weighed against other variables such as rising life expectancy and a declining infant mortality rate.

Two important demographic aspects need to be considered for the sustainable socio-economic development of Nigeria:

(i) the growing youth bulge, with those under 14 years accounting for more than 40% of the population, urging for the planning of the transition from youths to the next category especially, given the relatively high unemployment rate in the country.
(ii) the rapid urbanisation of the Nigerian society. According to the 2006 census, around 39% of the population lived in urban regions and World Bank statistics estimate that urban dwellers, will represent 50.2% of total population and will surpass their rural counterparts by 2018.

1.7. Economic Profile

Nigeria is a lower middle-income country. According to World Bank statistics, since 2012, the year during which it overtook South Africa, it has become the largest economy in Africa. In 2016, at current US$, the Nigerian GDP was $405.083 billion and the GDP per capita was 2178. Figure 1.4 illustrates the evolution of Nigeria's GDP during the period 2000 to 2016 (source: World Bank).

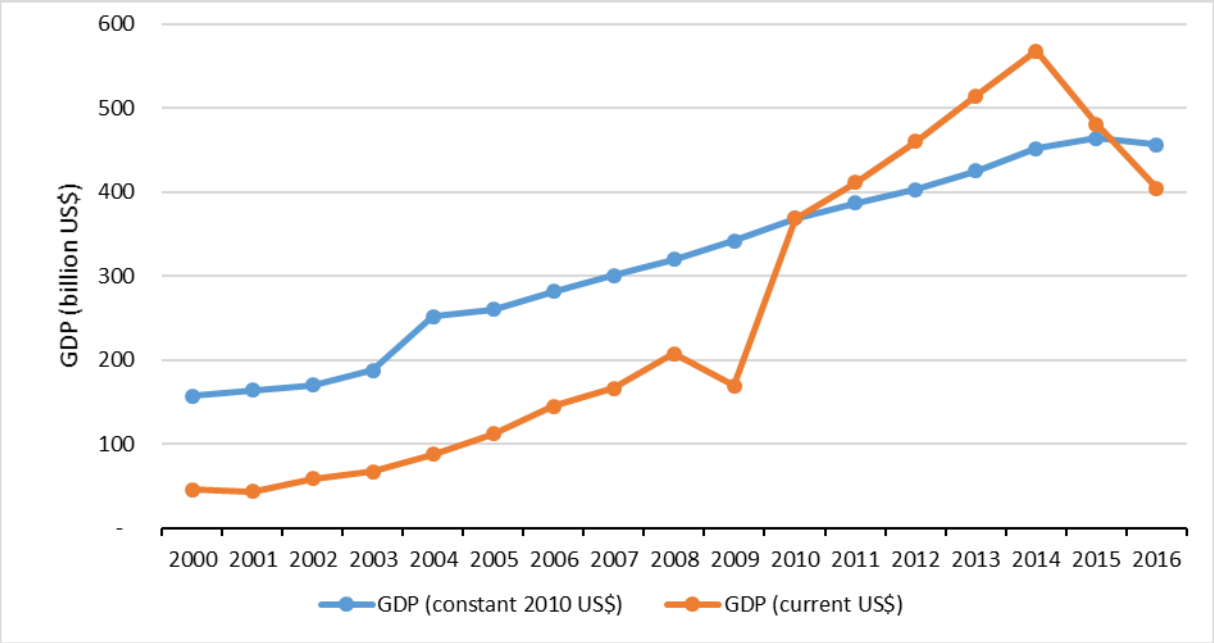

Figure 1.4 GDP of Nigeria in constant 2010 US$ and current US$

Between 2005 and 2014, the economy grew steadily by over 7% per annum, but exhibited a marked contraction from 2015 when GDP growth rate fell to 2.79% from 5.7% recorded for the previous 5 years (2010 - 2014), Figure 1.5. The situation worsened in 2016 when a negative growth of -1.5% was recorded.

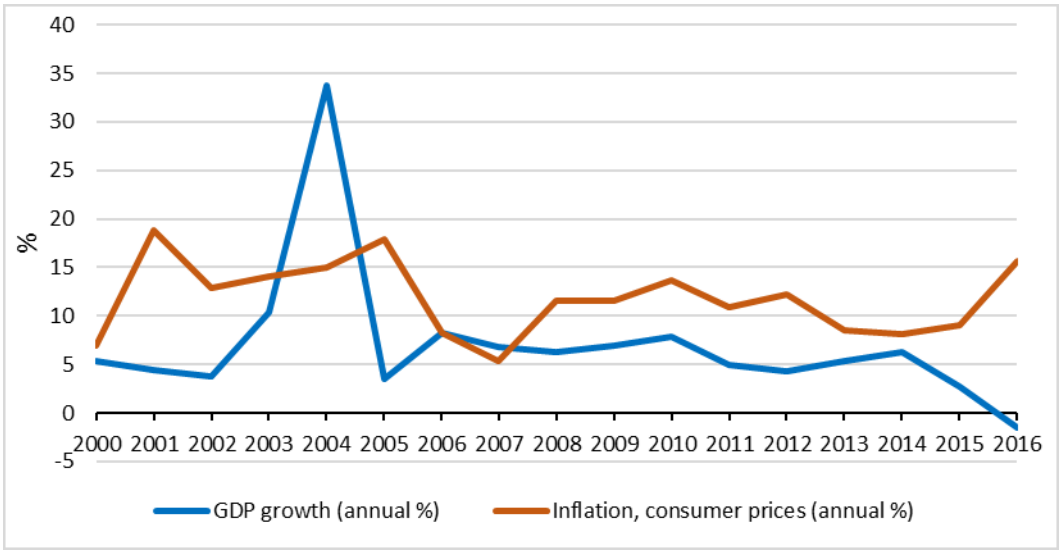

Figure 1.5 Nigeria's GDP growth and inflation rate

A sectoral analysis shows that within the whole economy, it was the oil sector which regressed most (Figure 1.6). Nigeria remains heavily dependent on oil revenues. In recent years, oil and gas have accounted for more than 90% of the country's exports and more than 70% of consolidated budgetary revenue. Hence, while the oil sector contributes less than 15% to total GDP and despite the contraction of that sector, inflows from oil sales still play a significant role in the economy and have helped bolster domestic demand, thereby driving economic growth (World Bank Group, 2015).

On the other hand, the other sectors of the economy have exhibited relatively more resilience. Hence, over the last five years ending 2016, the agriculture sector grew on average by 4.3% and the services

sector grew on average by 6.0% from 2012 to 2015 to regress only in 2016 by -0.8% (Figure 1.6). In 2016, the real contributions of the agriculture, industry and services sectors to national GDP were 24.4, 22.0 and 53.6% respectively. Trade, information and communications technology, and real estate together accounted for around 70% of the output of the services sector.

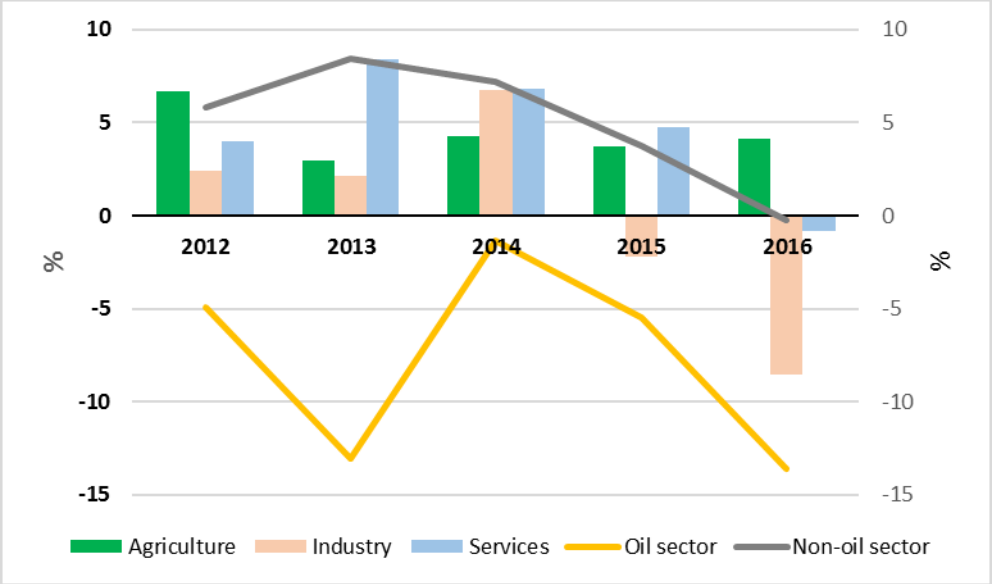

Figure 1.6 Growth rate of main economic sectors of Nigeria

1.8. Key Economic Sectors

1.8.1. Energy

Oil and natural gas, and biomass constitute the main sources of energy for Nigeria. There is, however, significant efforts to harness the high potentials available from solar and wind.

1.8.1.1. Oil and natural gas

Nigeria has the second largest proven crude oil reserves of Africa and according to Abstract of Statistics 2016 (NBS, 2017) of the Nigerian National Bureau of Statistics, the reserves stood at 37,448.25 million barrels in 2014. During the same period, the country produced 699,486 barrels of crude oil whereas it exported 773,833 barrels. The oil fields are in the south, specifically in the Niger Delta and offshore in the Gulf of Guinea. Current exploration activities are mostly focused in the deep and ultra-deep offshore, with some activities in the Chad Basin, located in the northeast of the country.

In general, the exploitation of petroleum resources in the last four decades has resulted in massive injection of hydrocarbons into the atmosphere as well as considerable environmental problems. This makes the sector an important one in the discussion of GHG-induced climate change, its consequences, and the need for mitigation and adaptation relative to this sector.

Nigeria is one of the main gas producers in Africa and production is expected to double between now and 2030, increasing to about 400 billion m^3 per annum. Proven recoverable reserves of natural gas in Nigeria at the end of 2011 were 5,110 billion m^3. Current production of 29 billion m^3, is estimated to last more than 100 years (WEC, 2013). A significant amount of Nigeria's gross natural gas production is flared (burned off) because some of Nigeria's oil fields lack the infrastructure needed to capture the natural gas produced with oil, known as associated gas. In 2014, Nigeria flared 10.73 billion m^3 of its associated gas production, or 12% of its gross production and ranked as the world's fifth-largest gas

flaring country, accounting for 8% of the total amount flared globally in 2014 (EIA, 2016). However, it is noteworthy that while Nigeria still flares a significant portion of its gross natural gas production (12% in 2014), the amount of gas flared has regressed by more than 50% over the past decade. Nigeria now ranks as the fifth-largest natural gas flaring country, down from the second position it held in 2011. Several recently developed and upcoming natural gas projects that are focused on monetizing previously flared natural gas will further reduce the country's contribution to global GHG emission through gas flaring that is proposed in the country's NDC to be completed by 2030.

1.8.1.2. Biomass

Nigeria is the third world's largest producer of bioenergy, after China and India respectively. In 2010, the share of bioenergy of total primary energy supply was over 80% (WEC, 2013). In 2011, Nigeria was one of the largest fuel wood producers, along with India, China, Brazil and Ethiopia. The biomass resources of Nigeria can be identified as crop residues, forage (grasses and shrubs), animal wastes and waste arising from forestry, municipal and industrial activities, as well as, aquatic biomass. Crops such as sweet sorghum, maize and sugarcane are the most promising feedstock for biofuel production. It has been estimated that Nigeria produces about 227,500 tons of fresh animal waste daily. As 1kg of fresh animal waste produces about $0.03m^3$ biogas, Nigeria can potentially produce about 6.8 million m^3 of biogas every day from animal waste only. Although biogas technology is not common in Nigeria, various studies have been carried out on the technology and policy aspects of biogas production by various scientists in the country.

1.8.1.3. Other energy sources

Coal: By the end of 2011, Nigeria had 21 million tonnes of proven recoverable bituminous coal reserves, including anthracite (WEC, 2013). It is among the top five (5) countries in Africa, by reserves.

Wind: Wind is not a major source of energy in Nigeria. In 2011, Nigeria had only 2MW of installed capacity (WEC, 2013).

Nuclear: Nigeria plans to have about 1,000MWe of nuclear power installed by 2017 and 4,000MWe by 2027. A draft strategy for the safe and sustainable management of radioactive waste and spent nuclear fuel has also been prepared. It includes an option for use when repatriation of spent fuel is not possible (ECN, 2012).

Geothermal: The literature indicates that more studies are necessary, but current indications point to the potential for geothermal energy (Zira, 2013), with the geothermal gradient of the Anambra Basin ranging from 2.5 to 4.90c /100m and that of the Bida Basin from 2 to 2.50c/100m.

Solar: Nigeria lies within a high sunshine belt and thus has enormous solar energy potentials. Solar radiation is fairly well distributed with an average of about $19.8MJm^{-2}$day and average sunshine hours of 6hrs day^{-1}. If solar collectors or modules were used to cover 1% of Nigeria's land area, it is possible to generate 1850 x103GWh of electricity per year, which is over one hundred times the current grid electricity consumption in the country. But this potential is yet to be properly harnessed. Nigeria is estimated to have only 20MW of solar energy installed (REN21, 2014).

Hydro: Nigeria is reasonably endowed with large rivers and few natural falls. Small rivers and streams also exist within the present split of the country's eleven River Basin Authorities, some of which maintain minimum discharges all year round. In a study carried out in twelve states and four river basins, over 278 unexploited small hydropower (SHP) sites with a total potential of 734.3MW was identified. However, SHP potential sites exist in virtually all parts of the country with an estimated total capacity of 3,500MW . They indicate that Nigeria possesses potential renewable sources of energy along

her numerous river systems, a total of 70 micro dams, 126 mini dams and 86 small sites have been identified.

1.8.2. Agriculture

The agriculture sector is a very important component of the Nigerian economy. Almost 78% of the total land mass of the country, representing 708,000km^2, are under agriculture. Of these, 48.0% constitute arable lands, 42.8% are under permanent meadows and pastures and the remaining 9.2% are under permanent Crop production is by far the most important component of the agriculture sector, contributing 89.7% to the total GDP of the sector. The sector is also the largest employer of the country and accounted for 24.4% of GDP in 2016. The present Federal administration since 2015, has been pursuing its commitment to revamp the agriculture sector. This is with a view to diversifying and stabilizing the nation's economy by reducing over- reliance on the petroleum sector. Climate change poses a threat to Nigerian agriculture. The World Bank recently predicted an up to 30% drop in the country's crop output due to erratic rainfall and higher temperatures.

1.8.3. Human Health

In 2010, the National Strategic Health Development Plan (NSHDP) 2010 - 2015 (Nigeria-FMOH, 2010) described Nigeria's health situation as follows: "The health indicators for Nigeria are among the worst in the world. Nigeria shoulders 10% of the global disease burden and is making slow progress towards achieving the 2015 targets for the health related Millennium Development Goals (MDGs). The health indicators in Nigeria have largely remained below country targets and internationally-set benchmarks due to weaknesses inherent in its health system."

According to the same report, the key challenges for achieving Nigeria's national health objectives were related to:

- the weak health system characterized by constrained governance systems and structures,
- low levels of health care financing and poor predictability and release of funds with inadequate financial protection for the poor,
- shortage and non-uniform distribution of human resources for health,
- poor quality service delivery,
- inadequate and untimely availability of quality health commodities,
- lack of routine health services data,
- low levels of research for health,
- weak partnership and coordination,
- poor community participation and poor utilization of health services, particularly child and maternal services."

It was nonetheless noted that Nigeria was making some progress in the achievement of the health-related MDGs. Development indicators also showed the need for more concerted efforts in the sector (WHO, 2015).

The prevalence of infectious and parasitic diseases like malaria (141 in 100,000), tuberculosis (282 in 100,000), HIV/AIDS (3.9% of the population) and schistosomiasis among others, remains very high. Furthermore, illnesses such as diabetes and cardio-vascular diseases, often associated with increasing socio-economic wellbeing, are becoming significant health problems in the country (Babatimehin, 2003). Only 48% of the population has "sustainable" access to clean water and a lower proportion, 44% has good sanitation (World Bank, 2008).

1.8.4. Transportation

Air, rail, pipelines, road and water transportation facilities are available in the country but the most important in terms of functionality and size of patronage is the road. The total length of Federal Government highways is about 34,340km. States also make complementary investments on high grade road development. The total rail length is about 4000km while water and air transportation are the least developed. The country has close to 8600km of water ways, the longest being on River Niger and the Benue system. Governments, at both the state and federal levels, are investing on airports to increase access to air travel. In general, every facet of transportation is inadequate or inefficient. Roads are often in a state of disrepair or incapable of handling the ever-increasing traffic volume. This has impacted negatively on the socio-economic development of the country. The contribution of the transport sector to the Gross National Product is 1.41% which is considered unacceptable for a sector that plays a major role in the nation's development. The transportation sector is now one of the President's economic development priorities (Federal Republic of Nigeria, Economy, 2016).

1.8.5. Telecommunications

Nigeria has less than a million landlines but certainly more than 100 million mobile cellular subscribers. The advent of mobile communications in the late 1990s has revolutionized the sector and impacted positively on the socio-economic development of the country. Incentives are being provided to enhance the development of information and communications technology (ICT) and its enabling infrastructure for every part of the country including the rural areas. While encouraging investment in ICT, appropriate legal and regulatory frameworks are being put in place to safeguard the investments. In 2016, this sector contributed around 11% to GDP, showing its importance in the country's economy (National Bureau of Statistics, 2016).

1.8.6. Manufacturing

The manufacturing sector has the potential to boost economic growth and stimulate employment generation, wealth creation and poverty eradication. The sector, handicapped by low capacity utilization, did not perform as much as expected for a long time. It started to take off in 2010 and eventually peaked at a contribution of almost 10% to GDP in value added terms in 2014 (Figure 1.7). However, the sector regressed in 2015 and 2016, amidst a general contraction of the economy.

Figure 1.7 Nigeria's manufacturing sector (value added, % of GDP)

The country's vision for the manufacturing sector is *'a technologically driven and globally competitive manufacturing sector, with a high level of local content and contributing a high proportion of the*

National GDP'. The stated focus of increasing annual growth in the manufacturing sector from 8% in 2005 to a minimum of 35.9% on the average annually (Vision 2020 Technical Report on Manufacturing) would no doubt have serious implications for energy use and climate change in the very near future.

1.8.7. Power Sector

Power supply in Nigeria is a big challenge to the economy of the nation. Despite efforts by various governments and huge sums of money invested in the sector, the power supply is still inefficient and this has continued to hamper industrial development of the nation. The per capita power consumption of 151KWh per year in Nigeria is among the lower end of the spectrum in the African continent.

The 23 grid-connected generating plants in operation in the Nigerian Electricity Supply Industry (NESI) has a total installed capacity of only 11,165MW and available capacity of 7,139.6MW as at June 2016. Equally, most of the generation are thermal based with an installed capacity of 9,044MW (81% of the total) and available capacity of 6,079.6MW (83% of the total).

Hydropower from three major plants accounts for 1,938.4MW of total installed capacity (an available capacity of (1,060MW, 77.8%) with limited contributions by non-hydropower renewable sources making up the remainder.

At present, less than half of Nigeria's population has access to grid-connected electricity. In 2015, power supply in Nigeria averaged 3.1GW, which is estimated to be only a third of the country's minimum demand.

The Electric Power Sector Reform Act was passed in 2005 to reposition the sector by changing its structure, and privatizing generation and distribution while retaining transmission under Government control. Today, Nigeria has 12.5GW of installed capacity, but less than one third is operational (average of 3.9GW in 2015; 3.0 GW in November 2016). Overall, only about 15% of installed capacity is eventually distributed to end users, resulting in a huge shortage of electricity supply across the country.

A report on the National Water Resources Master Plan by the Federal Ministry of Water Resources in 2016 revealed that Nigeria has hydropower potential of about 12,220MW, of which only about 1,930MW has been developed at Kainji, Jebba and Shiroro Dams. There are also existing dams with a combined potential hydropower capacity of over 200MW that are yet to be exploited while four dams that are under study and design have a combined potential of about 4,320MW, including Mambilla (3,050MW), Gurara 11 (360MW), Dasin Hausa (150MW) and Zungeru (760MW).

1.8.8. Wetlands

Wetlands are *"areas of marsh, fen, peat land or water, … with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres"* (Ramsar Convention, 1975). They support rural livelihoods as bases for crop production, grazing animals, fishing, and harvesting of medicinal plants among others. The *fadama*[1] projects have hung on their potentials. Wetlands are also important for biodiversity promotion. Nigeria presently has 11 sites designated as Wetlands of international importance, with a surface area of 1,076,728 hectares.

[1] In Nigeria, the term "Fadama" is a Hausa name for irrigable land—usually low-lying plains underlaid by shallow aquifers found along major river systems

1.9. Environmental Challenges

The main environmental challenges in Nigeria are land degradation, environmental pollution, floods and erosion. Land degradation is stemming from many factors, including pressure on the land resources, which lead to deforestation or de-vegetation and unproductive land. Environmental pollution is a serious challenge, especially around the major urban areas.

1.9.1. Climate Change

Accelerated climatic changes are expected to lead to potentially large impacts across Africa, including Nigeria, in the future. The scale of climate change will increase with high anthropogenic emissions, greenhouse gas (GHG) concentration, and average global temperature. Climate models suggest that Africa's climate will generally become more variable, with high levels of uncertainty regarding climate projections in the Africa Sahel zone. Temperatures in West Africa, and particularly the Sahel, have increased more sharply than the global trend, and the average predicted rise in temperature between 1980/99 and 2080/99 is between 3^{o}C and 4^{o}C , which is more than 1.5 times the average global trend. For Nigeria, sea level rise of 1m could result in loss of 75% of the Niger Delta (IPCC, 2007).

1.9.2. Deforestation

Nigeria is well endowed with forest resources but the excessive exploitation of these resources is a source of concern to Government and a threat to sustainable socio-economic development of the nation. Apart from providing a large proportion of the global supply of timber and fuel, forests also provide a wide range of non-wood products and environmental functions. These products include bush meat, medicine, watershed protection, stabilisation of the hydrological regime and carbon sequestration. Forests regulate global climate and act as a major agent of carbon exchange in the atmosphere (Obioha, 2009).

Deforestation is a significant environmental issue in Nigeria because of the direct impacts of growing demand for land for various other uses, including settlement development, logging, fuel wood extraction, transport facility development and mining.

According to the Food and Agricultural Organization (FAO), the remaining forest areas in Nigeria will likely disappear by 2020 if the current rate of forest depletion continues unabated. To protect natural areas for ecological purposes, efforts need to be made to intensify forest preservation, encourage the use of alternatives to wood and continue sensitize the communities on the need to protect the forests. Desertification is also a key environmental challenge in the northern parts of the country.

According to Obioha (2009), Nigeria has been losing about 351 000km^2 of landmass to the desert, which is advancing southward at the rate of 0.6km^2 annually. Other authors have reported desert encroachment at the rate of 1km per year towards the same general southward trend.

1.9.3. Floods

Floods in the last two decades have become more frequent in every part of the country. Inadequate watershed management, unplanned rapid urbanization, blockage of river/drainage channels through careless waste disposal, poor land use practices, land clearing for agricultural purposes, sub-standard dam construction and deforestation among other factors influence the occurrence and severity of flooding in the country. The most flood-prone areas include:

- The low-lying coastal areas of southern Nigeria such as Calabar, Warri, Port-Harcourt and Lagos where annual rainfall is quite high. The adverse impacts of flooding are felt more when stormy weather coincides with high tides.
- The floodplains of the major rivers such as the Niger, Benue, Gongola, Sokoto, Hadejia, Katsina-Ala, Donga, Kaduna, Gurara, Ogun and Anambra.
- The flat, low-lying areas around and to the South of Lake Chad which may be flooded during and even a few weeks after the rains.

1.9.4. Environmental Pollution

Environmental pollution is increasing due to large human population concentrations, industrial activities, agricultural change, use of inappropriate technologies, including poor recycling practices as well as poor institutional, logistic and policy framework for managing pollutants. Air pollution is influenced by many factors, particularly industrial activities and use of spent automobile engine oil. Water pollution results mainly from the discharge of household and industrial effluents as well as petroleum products through oil spills into water bodies and streams. The use of fertilizers and other farm inputs are also contributing factors to soil and water pollution in many parts of the country.

1.9.5. Wastes

The burden of waste management is growing everywhere, more particularly in the urban areas. The total amount of domestic waste per annum in Nigeria is estimated at about 63 million tonnes (0.45 kg/capital/annum) and is increasing (Osibanjo, 2008). The problem is largely with collection and disposal. Waste is indiscriminately disposed of in many areas, and solid waste dumps dot the urban landscape in many parts of the country. Usually only about 30-50% of waste in Nigeria is collected (Osibanjo, 2008), leaving so much unattended to. There are generally inadequate frameworks for refuse collection and management in many parts of the country.

1.10. Economic Challenges

The Nigerian economy continues to be dominated by the oil sector which fetches more than 90% of the foreign exchange for the country. The impact of the sector is however little felt by the vast majority of the people. The agricultural sector, which once occupied a dominant position, has been relegated to a poor second place and Nigeria now imports a substantial proportion of its food. For instance, more than 50% of rice consumed is imported from Thailand (Ezedinma, 2004”). Linkages between various sectors of the economy are weak and unemployment and underemployment are high. Most people are consequently poor with two-thirds of the population living on USD2 or less per day. For example, the poor development of the nations’ energy sector is keeping large industrial establishments in the Lagos, Kaduna and Kano axis out of business. The critical economic issues concern the need to foster sustainable rapid economic growth that will cater for the needs of over 182 million people and the imperative for proper integration of its domestic economy with the world economy.

2. National Greenhouse Gas Inventory

2.1. Introduction

In line with articles 4 and 12 of the United Nations Framework Convention on Climate Change (UNFCCC), which state that non-Annex I Parties should include information on a national inventory of anthropogenic emissions by source and absorption by sinks of all GHGs not controlled by the Montreal Protocol, within the limits of their possibilities, using in its preparation the comparable methodologies promoted and approved by the Conference of Parties, Nigeria has prepared and submitted two GHG inventories for the years 1994 and 2000 in the Initial and Second National Communications respectively. Decision 1/CP.16 paragraphs 60(a-c) introduced an enhanced reporting regime for Non-Annex I Parties, requiring them to submit:

a. A National Communication every four years, and
b. A Biennial Update Report (BUR) every two years (either as a summary of parts of their national communication in the year when national communication is submitted or as a stand-alone update report.

The Federal Republic of Nigeria has embarked on the preparation of its First Biennial Update Report, including a National Inventory in accordance with the UNFCCC guidelines for the preparation of national communications from non-Annex I Parties (decision 17/CP.8) and the UNFCCC biennial update reporting guidelines for Parties not included in Annex I to the Convention (Decision 2/CP.17, in its Annex III).

2.2. National GHG Inventory Institutional Arrangement

The Department of Climate Change (DCC) of the Federal Ministry of Environment has the responsibility of Climate Change activities in the country. The mandate of the DCC is:

"To co-ordinate national implementation of United Nation Framework Convention on Climate Change, its protocol and any other legally binding agreements for implementing climate change activities"[2].

DCC's mission, as the country's focal point with the UNFCCC, is

"To regularly update information regarding national inventory of the Green House Gas emission and mitigation options, vulnerability assessment and adaptation measures and to satisfactorily provide a sustainable policy framework and enabling environment for the implementation of the UNFCCC and Kyoto Protocol and any other climate change guidelines, laws and control in Nigeria".

In terms of the institutional setup, DCC is one of six technical departments in Nigeria's Federal Ministry of Environment. It has four divisions, each responsible for a major thematic area of climate change. One of these divisions is the GHG Division with which also rests the responsibility of producing the GHG inventories for reporting to the Convention. DCC is supported by the Inter-Ministerial Committee on Climate Change (ICCC) which it chairs. The institutional arrangements and GHG inventory management system is more fully described in the Chapter four on MRV.

[2] The GHG inventory cycle

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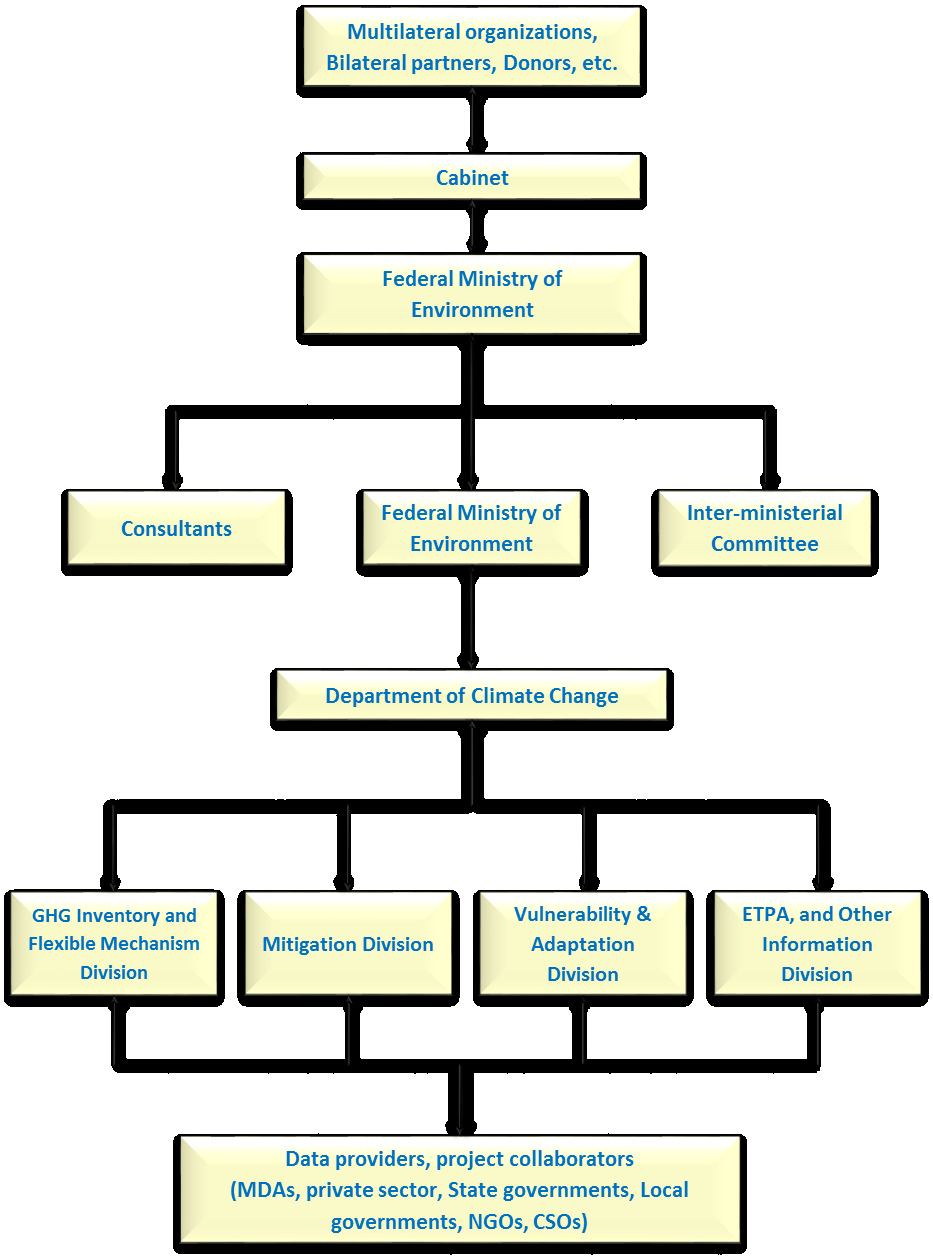

Figure 2.1 Institutional arrangements for reporting and implementing climate change activities

The compilation and production of a national GHG inventory requires the successful implementation of well-defined steps. Nigeria lacked a fully-fledged GHG inventory management system (IMS) and perfect institutional arrangements (IA) when producing the inventory for the BUR1. This is because previous inventories were prepared on an ad-Hoc basis with the support of international consultants. Nonetheless, as per existing IMS and IA, the country implemented the steps for the compilation of this GHG inventory and intends to further improve in future compilations. The steps followed for the compilation of this inventory is provided in Figure 2.2.

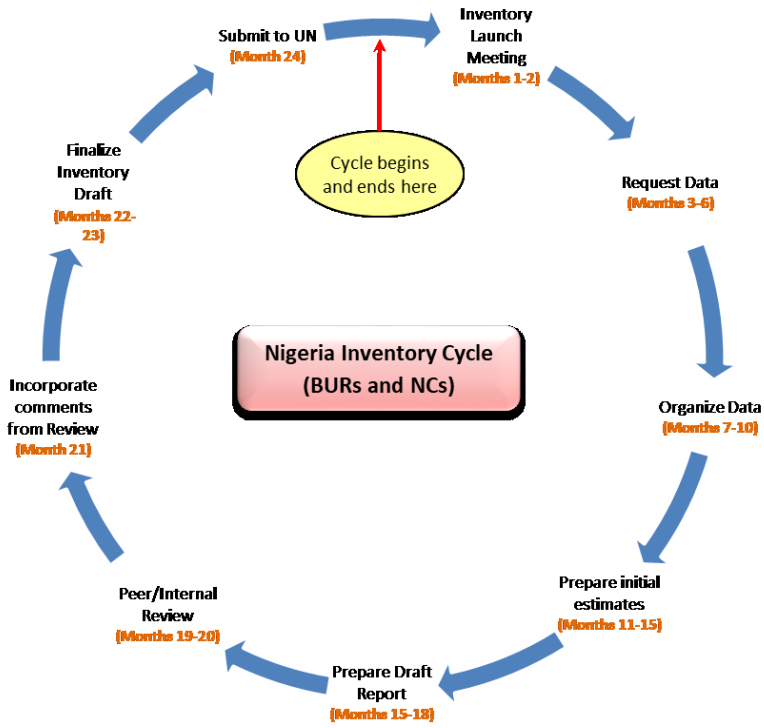

Figure 2.2 The Inventory cycle of Nigeria for BURs and NCs

2.3. Overview of the Inventory

2.3.1. Coverage

This GHG inventory covers the whole territory of the Federal Republic of Nigeria and estimates are computed at the national scale.

The national GHG inventory includes estimates from the four IPCC sectors, Energy; Industrial Processes and Product Use (IPPU); Agriculture, Forestry and Other Land Use (AFOLU) and Waste. However, the categories and subcategories have not been exhausted due to lack of activity data in some cases. The level of details is provided under Completeness (Section 2.3.3) in this report.

The GHG inventory addressed emissions of the direct GHGs carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Additionally, estimates of the GHG precursors NO_X, CO, NMVOCs, and SO_2 have been compiled whenever activity data were available.

Estimates have been made for the year 2015 as needed under the BUR requirements to be at most 4 years prior to the date of submission. In line with the recommendation to provide a trend of estimates, the period 2001 to 2015 have been adopted. Furthermore, to be consistent for reporting, estimates for the year 2000 have been recalculated using the same methodology and data source as for the period under review.

Global Warming Potentials adopted for uniformizing emissions of all GHGs in CO_2 equivalent are those from the IPCC Second Assessment Report. The GWPs used in this report for the direct GHGs are:

- CO_2 1
- CH_4 21
- N_2O 310

2.3.2. Methods

Estimates of GHG emissions provided in this report have been compiled in line with the IPCC 2006 Guidelines for National GHG Inventories (IPCC, 2006) and the IPCC Good Practice Guidance and Uncertainty Management in National GHG Inventories (IPCC, 2000). The purpose of adopting these guidelines and GPG is to ensure that the GHG emission estimates are Transparent, Accurate, Complete, Consistent and Comparable (TACCC). The emission estimates in this report will be subject to international technical assessment as required under the International Consultation and Analysis (ICA) process, consistent with the relevant modalities and guidelines (decision 2/CP.17 and annex IV).

Selection of the Tier level was guided by the decision-tree reproduced in Figure 2.3. Generally, the selection of the Tier level for all sectors was determined by the availability of relevant activity data (e.g. facility level data) and national emission factors. In all cases, the tier 1 level was adopted. The estimation of the emissions and removals used the IPCC methodologies and emission factors (EFs). Detailed descriptions of the methods adopted for each sector are provided in the relevant sections of this report.

2.3.3. Completeness

A source category analysis was conducted to identify activities in the four IPCC sectors responsible for emissions and sinks within the economy. The objective was to be as exhaustive as possible in the coverage of activities contributing to emissions and sinks for inclusion in the compilation. Results of the GHG inventory of the SNC, availability of resources, existing capacity, availability of activity data and national emission factors dictated the choice of source categories to be included for compilation. A prioritization exercise was conducted and the highest emitting source categories were identified.. The detailed results of the Completeness of the GHG Inventory is presented in Table 2.1. In order to simplify the completeness table, the sub-categories where activities are not occurring in the country have not been spelt out fully but rather kept at the category level only.

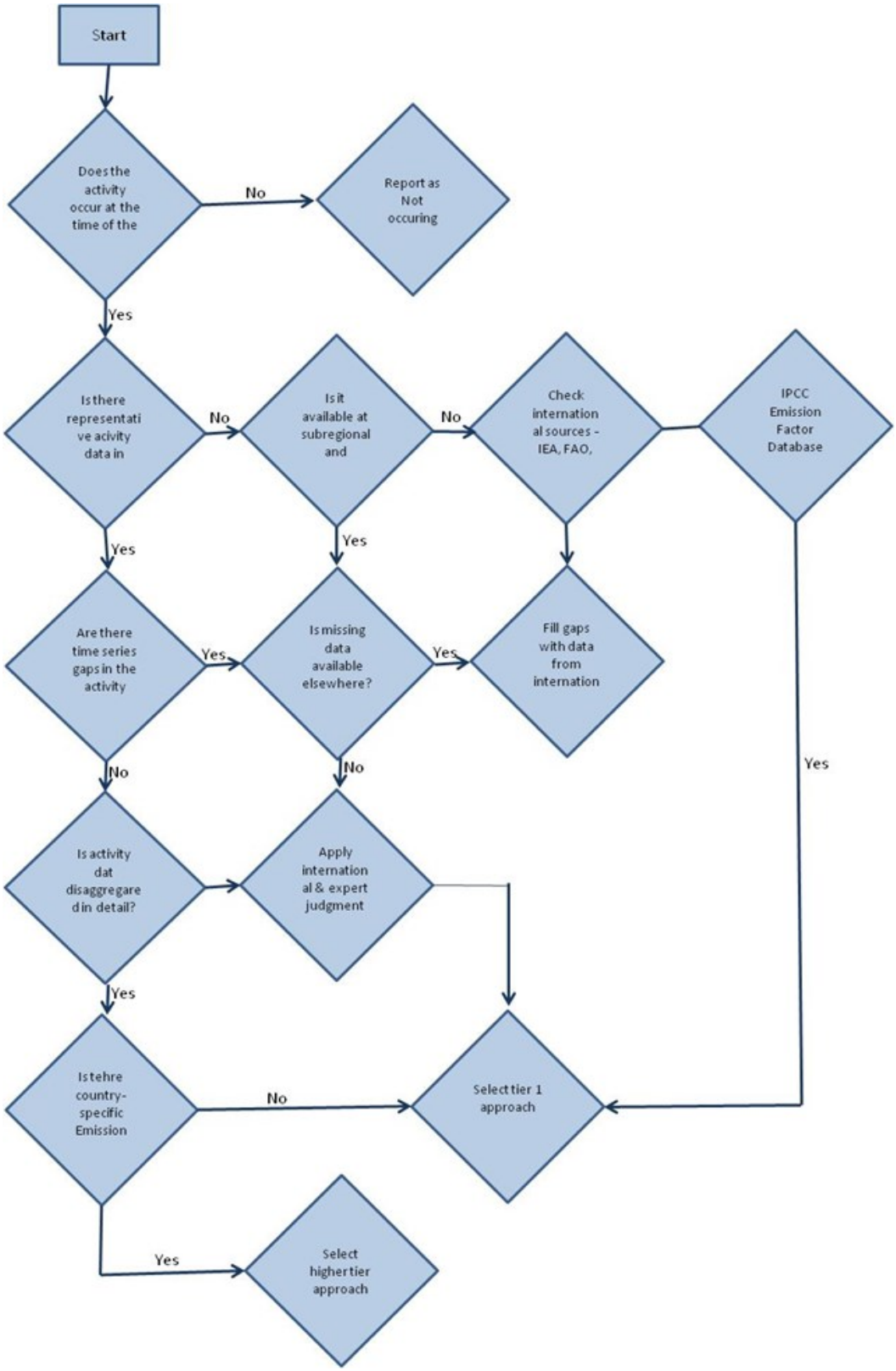

Figure 2.3 Decision tree used to determine Tier level method

Table 2.1 Completeness of the GHG inventory

Categories	Net CO_2 (1)(2)	CH_4	N_2O	HFCs	PFCs	SF6	Other halogenated gases with CO_2-eq conversion factors (3)	Other halogenated gases without CO_2-eq conversion factors (4)	NO_X	CO	NMVOCs	SO_2
1 - Energy	X	X	X	NA	NA	NA	NA	NA	X	X	X	X
1.A - Fuel Combustion Activities	X	X	X	NA	NA	NA	NA	NA	X	X	X	X
1.A.1 - Energy Industries	X	X	X	NA	NA	NA	NA	NA	X	X	X	X
1.A.1.a - Main Activity Electricity and Heat Production	X	X	X	NA	NA	NA	NA	NA	X	X	X	X
1.A.1.a.i - Electricity Generation	X	X	X						X	X	X	X
1.A.1.a.ii - Combined Heat and Power Generation (CHP)	NO	NO	NO						NO	NO	NO	NO
1.A.1.a.iii - Heat Plants	NO	NO	NO						NO	NO	NO	NO
1.A.1.b - Petroleum Refining	X	X	X						X	X	X	X
1.A.1.c - Manufacture of Solid Fuels and Other Energy Industries	X	X	X	NA	NA	NA	NA	NA	X	X	X	NE
1.A.1.c.i - Manufacture of Solid Fuels	IE	X	X						X	X	X	NE
1.A.1.c.ii - Other Energy Industries	X	X	X						X	X	X	NE
1.A.2 - Manufacturing Industries and Construction	X	X	X	NA	NA	NA	NA	NA	X	X	X	X
1.A.2.a - Iron and Steel	X	X	X						X	X	X	X
1.A.2.b - Non-Ferrous Metals	X	X	X						X	X	X	X
1.A.2.c - Chemicals	X	X	X						X	X	X	X
1.A.2.d - Pulp, Paper and Print	X	X	X						X	X	X	X
1.A.2.e - Food Processing, Beverages and Tobacco	X	X	X						X	X	X	X
1.A.2.f - Non-Metallic Minerals	X	X	X						X	X	X	X
1.A.2.g - Transport Equipment	X	X	X						X	X	X	X
1.A.2.h - Machinery	X	X	X						X	X	X	X
1.A.2.i - Mining (excluding fuels) and Quarrying	X	X	X						X	X	X	X
1.A.2.j - Wood and wood products	X	X	X						X	X	X	X
1.A.2.k - Construction	X	X	X						X	X	X	X

Categories	Net CO_2 (1)(2)	CH_4	N_2O	HFCs	PFCs	SF6	Other halogenated gases with CO_2-eq conversion factors (3)	Other halogenated gases without CO_2-eq conversion factors (4)	NO_X	CO	NMVOCs	SO_2
1.A.2.l - Textile and Leather	X	X	X						X	X	X	X
1.A.2.m - Non-specified Industry	X	X	X						X	X	X	X
1.A.3 - Transport	X	X	X	NA	NA	NA	NA	NA	X	X	X	X
1.A.3.a - Civil Aviation	X	X	X	NA	NA	NA	NA	NA	NE	NE	NE	NE
1.A.3.a.i - International Aviation (International Bunkers) (1)	Memo items											
1.A.3.a.ii - Domestic Aviation	X	X	X						NE	NE	NE	NE
1.A.3.b - Road Transportation	X	X	X	NA	NA	NA	NA	NA	X	X	X	X
1.A.3.b.i - Cars	X	X	X	NA	NA	NA	NA	NA	X	X	X	X
1.A.3.b.i.1 - Passenger cars with 3-way catalysts	X	X	X						X	X	X	X
1.A.3.b.i.2 - Passenger cars without 3-way catalysts	X	X	X						X	X	X	X
1.A.3.b.ii - Light-duty trucks	X	X	X	NA	NA	NA	NA	NA	X	X	X	NE
1.A.3.b.ii.1 - Light-duty trucks with 3-way catalysts	X	X	X						X	X	X	X
1.A.3.b.ii.2 - Light-duty trucks without 3-way catalysts	X	X	X						X	X	X	X
1.A.3.b.iii - Heavy-duty trucks and buses	X	X	X						X	X	X	X
1.A.3.b.iv - Motorcycles	X	X	X						X	X	X	NE
1.A.3.b.v - Evaporative emissions from vehicles	NE	NE	NE						NE	NE	NE	NE
1.A.3.b.vi - Urea-based catalysts	NE	NE	NE						NE	NE	NE	NE
1.A.3.c - Railways	X	X	X						X	X	X	X
1.A.3.d - Water-borne Navigation	X	X	X	NA	NA	NA	NA	NA	X	X	X	X
1.A.3.d.i - International water-borne navigation (International bunkers) (1)	Memo items											
1.A.3.d.ii - Domestic Water-borne Navigation	X	X	X						X	X	X	X
1.A.3.e - Other Transportation	NE	NE	NE	NA	NA	NA	NA	NA	NE	NE	NE	NE

Categories	Net CO_2 (1)(2)	CH_4	N_2O	HFCs	PFCs	SF6	Other halogenated gases with CO_2-eq conversion factors (3)	Other halogenated gases without CO_2-eq conversion factors (4)	NO_X	CO	NMVOCs	SO_2
1.A.3.e.i - Pipeline Transport	NE	NE	NE						NE	NE	NE	NE
1.A.3.e.ii - Off-road	NE	NE	NE						NE	NE	NE	NE
1.A.4 - Other Sectors	X	X	X	NA	NA	NA	NA	NA	X	X	X	X
1.A.4.a - Commercial / Institutional	X	X	X						X	X	X	X
1.A.4.b - Residential	X	X	X						X	X	X	X
1.A.4.c - Agriculture / Forestry / Fishing / Fish Farms	X	X	X	NA	NA	NA	NA	NA	X	X	X	X
1.A.4.c.i - Stationary	NE	NE	NE						NE	NE	NE	NE
1.A.4.c.ii - Off-road Vehicles and Other Machinery	X	X	X						X	X	X	X
1.A.4.c.iii - Fishing (mobile combustion)	NE	NE	NE						NE	NE	NE	NE
1.A.5 - Non-Specified	NE	NE	NE	NA	NA	NA	NA	NA	NE	NE	NE	NE
1.B - Fugitive emissions from fuels	X	X	X	NA	NA	NA	NA	NA	NE	NE	X	NE
1.B.1 - Solid Fuels	NE	NE	NE	NA	NA	NA	NA	NA	NE	NE	NE	NE
1.B.2 - Oil and Natural Gas	X	X	X	NA	NA	NA	NA	NA	NE	NE	X	NE
1.B.2.a - Oil	X	X	X	NA	NA	NA	NA	NA	NE	NE	X	NE
1.B.2.a.i - Venting	X	X							NO	NO	X	NE
1.B.2.a.ii - Flaring	X	X	X						NE	NE	NO	NE
1.B.2.a.iii - All Other	X	X	X	NA	NA	NA	NA	NA	IE	IE	IE	IE
1.B.2.a.iii.1 - Exploration	IE	IE							IE	IE	IE	IE
1.B.2.a.iii.2 - Production and Upgrading	IE	IE	IE						IE	IE	IE	IE
1.B.2.a.iii.3 - Transport	X	X	X						NE	NE	NE	NE
1.B.2.a.iii.4 - Refining	NE	X							NE	NE	NE	NE
1.B.2.a.iii.5 - Distribution of oil products	NE	NE							NE	NE	NE	NE
1.B.2.a.iii.6 - Other	NO	NO	NO						NO	NO	NO	NO
1.B.2.b - Natural Gas	X	X	X	NA	NA	NA	NA	NA	NE	NE	X	NE
1.B.2.b.i - Venting	X	X							NO	NO	X	NE
1.B.2.b.ii - Flaring	X	X	X						NE	NE	X	NE
1.B.2.b.iii - All Other	X	X	NO	NA	NA	NA	NA	NA	IE	IE	X	IE
1.B.2.b.iii.1 - Exploration	IE	IE							IE	IE	IE	IE

Categories	Net CO_2 (1)(2)	CH_4	N_2O	HFCs	PFCs	SF6	Other halogenated gases with CO_2-eq conversion factors (3)	Other halogenated gases without CO_2-eq conversion factors (4)	NO_X	CO	NMVOCs	SO_2
1.B.2.b.iii.2 - Production	IE	IE							IE	IE	IE	IE
1.B.2.b.iii.3 - Processing	IE	IE							IE	IE	IE	IE
1.B.2.b.iii.4 - Transmission and Storage	X	X							NO	NO	X	NE
1.B.2.b.iii.5 - Distribution	X	X							NO	NO	X	NE
1.B.2.b.iii.6 - Other	NO	NO	NO						NO	NO	NO	NO
1.B.3 - Other emissions from Energy Production	NO	NO	NO						NO	NO	NO	NO
1.C - Carbon Dioxide Transport and Storage	NO	NO	NO	NA	NA	NA	NA	NA	NO	NO	NO	NO
2 - Industrial Processes and Product Use	X	X	NE	NA	NA	NA	NA	NA	NO	NO	NO	NO
2.A - Mineral Industry	X	NA	NA	NA	NA	NA	NA	NA	NE	NE	NE	NE
2.A.1 - Cement production	X								NE	NE	NE	NE
2.A.2 - Lime production	NO								NO	NO	NO	NO
2.A.3 - Glass Production	NO								NO	NO	NO	NO
2.A.4 - Other Process Uses of Carbonates	NO	NO	NO	NA	NA	NA	NA	NA	NO	NO	NO	NO
2.A.4.a - Ceramics	NO								NO	NO	NO	NO
2.A.4.b - Other Uses of Soda Ash	NO								NO	NO	NO	NO
2.A.4.c - Non-Metallurgical Magnesia Production	NO								NO	NO	NO	NO
2.A.4.d - Other (please specify) (3)	NO								NO	NO	NO	NO
2.A.5 - Other (please specify) (3)	NO	NO	NO						NO	NO	NO	NO
2.B - Chemical Industry	X	NO	NE	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.B.1 - Ammonia Production	X								NE	NE	NE	NE
2.B.2 - Nitric Acid Production			NE						NE	NE	NE	NE
2.B.3 - Adipic Acid Production			NO						NO	NO	NO	NO
2.B.4 - Caprolactam, Glyoxal and Glyoxylic Acid Production			NO						NO	NO	NO	NO
2.B.5 - Carbide Production	NO	NO							NO	NO	NO	NO
2.B.6 - Titanium Dioxide Production	NO								NO	NO	NO	NO

Categories	Net CO_2 (1)(2)	CH_4	N_2O	HFCs	PFCs	SF6	Other halogenated gases with CO_2-eq conversion factors (3)	Other halogenated gases without CO_2-eq conversion factors (4)	NO_X	CO	NMVOCs	SO_2
2.B.7 - Soda Ash Production	NO								NO	NO	NO	NO
2.B.8 - Petrochemical and Carbon Black Production	NO	NO	NA	NA	NA	NA	NA	NA	NO	NO	NO	NO
2.B.9 - Fluoro chemical Production	NA	NA	NA	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C - Metal Industry	X	X	NO	NO	NO	NO	NO	NO	NO	NO	X	NO
2.C.1 - Iron and Steel Production	X	X							NO	NO	X	NO
2.C.2 - Ferroalloys Production	NO	NO							NO	NO	NO	NO
2.C.3 - Aluminium production	NO				NO			NO	NO	NO	NO	NO
2.C.4 - Magnesium production (5)	NO					NO		NO	NO	NO	NO	NO
2.C.5 - Lead Production	NO								NO	NO	NO	NO
2.C.6 - Zinc Production	NO								NO	NO	NO	NO
2.C.7 - Other (please specify) (3)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D - Non-Energy Products from Fuels and Solvent Use (6)	X	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D.1 - Lubricant Use	NE								NE	NE	NE	NE
2.D.2 - Paraffin Wax Use	NE								NE	NE	NE	NE
2.D.3 - Solvent Use (7)									NE	NE	NE	NE
2.D.4 - Other (please specify) (3), (8)	NO	NO	NO						NO	NO	NO	NO
2.E - Electronics Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.F - Product Uses as Substitutes for Ozone Depleting Substances	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.F.1 - Refrigeration and Air Conditioning	NA	NA	NA	NO	NO	NA	NA	NO	NO	NO	NO	NO
2.F.1.a - Refrigeration and Stationary Air Conditioning				NE				NE	NE	NE	NE	NE
2.F.1.b - Mobile Air Conditioning				NE				NE	NE	NE	NE	NE
2.F.2 - Foam Blowing Agents				NO				NO	NO	NO	NO	NO
2.F.3 - Fire Protection				NE	NE			NE	NE	NE	NE	NE
2.F.4 - Aerosols				NE				NE	NE	NE	NE	NE
2.F.5 - Solvents				NE	NE			NE	NE	NE	NE	NE
2.F.6 - Other Applications				NO	NO			NO	NO	NO	NO	NO

Categories	Net CO_2 (1)(2)	CH_4	N_2O	HFCs	PFCs	SF6	Other halogenated gases with CO_2-eq conversion factors (3)	Other halogenated gases without CO_2-eq conversion factors (4)	NO_X	CO	NMVOCs	SO_2
(please specify) (3)												
2.G - Other Product Manufacture and Use	NA	NA	NA	NA	NE	NE	NA	NE	NE	NE	NE	NE
2.G.1 - Electrical Equipment	NA	NA	NA	NA	NE	NE	NA	NE	NE	NE	NE	NE
2.G.1.a - Manufacture of Electrical Equipment					NE	NE		NE	NE	NE	NE	NE
2.G.1.b - Use of Electrical Equipment					NE	NE		NE	NE	NE	NE	NE
2.G.1.c - Disposal of Electrical Equipment					NE	NE		NE	NE	NE	NE	NE
2.G.2 - SF6 and PFCs from Other Product Uses	NA	NA	NA	NA	NO	NO	NA	NO	NO	NO	NO	NO
2.G.3 - N_2O from Product Uses	NA	NA	NE	NA	NA	NA	NA	NA	NE	NE	NE	NE
2.G.3.a - Medical Applications			NE						NE	NE	NE	NE
2.G.3.b - Propellant for pressure and aerosol products			NO						NO	NO	NO	NO
2.G.3.c - Other (Please specify) (3)			NO						NO	NO	NO	NO
2.G.4 - Other (Please specify) (3)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.H - Other	NE	NE	NO	NA	NA	NA	NA	NA	NE	NE	NE	NE
2.H.1 - Pulp and Paper Industry	NE	NE							NE	NE	NE	NE
2.H.2 - Food and Beverages Industry	NE	NE							NE	NE	NE	NE
2.H.3 - Other (please specify) (3)	NO	NO	NO						NO	NO	NO	NO
3 - Agriculture, Forestry, and Other Land Use	X	X	X	NO	NO	NO	NO	NO	X	X	NE	NO
3.A - Livestock	NA	X	X	NO	NO	NO	NO	NO	NA	NA	NA	NA
3.A.1 - Enteric Fermentation	NA	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3.A.1.a - Cattle	NA	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3.A.1.a.i - Dairy Cows		X							NA	NA	NA	NA
3.A.1.a.ii - Other Cattle		X							NA	NA	NA	NA
3.A.1.b - Buffalo		NO							NA	NA	NA	NA
3.A.1.c - Sheep		X							NA	NA	NA	NA

Categories	Net CO_2 (1)(2)	CH_4	N_2O	HFCs	PFCs	SF6	Other halogenated gases with CO_2-eq conversion factors (3)	Other halogenated gases without CO_2-eq conversion factors (4)	NO_X	CO	NMVOCs	SO_2
3.A.1.d - Goats		X							NA	NA	NA	NA
3.A.1.e - Camels		X							NA	NA	NA	NA
3.A.1.f - Horses		X							NA	NA	NA	NA
3.A.1.g - Mules and Asses		X							NA	NA	NA	NA
3.A.1.h - Swine		X							NA	NA	NA	NA
3.A.1.j - Other (please specify)		NO							NA	NA	NA	NA
3.A.2 - Manure Management (1)	NA	X	X	NA	NA	NA	NA	NA	NA	NA	NA	NA
3.A.2.a - Cattle	NA	X	X	NA	NA	NA	NA	NA	NA	NA	NA	NA
3.A.2.a.i - Dairy cows		X	X						NA	NA	NA	NA
3.A.2.a.ii - Other cattle		X	X						NA	NA	NA	NA
3.A.2.b - Buffalo		NO	NO						NA	NA	NA	NA
3.A.2.c - Sheep		X	X						NA	NA	NA	NA
3.A.2.d - Goats		X	X						NA	NA	NA	NA
3.A.2.e - Camels		X	X						NA	NA	NA	NA
3.A.2.f - Horses		X	X						NA	NA	NA	NA
3.A.2.g - Mules and Asses		X	X						NA	NA	NA	NA
3.A.2.h - Swine		X	X						NA	NA	NA	NA
3.A.2.i - Poultry		X	X						NA	NA	NA	NA
3.A.2.j - Other (please specify)		NO	NO						NA	NA	NA	NA
3.B - Land	X	NE	NE	NO	NO	NO	NO	NO	NE	NE	NE	NO
3.B.1 - Forest land	X	NO	NO	NO	NO	NO	NO	NO	NE	NE	NE	NO
3.B.1.a - Forest land Remaining Forest land	X								NE	NE	NE	NO
3.B.1.b - Land Converted to Forest land	NE	NO	NO	NO	NO	NO	NO	NO	NE	NE	NE	NO
3.B.1.b.i - Cropland converted to Forest Land	NE								NE	NE	NE	NO
3.B.1.b.ii - Grassland converted to Forest Land	NE								NE	NE	NE	NO
3.B.1.b.iii - Wetlands converted to Forest Land	NE								NE	NE	NE	NO
3.B.1.b.iv - Settlements converted to Forest Land	NE								NE	NE	NE	NO
3.B.1.b.v - Other Land	NE								NE	NE	NE	NO

Categories	Net CO_2 (1)(2)	CH_4	N_2O	HFCs	PFCs	SF6	Other halogenated gases with CO_2-eq conversion factors (3)	Other halogenated gases without CO_2-eq conversion factors (4)	NO_X	CO	NMVOCs	SO_2
converted to Forest Land												
3.B.2 - Cropland	NE	NO	NO	NO	NO	NO	NO	NO	NE	NE	NE	NO
3.B.2.a - Cropland Remaining Cropland	NE								NE	NE	NE	NO
3.B.2.b - Land Converted to Cropland	NE	NO	NO	NO	NO	NO	NO	NO	NE	NE	NE	NO
3.B.2.b.i - Forest Land converted to Cropland	NE								NE	NE	NE	NO
3.B.2.b.ii - Grassland converted to Cropland	NE								NE	NE	NE	NO
3.B.2.b.iii - Wetlands converted to Cropland	NE								NE	NE	NE	NO
3.B.2.b.iv - Settlements converted to Cropland	NE								NE	NE	NE	NO
3.B.2.b.v - Other Land converted to Cropland	NE								NE	NE	NE	NO
3.B.3 - Grassland	NE	NO	NO	NO	NO	NO	NO	NO	NE	NE	NE	NO
3.B.3.a - Grassland Remaining Grassland	NE								NE	NE	NE	NO
3.B.3.b - Land Converted to Grassland	NE	NO	NO	NO	NO	NO	NO	NO	NE	NE	NE	NO
3.B.3.b.i - Forest Land converted to Grassland	NE								NE	NE	NE	NO
3.B.3.b.ii - Cropland converted to Grassland	NE								NE	NE	NE	NO
3.B.3.b.iii - Wetlands converted to Grassland	NE								NE	NE	NE	NO
3.B.3.b.iv - Settlements converted to Grassland	NE								NE	NE	NE	NO
3.B.3.b.v - Other Land converted to Grassland	NE								NE	NE	NE	NO
3.B.4 - Wetlands	NE	NO	NE	NO	NO	NO	NO	NO	NE	NE	NE	NO
3.B.4.a - Wetlands Remaining Wetlands	NE	NO	NE	NO	NO	NO	NO	NO	NE	NE	NE	NO
3.B.4.a.i - Peatlands	NE		NE						NE	NE	NE	NO

Categories	Net CO_2 (1)(2)	CH_4	N_2O	HFCs	PFCs	SF6	Other halogenated gases with CO_2-eq conversion factors (3)	Other halogenated gases without CO_2-eq conversion factors (4)	NO_X	CO	NMVOCs	SO_2
remaining peatlands												
3.B.4.a.ii - Flooded land remaining flooded land									NE	NE	NE	NO
3.B.4.b - Land Converted to Wetlands	NE	NO	NE	NO	NO	NO	NO	NO	NE	NE	NE	NO
3.B.4.b.i - Land converted for peat extraction			NE						NE	NE	NE	NO
3.B.4.b.ii - Land converted to flooded land	NE								NE	NE	NE	NO
3.B.4.b.iii - Land converted to other wetlands									NE	NE	NE	NO
3.B.5 - Settlements	NE	NO	NO	NO	NO	NO	NO	NO	NE	NE	NE	NO
3.B.5.a - Settlements Remaining Settlements	NE								NE	NE	NE	NO
3.B.5.b - Land Converted to Settlements	NE	NO	NO	NO	NO	NO	NO	NO	NE	NE	NE	NO
3.B.5.b.i - Forest Land converted to Settlements	NE								NE	NE	NE	NO
3.B.5.b.ii - Cropland converted to Settlements	NE								NE	NE	NE	NO
3.B.5.b.iii - Grassland converted to Settlements	NE								NE	NE	NE	NO
3.B.5.b.iv - Wetlands converted to Settlements	NE								NE	NE	NE	NO
3.B.5.b.v - Other Land converted to Settlements	NE								NE	NE	NE	NO
3.B.6 - Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NE	NE	NE	NO
3.B.6.a - Other Land Remaining Other land									NE	NE	NE	NO
3.B.6.b - Land Converted to Other land	NE	NO	NO	NO	NO	NO	NO	NO	NE	NE	NE	NO
3.B.6.b.i - Forest Land converted to Other Land	NE								NE	NE	NE	NO
3.B.6.b.ii - Cropland converted to Other Land	NE								NE	NE	NE	NO

Categories	Net CO_2 (1)(2)	CH_4	N_2O	HFCs	PFCs	SF6	Other halogenated gases with CO_2-eq conversion factors (3)	Other halogenated gases without CO_2-eq conversion factors (4)	NO_X	CO	NMVOCs	SO_2
3.B.6.b.iii - Grassland converted to Other Land	NE								NE	NE	NE	NO
3.B.6.b.iv - Wetlands converted to Other Land	NE								NE	NE	NE	NO
3.B.6.b.v - Settlements converted to Other Land	NE								NE	NE	NE	NO
3.C - Aggregate sources and non-CO_2 emissions sources on Land (2)	NO	X	X	NO	NO	NO	NO	NO	X	X	NE	NO
3.C.1 - Emissions from biomass burning	NO	X	X	NA	NA	NA	NA	NA	X	X	NE	NO
3.C.1.a - Biomass burning in forest lands		NE	NE						NE	NE	NE	NO
3.C.1.b - Biomass burning in croplands		X	X						X	X	NE	NO
3.C.1.c - Biomass burning in grasslands		X	X						X	X	NE	NO
3.C.1.d - Biomass burning in all other land		NE	NE						NE	NE	NE	NO
3.C.2 - Liming	NO								NO	NO	NO	NO
3.C.3 - Urea application	NE								NE	NE	NE	NO
3.C.4 - Direct N_2O Emissions from managed soils (3)			X						NE	NE	NE	NO
3.C.5 - Indirect N_2O Emissions from managed soils			X						NE	NE	NE	NO
3.C.6 - Indirect N_2O Emissions from manure management			X						NE	NE	NE	NO
3.C.7 - Rice cultivations		X							NE	NE	NE	NO
3.C.8 - Other (please specify)		NE	NE						NE	NE	NE	NO
3.D - Other	X	NO	NO	NA	NA	NA	NA	NA	NE	NE	NE	NO
3.D.1 - Harvested Wood Products	X								NE	NE	NE	NO
4 - Waste	X	X	X	NO	NO	NO	NO	NO	NE	NE	NE	NE
4.A - Solid Waste Disposal	NO	X	NO	NO	NO	NO	NO	NO	NE	NE	NE	NE
4.A.1 - Managed Waste Disposal Sites									NE	NE	NE	NE

Categories	Net CO_2 (1)(2)	CH_4	N_2O	HFCs	PFCs	SF6	Other halogenated gases with CO_2-eq conversion factors (3)	Other halogenated gases without CO_2-eq conversion factors (4)	NO_X	CO	NMVOCs	SO_2
4.A.2 - Unmanaged Waste Disposal Sites									NE	NE	NE	NE
4.A.3 - Uncategorised Waste Disposal Sites									NE	NE	NE	NE
4.B - Biological Treatment of Solid Waste	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4.C - Incineration and Open Burning of Waste	X	X	X	NO	NO	NO	NO	NO	NE	NE	NE	NE
4.C.1 - Waste Incineration	NE	NE	NE						NE	NE	NE	NE
4.C.2 - Open Burning of Waste	X	X	X						NE	NE	NE	NE
4.D - Wastewater Treatment and Discharge	NO	X	X	NO	NO	NO	NO	NO	NE	NE	NE	NE
4.D.1 - Domestic Waste water Treatment and Discharge		X	X						NE	NE	NE	NE
4.D.2 - Industrial Wastewater Treatment and Discharge		NE							NE	NE	NE	NE
4.E - Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo Items (3)												
International Bunkers	X	X	X	NO	NO	NO	NO	NO				
1.A.3.a.i - International Aviation (International Bunkers) (1)	X	X	X						NE	NE	NE	NE
1.A.3.d.i - International water-borne navigation (International bunkers) (1)	NE	NE	NE						NE	NE	NE	NE
1.A.5.c - Multilateral Operations (1)(2)	NE	NE	NE	NO	NO	NO	NO	NO	NE	NE	NE	NE
Information Items												
CO_2 from Biomass Combustion for Energy Production	X											

"X " indicates that emissions/removals have been estimated, "NE" means not estimated, "NO" means Not occurring, and "IE" means indicated elsewhere

2.3.4. Data Sources

Activity data used in the compilation of this inventory were sourced from a combination of national and international institutions. During data collection, priority was given to data generated within the country. However, in cases where the required data was not available in the country, data from credible international organizations such as IEA, United Nations databases, World Bank and FAO were used. Table 2.2 provides an overview of activity data sources used in the GHG estimation including some data providers.

Table 2.2 Overview of activity data sources

Sector/Source category	Data Type	Data Source	Data Providers
1 – Energy			
1.A.1 - Energy Industry	Oil & Gas Statistics	NNPC, DPR	
	Petroleum Products & Natural Gas Distribution/consumption	NNPC, ECN, IEA, NERC	
	National non-conventional energy consumption	ECN, UN Database, IEA	
2 - Industrial Processes and Product Use (IPPU)			
2.A - Mineral Industry			
2.A.1 - Cement Production	Annual production of cement	CEMAN	CEMAN
2.B - Chemical Industry			
2.B.1 - Ammonia Production	Annual ammonia production	NBS	NBS
2.B.2 - Nitric Acid Production	Annual Nitric Acid production	NBS	NBS
2.C - Metal Industry			
2.C.1 - Iron and Steel Production	Annual production of Iron and Steel	NBS	NBS
3 - Agriculture, Forestry, and Other Land Use (AFOLU)			
3.A.1 - Enteric Fermentation	Average Annual Animal population	FAOSTAT	FAO
3.A.2 - Manure Management	Average Annual Animal population	FAOSTAT	FAO
3.C.1 - Emissions from biomass burning			
3.C.1.b - Biomass Burning in croplands	Actual mass of biomass burnt	FAOSTAT	FAO
3.C.1.c - Biomass Burning in grasslands	Actual mass burnt	FAOSTAT	FAO
4 – Waste			
4.A - Solid Waste Disposal	Annual Solid Wastes generated in metric tonnes	LAWMA, MEnv, ECN, NBS	DCC
4.D - Wastewater Treatment and Discharge	Annual Wastewater collected in cubic metres	LSMEnv	LSWMO

2.3.5. QA/QC Procedures

Quality Assurance/Quality Control (QA/QC) procedures were developed and implemented in line with the *IPCC 2006 Guidelines for National GHG inventories.* The inventory compilers were responsible for the implementation of the QA/QC activities. In addition, the DCC provided support in coordinating QA/QC and verification activities, especially in the areas of data collection, documentation and archiving, reviewing progress reports for completeness and compliance with standards, follow up to ensure that the required QA/QC and verification procedures are followed, ensuring a synergistic effort among the different teams working on the Inventory, Mitigation and MRV components. DCC also facilitated technical reviews and capacity building with regard to the project. Table 2.3 presents the General QC procedures followed.

Table 2.3 General QC procedures followed

QC Activity	Procedures	Responsible Party
Check integrity of activity data source	• Ensured that all activity data were sourced from the database of national organizations primarily responsible for preparing and disseminating such information. • Ensured adequate documentation and archiving of database.	Inventory compilers and Database administrator
Check for correctness in parameters, units of activity data and conversion factors.	• Ensured correct labelling of units in calculation sheets • Ensured the correct conversion factors were used during activity data preparation. • Checked and documented unusual and unexplained trends noticed for activity data across the time series.	Inventory compilers
Check that assumptions and criteria for AD and Emission Factors selection are documented	• Cross-checked AD description for each category, eliminating all possible double counting. • Documenting information on estimations for all categories to ensure transparency.	Inventory compilers
Check for correctness in emissions and removals calculations	• Ensured that Activity data were correctly entered into the IPCC software. • Ensured appropriate conversion factors and Emission factors for the country was selected for calculations. • Use of the reference approach to calculate emissions from the Energy sector to ensure correctness. • Ensured that estimates were reported for all categories and for all years from base year to the current inventory year. • Ensured that all relevant subcategories were covered for each category. • Ensured that total GHG emissions equalled sum of the individual emissions from the sectors and categories • Ensured emissions reported in text correspond to data in the calculation spreadsheets. • Compared current inventory estimates to previous estimates and reporting changes and departures from expected trends. • Ensured emissions were calculated and reported according to the IPCC guidelines.	Inventory compilers/DCC

2.3.6. General QA Procedures Followed

Personnel not directly involved in the inventory compilation process conducted QA review procedures. Reviews were organized and coordinated by DCC to monitor progress and ensure that measurable objectives were met.

2.3.7. General Uncertainty Assessment

The estimation of GHG emissions has several inherent uncertainties. Activity data and emission factor generation either by physical measurements or modelling engenders some levels of uncertainty. Use of data produced through these processes introduces inherent uncertainties into the inventory. Use of expert judgement for infilling of time series data gaps for activity data and choosing default emission factors are also potential sources of uncertainties. Management of these uncertainties to as much as possible reduce them over time is recognised by the IPCC GPGs 2000 and 2003. However, due to the fact that most of the activity data were primarily from secondary sources that hardly reported uncertainty ranges in their data, a qualitative approach, backed by experts' judgement, were used in a consistent and transparent manner to assign uncertainty ranges based on the data sources. In addition, the uncertainty ranges associated with the IPCC emission factors were also adopted. Based on the IPCC

recommended minimum uncertainty range of ±5% for peer reviewed literature and activity data generated through research, uncertainty ranges were assigned in accordance with the source of the activity data. Uncertainty ranges were assumed to increase according to the level of verifiability and reliability of the data source. Table 2.4 presents the uncertainty ranges adopted for input activity data.

Table 2.4 Range of uncertainty adopted for activity data

Activity data origin	Uncertainty Range		Data sources
Peer reviewed literature	+5%	-5%	
Research results	+5%	-5%	
International sources	+6%	-5.5%	Data from IEA, FAO, UN, WB etc.
National Reports/publications			
• Project reports	+5%	-5.5%	Data from CBN etc.
• Energy Statistics	+6%	-5.5%	Data from NNPC, ECN, DPR etc.
• National Census	+5%	-5%	Data from NPC etc.
• Personal Communication	+10%	-10%	

2.3.8. Results

Total net national emissions (Table 2.5), including removals, amounted to 712638 Gg CO_2-eq from the four (4) IPCC sectors. AFOLU headed the sectors with 476949 Gg CO_2-eq (66.9%) of total aggregated emissions followed by Energy with 28.2%, Waste, 3.0%" and the remaining 1.9% from IPPU. Regarding the direct GHGs, CO_2 was responsible for 82.3% of the emissions, CH_4 for 12.4% and N_2O for 5.3%.

On an individual gas basis, AFOLU was the major contributor for CO_2 and N_2O with 71.4% and 62.1% respectively while Energy emitted most of the CH_4 with 44.6% and more than 99.9% for NO_X, CO and NMVOCs. More than 99% of SO_2 also came from the Energy sector.

Table 2.5 National emissions for the year 2015

Categories	Net CO_2 (Gg)	CH_4 (Gg)	N_2O (Gg)	Total (Gg CO_2-eq)	NO_X (Gg)	CO (Gg)	NMVOCs (Gg)	SO_2 (Gg)
Total National Emissions and Removals	586807	4205	121	712638	738	19516	3069	88
1 - Energy	154671	1874.61	23.49	201319	738.2	19515	3068	87.66
2 - IPPU	13255	0.58	0	13267	0.00052	0.00005	0.87	0
3 - AFOLU	418811	1659.84	75.10	476949	0.06	1.38	0	0
4 - Waste	70	670.37	22.44	21103	0.00006	0.0008	0	0.00001
5 - Other	0	0	0	0	0	0	0	0
Memo Items (5)								
International Bunkers	993	0.01	0.03	1002	0.00	0.00	0	0
1.A.5.c - Multilateral Operations	0	0	0	0	0	0	0	0

2.3.9. Key Category Analysis

The 2000 and 2003 IPCC GPG provides guidance to steps for the identification of key categories. The documents explain the significance of key categories in influencing total GHG inventory in terms of absolute levels of emissions or removals and/or the trend in emissions or removals. The tier 1 level and

trend assessments were conducted to identify key categories for this inventory. The key sources are those that cumulatively contribute to 95% of the total emissions or trend of the inventory in absolute terms. The method used for the identification of key categories was the level assessment for 2000 and 2015, and trend assessment for 2015 with respect to the 2000 base year. The results of the identified key categories including AFOLU sector emissions and using the level and trend assessments are presented in Tables 2.6 and 2.7 respectively.

For the level assessment, Forest Land Remaining Forest Land was identified as the most significant of the key categories (contributing about 58.7%) of national emissions in 2015. The remaining key categories in 2015 were Energy Industries (Gaseous Fuels), Road Transportation, Other Sectors (Biomass), Enteric Fermentation, Manufacturing Industries and Construction (Gaseous Fuels), Direct N2O emissions from managed soils, Oil, Other sectors (liquid fuels), Natural Gas, Wastewater Treatment and Discharge (CH_4 and N_2O), Rice cultivations, Cement production and Iron and Steel Production. The contribution of these categories along with the GHG concerned is given in Table 2.6.

Table 2.6 Identified key category using the level assessment

IPCC Category	GHG	2000 Ex,t (Gg CO_2-eq)	|Ex,t| (Gg CO_2-eq)	Lx,t	Cumulative Total of Column F
3.B.1.a - Forest land Remaining Forest land	CO_2	421433.8	421433.8	58.7%	58.7%
1.A.1 - Energy Industries - Gaseous Fuels	CO_2	52544.2	52544.2	7.3%	66.0%
1.A.3.b - Road Transportation	CO_2	33565.2	33565.2	4.7%	70.7%
1.A.4 - Other Sectors - Biomass	CH_4	28795.7	28795.7	4.0%	74.7%
3.A.1 - Enteric Fermentation	CH_4	26379.4	26379.4	3.7%	78.4%
1.A.2 - Manufacturing Industries and Construction - Gaseous Fuels	CO_2	23001.7	23001.7	3.2%	81.6%
3.C.4 - Direct N_2O Emissions from managed soils	N_2O	15365.3	15365.3	2.1%	83.7%
1.B.2.a - Oil	CO_2	14870.7	14870.7	2.1%	85.8%
1.A.4 - Other Sectors - Liquid Fuels	CO_2	13835.5	13835.5	1.9%	87.7%
1.B.2.b - Natural Gas	CO_2	12688.5	12688.5	1.8%	89.5%
4.D - Wastewater Treatment and Discharge	CH_4	12115.0	12115.0	1.7%	91.2%
3.C.7 - Rice cultivations	CH_4	7356.2	7356.2	1.0%	92.2%
2.A.1 - Cement production	CO_2	7083.3	7083.3	1.0%	93.2%
4.D - Wastewater Treatment and Discharge	N_2O	6834.3	6834.3	1.0%	94.1%
2.C.1 – Iron and Steel Production	CO_2	6169.9	6169.9	0.9%	95.0%

When considering the trend assessment, Forest Land Remaining Forest Land remained the highest key emitting sector but with only 41.0% of national emission trend compared to the 58.7% of the level assessment. The order did not change for the second highest emitter Energy Industries – Gaseous Fuels also for both assessments, the contribution rising from 7.3 to 20.5% from level to trend type. Considering the fully disaggregated results of both types of assessment, the number of key categories regressed from 15 to 13 when changing from level to trend assessment. The trend assessment is a good indicator of categories gaining importance over time following development trends as opposed to the level assessment that considers absolute emissions of one year only.

Table 2.7 Identified key category using the approach 1 trend assessment

IPCC Category	GHG	2000 Year Estimate $E_{x,0}$ (Gg CO_2-eq)	2015 Year Estimate $E_{x,t}$ (Gg CO_2-eq)	Trend Assessment ($T_{x,t}$)	% Contribution to Trend	Cumulative Total of Column G
3.B.1.a - Forest land Remaining Forest land	CO_2	338091.7	421433.8	0.174	41.0%	41.0%

1.A.1 - Energy Industries - Gaseous Fuels	CO_2	6999.2	52544.2	0.087	20.5%	61.5%
1.A.2 - Manufacturing Industries and Construction - Gaseous Fuels	CO_2	1705.4	23001.7	0.042	10.0%	71.4%
1.A.3.b - Road Transportation	CO_2	14572.3	33565.2	0.024	5.7%	77.2%
1.B.2.a - Oil	CO_2	15823.5	14870.7	0.018	4.3%	81.5%
1.A.4 - Other Sectors - Biomass	CO_2	4199.5	13835.5	0.016	3.7%	85.1%
2.A.1 - Cement production	CO_2	713.6	7083.3	0.012	2.9%	88.1%
2.C.1 - Iron and Steel Production	CO_2	1608.3	6169.9	0.008	1.8%	89.9%
3.A.1 - Enteric Fermentation	CH_4	19458.0	26379.4	0.006	1.3%	91.2%
1.B.2.a - Oil	CH_4	4751.0	4501.4	0.005	1.3%	92.5%
1.B.2.b - Natural Gas	CO_2	6987.0	12688.5	0.005	1.1%	93.6%
1.B.2.b - Natural Gas	CH_4	2057.0	5152.9	0.004	1.0%	94.6%
1.A.1 - Energy Industries - Liquid Fuels	CO_2	2647.7	2220.6	0.004	0.8%	95.5%

2.3.10. Constraints and Gaps

Several constraints and gaps were encountered during the preparation of this inventory, especially during data collection and estimation of GHG for the various sectors. These gaps and constraints are presented below:

1. Lack of country-specific emission factors constrained the inventory compilers to the use of Tier 1 methods.
2. Lack of disaggregated information in the Manufacturing Industries and Construction source category dictated the inventory compilers to adopt the Tier 1 method.
3. Lack of information on classification of vehicles by the recommended IPCC types and vehicle kilometres run annually restricted the inventory compilers to use the Tier 1 approach.
4. Fugitive emissions from coal mining, processing, storage and transportation could not be estimated as a result of lack of relevant data.
5. Emissions from fuels combusted for inland, coastal and deep-sea fishing could not be estimated due to lack of activity data.
6. The NNPC and DPR Annual Statistical Bulletins, which were the primary sources of activity data for the energy sector, did not provide information on importation of petroleum products by independent and major oil marketers for the years 2000-2009.
7. The NNPC Annual Statistical Bulletins have no records on Aviation Turbine Kerosene (ATK) sales for international bunkers.
8. Information on domestic utilization of natural gas for power generation and industrial use was only reported up to the year 2005 in the NNPC Annual Statistical Bulletins.
9. All the source categories occurring in the country were not covered due to paucity of data. In some cases, estimations such as AFOLU relied almost entirely on international data (FAOSTAT dataset).
10. Lack of coordination among relevant agencies for waste management due to problems associated with the absence of archiving of relevant waste management data. While very limited data could only be obtained for the estimation of GHG emissions of municipal solid wastes, enormous data gaps exist in the waste water category, hence the high reliance on extrapolation to generate the data required for estimating emissions in the wastewater category.

11. There were no alternative sources to verify activity data used for GHG emission estimates in the AFOLU sector. Therefore, the study could not determine the validity, authenticity and otherwise the correctness of the only source of activity data (FAOSTAT dataset) used.
12. Limited technical capacity in carrying out uncertainty assessment for activity data and emission factors may have also contributed to the relatively high uncertainty level of activity data used in this estimation.
13. Lack of disaggregated activity data in most sectors prevented the compilers to move to higher tiers for estimating emissions in this inventory.
14. Reliance on default emission factors (tier 1) in all cases in this inventory may have contributed to lower accuracy of this inventory.
15. Institutional arrangements for data collection, archiving, monitoring and reporting are weak. This may have also restricted the DCC to play its central coordinating role in GHG inventory data management.
16. Activity data are in most cases scattered among various agencies, resulting to high level of inconsistency. This may have also been underscored by the overlapping mandates among various potential data providers (agencies and ministries).
17. Inability of the National Bureau of Statistics to carry out due quality checks on all data sent to it by all relevant agencies questions the reliability of activity data from this office.
18. Most national GHG inventories are conducted under programmes and projects funded by international donor agencies. Involvement of line ministries, sectors and stakeholders are limited.

2.3.11. National GHG Inventory Improvement Plan

The most recurring theme encountered during the compilation of the inventory is the serious lack of activity data. Available data are quite inconsistent in the Energy and IPPU sectors and very restricted in the AFOLU and Waste sectors. This resulted in a heavy dependency on international data sources. Statistical techniques and expert judgement were resorted to support activity data generation for use in computing emission estimates for numerous sources. This was the biggest challenge and will remain so in the near future. In addition, this activity data issue coupled with the practical inexistence of national emission factors restricted compilation to Tier 1 level in all sectors.

Some of the salient features that are prioritized to ensure improvement for compiling the next GHG inventory are:

- The DCC will establish and implement a GHG inventory management system to oversee and coordinate the preparation of GHG inventories on a sustainable basis for reporting and implementing the Convention.
- The present institutional arrangement for compiling the GHG inventory will be further strengthened while ensuring buy in of all concerned stakeholders.
- The NBS in close collaboration with the DCC will develop a network for collecting appropriate activity to raise the standard and quality of future inventories.
- A QA/QC system will be set up to ensure quality reliable activity data are collected, archived and made available for compiling inventories and to serve other purposes such as mitigation.
- Officers of the DCC, members of the GHG inventory management system, those forming part of the institutional arrangements and not the least, the team members to compile the inventory of the four (4) IPCC sectors will be strengthened with adequate capacity building to deliver on their allocated responsibilities.

- Nigeria will develop national emission factors, namely for the key categories to upgrade the inventory quality and enable adoption of higher Tier methods.
- The country will develop land use cover and change maps and overlay them with the climate and soil maps to enable proper estimation of estimates in the Forestry and Other Land Use category.
- Biomass stocks will be assessed for use in the AFOLU emissions assessment.
- Information on technologies used in manufacturing processes and in other emitting activity areas will be collected along with the appropriate activity data.

Successful implementation of these salient features will require resources and the support of bilateral and/or multilateral partners.

2.4. Energy Sector

2.4.1. Introduction

The process of fuel combustion to generate heat (a form of energy) used directly or indirectly through the production of mechanical energy releases carbon dioxide (CO_2) and other GHGs, GHG precursors, water and SO_2.

In Nigeria, fuel combustion activities and fugitive emissions are responsible for emissions in the Energy sector. The contribution of emissions come from the following activities:

- Upstream exploration and exploitation of primary energy sources:
  - Emissions from burning of natural gas and fuel oils for steam and other extraction processes,
  - Fugitive emissions a result of flaring during oil and gas production,
  - Fugitive emission of methane during coal mining.
- Transformation of primary energy sources into more usable energy forms in refineries and power plants:
  - Emissions from flaring and fuel combustion in refineries and power plants for steam, heat for use in process units and electricity generation.
- Transmission and distribution of fuels:
  - Fuel combustion to generate electrical power for pipelines,
  - fuel combustion in transport trucks/vessels,
  - Fugitive emissions during transmission and distribution.
- Use of fuels in stationary and mobile applications:
  - Fuel combustion in the transport sector,
  - on-site power generation plants,
  - For use in industries for heat generation and to power machinery.

2.4.2. Methodology

Emission estimates were computed according to the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (IPCC, 2007) from fossil fuel combustion activities and from fugitive emissions. The IPCC Tier 1 Reference and Sectoral approaches were adopted as per the decision trees illustrated in Figures 2.1-2.4 of the guidelines (Vol. 2 Energy, Chapter 1, page 1.7).

The Reference Approach is a Top-Down method which estimates net CO_2 emissions from combustion of primary and secondary fuels supplied to the economy while the Sectoral Approach is a Bottom-up method for a more accurate estimation of GHG emissions occurring in each source category from both fuel combustion and fugitive processes.

2.4.3. The IPCC Reference Approach and the Energy Activities Data

The Reference approach, which is part of the required QA/QC procedures was used as a validation method for the energy sector and involved the following steps:

- Estimation of apparent consumption of fuels by type in the country for the inventory years (2000-2015).
- Conversion of fuels amounts to energy units (TJ)
- Multiply apparent consumption of fuels by the carbon content to compute total carbon
- Subtraction of stored carbon (excluded carbon) from fuel carbon
- Correct for carbon not oxidized (assuming complete oxidation)
- Convert carbon amounts to CO_2 emissions

The Reference Approach for estimating CO_2 Emissions for combustion processes is expressed as follows:

$$CO_2\ Emissions = \sum_{all\ fuels}\left[\begin{array}{l}((Apparent\ Consumption_{fuel} \bullet Conv\ Factor_{fuel} \bullet CC_{fuel}) \bullet 10^{-3} \\ -Excluded\ Carbon_{fuel}) \bullet COF_{fuel} \bullet 44/12\end{array}\right]$$

Where:

Apparent Consumption	= production + imports-exports-international bunkers- stock change
Conv Factor (Conversion Factor)	= conversion factor for the fuel to energy units (TJ) on net calorific value basis
CC	= carbon content (tonne C/TJ)
Excluded Carbon	= carbon in feed stocks and non-energy use excluded from fuel combustion emissions (Gg C)
COF (Carbon oxidation factor)	= fraction of carbon oxidized. For this inventory is 1, reflecting complete oxidation
44/22	= molecular weight ratio of CO_2 to C

2.4.4. Energy Activities Data

Estimation of apparent consumption of fuels for the Reference Approach requires a supply balance of primary and secondary fuels. That is primary and secondary fuels production, imports, exports, international bunkers, changes in fuels stocks as well as fuels used for non-energy purposes. The energy statistics for computing apparent consumption of primary and secondary fuels were obtained primarily from the NNPC Annual Statistical Bulletin (2000-2015), the DPR Annual Statistical Bulletin (2013-2015), and the UN database. Data gaps were filled by interpolations and extrapolations to ensure time series completeness in accordance with the *Good Practice Guidance and Uncertainty Management* (IPCC, 2000). The activity data for calculating fugitive emissions from Oil and Gas processes by the Sectoral Approach were also derived from Tables 2.8 and 2.9. Only the activities occurring for each fuel type are presented.

Table 2.8 Flow of Primary and Secondary Liquid Fuels into the Economy

Fuel/Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Crude Oil (000 bbls)																
Production	823031.2	863744.5	725860.0	844100.3	910156.5	918660.6	869196.5	803000.7	768745.9	780347.9	896043.4	867475.6	852776.7	800488.1	798541.6	773458.6
Exports	714356.2	780093.7	663326.5	791016.3	878077.3	844151.5	817996.1	791826.5	724479.8	769195.2	864702.1	822084.2	830772.0	762045.2	796654.1	780429.7
Deliveries to Local Refineries	36189.1	82578.5	78160.6	42754.8	40529.3	72478.3	42471.7	18191.1	45533.3	19392.6	33633.9	40405.6	33595.3	36193.2	25839.4	9871.0
Crude Processed	36282.8	81512.1	79579.0	44811.9	38027.0	70637.0	43445.4	19059.7	39264.5	17745.7	34871.7	39408.1	33628.6	35233.1	23360.4	7991.6
Stock Change	72392.2	2138.7	-17045.5	8272.1	-5947.8	3872.1	7755.0	-7885.5	5001.6	-6592.9	-3530.4	5983.3	-11624.0	3209.8	-21472.9	-14962.6
LPG (000 t)																
Deliveries from local refineries	6.1	68.6	80.8	25.6	1.7	6.0	0.2	0.0	45.6	40.7	75.8	120.4	19.3	28.4	22.4	6.5
Imports	8.5	0.0	94.4	0.0	170.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exports	0.0	5.5	16.8	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Local Consumption	12.0	13.1	21.9	20.5	28.2	7.5	12.4	3.3	6.8	17.4	13.3	17.2	8.3	10.7	13.8	18.6
Stock Change	2.7	50.0	136.5	2.6	143.8	-1.5	-12.2	-3.3	38.8	23.3	62.5	103.2	11.0	17.6	8.6	-12.1
PMS (000 t)																
Deliveries from local refineries	2133.5	3012.5	3230.1	2459.9	533.9	2448.7	1552.8	971.0	1338.9	911.4	1249.2	1205.7	1413.2	1214.3	955.8	716.2
Imports	5736.9	5660.7	6079.0	7717.4	8316.1	8449.6	8767.6	9597.6	8905.5	10868.9	10558.2	10346.7	11855.2	11904.7	13473.0	14154.2
Exports	0.0	0.0	15.3	9.5	9.5	0.1	4.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Local Consumption	3524.1	5287.0	6430.5	6458.9	6073.3	6398.4	6148.8	6558.0	7032.1	7036.0	4702.8	4210.5	3713.9	11765.0	12879.0	11765.0
Stock Change	4346.3	3386.2	2863.4	3708.8	2767.1	4499.8	4166.7	4010.6	3212.3	4744.3	7104.6	7341.9	9554.4	1354.1	1549.8	3105.4
Household Kerosene (000 t)																
Deliveries from local refineries	940.9	1620.6	1525.8	934.6	629.7	1272.2	878.9	335.4	674.8	374.7	658.7	732.9	573.5	741.0	500.2	204.4
Imports	1208.3	522.2	476.3	720.5	514.6	783.8	1302.4	1485.9	1084.8	1374.5	1844.9	1643.3	2501.5	2970.2	3145.4	2145.2
Exports	0.0	0.0	14.8	1.9	1.9	9.8	8.2	4.8	9.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Local Consumption	885.6	1655.9	155.3	1113.0	1132.9	1127.2	751.9	434.3	794.8	572.8	542.7	731.1	512.1	2162.0	2341.0	2162.0
Stock Change	1263.6	487.0	1832.0	540.2	9.4	919.0	1421.1	1382.3	954.9	1176.4	1960.9	1645.1	2562.8	1549.1	1304.6	187.5

Fuel/Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
AGO/Diesel (000 t)																
Deliveries from local refineries	1282.8	2579.5	2484.1	1525.7	1179.2	2115.7	1170.1	590.4	1222.0	515.8	970.0	1043.8	816.7	1031.9	629.0	242.9
Imports	2277.2	543.6	574.5	1730.9	2413.5	864.6	1051.8	1279.5	1556.6	1893.7	2303.7	1663.2	1774.8	2198.8	6409.7	3768.2
Exports		42.4	14.1	19.6	0.0	30.3	0.0	11.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
International Bunkers	118.8	1.9	0.0	0.0	0.0	13.2	123.0	0.0	109.0	7.3	16.6	70.9	10.0	0.0	0.0	0.0
Local Consumption	2210.7	2289.1	2402.2	2286.1	1646.0	2034.5	1417.3	1189.8	1303.7	971.2	755.5	840.1	581.4	2431.9	2765.6	2431.9
Stock Change	1230.5	789.7	642.4	950.9	1946.6	902.4	681.5	669.1	1365.9	1430.9	2501.6	1796.0	2000.1	798.8	4273.0	1579.2
Fuel Oil (000 t)																
Deliveries from local refineries	1247.9	2691.3	2592.9	1822.0	1847.5	2768.5	2165.2	966.1	1441.7	625.0	924.0	1280.6	809.7	1242.5	773.6	149.8
Imports	0.2	0.5	0.9	1.7	3.2	6.2	11.8	22.7	43.6	83.6	170.5	103.8	88.4	15.0	153.4	63.5
Exports	1145.8	2126.5	2126.7	118.0	878.7	2059.9	1869.7	1244.7	758.5	306.8	498.0	686.7	332.2	720.6	302.9	83.5
International Bunkers	66.8	13.3	0.0	0.0	0.0	0.2	0.0	0.0	0.0	3344.0	8.9	3.2	5.5	0.0	260.0	0.0
Local Consumption	237.5	231.7	252.0	1689.1	557.6	289.0	155.9	120.8	482.8	367.3	248.1	290.8	378.0	466.9	576.6	52.5
Stock Change	-202.0	320.2	215.1	16.7	414.4	425.5	151.4	-376.7	244.0	-3309.5	339.5	403.8	182.4	70.0	-212.4	77.3
ATK (000 t)																
Imports	208.3	225.2	243.5	263.2	496.0	307.6	332.6	359.5	388.7	420.2	454.3	479.3	525.1	413.0	344.1	440.7
Local Consumption	148.9	254.5	277.5	320.7	72.1	228.0	230.1	278.1	850.6	645.2	166.4	185.4	43.9	346.1	308.6	346.1
Stock Change	59.5	-29.3	-34.0	-57.5	423.9	79.7	102.4	81.4	-461.9	-225.0	287.8	293.9	481.1	66.9	35.6	94.6
Returns of Other Products from Local Refineries																
LRS (000 t)	231.6	485.2	354.1	154.6	0.0	-0.6	0.0	0.0	0.4	0.0	1.0	0.0	0.0	0.0	0.0	11.8
Asphalt (000 t)	0.0	0.0	0.0	2.5	0.0	42.0	0.0	0.0	22.3	0.0	11.3	33.4	0.0	5.3	0.0	0.0
VGO (000 t)	0.0	0.0	0.0	0.0	0.0	18.9	-1.1	11.2	9.0	1.5	55.0	55.8	46.7	1.5	16.5	80.0
Kerosene solvent (000 t)	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.1
Intermediate Products (000 t)	125.1	108.7	58.5	248.8	0.0	509.8	129.7	220.3	407.5	199.6	936.5	779.9	374.9	558.8	247.7	297.8

Table 2.9 Natural Gas Accounting Data for Nigeria (MMscm) (2000-2015) (NNPC Annual Statistical Bulletin)

Table 2.8	Production	Gas Flared	%Flared	Gas Utilized	Re-injection	Gas for Field Use	Gas for LNG	Gas for NGL	Gas Lift	Fuel Gas for EPCL	Domestic Sales
2000	45282.3	24999.8	55.2	20282.5	8488.6	2220.6	7168.4	653.1	609.9	203.1	1886.4
2001	51644.2	26080.2	50.5	25564.1	9483.0	2663.2	8286.7	1214.2	740.4	259.4	2917.3
2002	46773.1	21073.1	45.1	25699.9	7657.8	2036.1	8214.1	1351.5	485.7	259.4	5420.9
2003	51784.3	23959.1	46.3	27825.2	5302.8	1875.8	13122.9	1020.8	550.1	256.0	5726.1
2004	58970.3	25106.8	42.6	33863.4	9425.1	2025.8	11615.9	1333.9	336.5	282.6	8843.5
2005	59291.6	23005.3	38.8	36286.3	11264.1	2382.8	5304.0	1312.3	854.6	292.8	14904.8
2006	61806.5	22656.0	36.7	39150.5	9450.0	2174.9	6822.7	1257.7	1286.8	224.5	17830.2
2007	68411.2	22360.0	32.7	46051.2	10042.6	2167.2	10439.5	990.7	1445.8	266.7	21544.4
2008	64638.7	17875.3	27.7	46763.5	11075.3	2277.0	9390.0	657.7	1658.4	216.4	23296.4
2009	52031.7	14424.9	27.7	37606.9	11606.9	2281.9	7620.8	1200.8	1584.7	229.0	13082.8
2010	67765.2	16470.0	24.3	51295.2	13970.5	2045.7	4734.8	732.6	4787.7	147.4	24876.5
2011	67979.4	17531.0	25.8	50448.4	9864.7	2960.6	8866.6	1093.4	2236.4	267.2	25159.4
2012	73070.3	16671.0	22.8	56399.3	13108.7	3276.0	9341.7	1336.3	2064.7	435.2	26836.7
2013	65847.9	11591.7	17.6	54256.2	18082.5	3639.8	8520.9	1588.1	1328.2	261.1	20855.7
2014	71487.3	8201.5	11.5	63285.8	18232.6	4371.8	11083.6	1098.7	2961.6	311.7	25225.8
2015	82973.4	9667.7	11.7	73305.8	20601.5	4508.3	11928.2	1187.0	2182.6	308.9	32589.2

2.4.5. The IPCC Tier 1 Sectoral Approach

The equations used for the estimation of GHGs under the Tier 1 method are:

Equation for GHG emissions from stationary combustion

$$\text{Emissions}_{GHG,fuel} = \text{Fuel Combustion}_{fuel} * \text{Emisson Factor}_{GHG,fuel}$$

where:

Emissions $_{GHG,fuel}$ = emissions of a given GHG by type of fuel (kg GHG)
Fuel Combustion $_{fuel}$ = amount of fuel combusted (TJ)
Emisson Factor $_{GHG,fuel}$ = default emission factor of a given GHG by type of fuel (kg gas/TJ).

Equation for GHG emissions from mobile combustion

$$\text{Emission} = \sum [\text{Fuel}_a * \text{EF}_a]$$

where:

Emissions	= emission in kg
EFa	= emission factor kg/TJ
Fuelsa	= fuel consumed, (TJ) (as represented by fuel sold)
A	= fuel type a (e.g., diesel, ATK, Gasoline, AGO etc)

Equation for GHG emissions from the Oil & Gas sector

$$E_{gas/oil,\ industry\ segment} = A_{industry\ segment} * EF_{gas/oil,\ industry\ segment}$$

where:

$E_{gas/oil,\ industry\ segment}$	= Annual Emissions (Gg)
$EF_{gas/oil,\ industry\ segment}$	= emission factor (Gg/unit of activity)
$A_{industry\ segment}$	= activity value (unitis of activity)

2.4.6. Tier 1 Sectoral Approach Activity Data

The AD for the energy sector inventory include data on energy production, processing (primary & secondary processing), transmission/transportation, and consumption. During the inventory, considerable attention was paid to data from both national and international sources, data preparation and documentation. Priority was given to using data sourced directly or estimated from available national sources covering the period 2000-2015. Existing gaps were filled either by obtaining additional data from other public sources approved in the 2006 IPCC Guidelines or by appropriate statistical methods.

The main data providers were the Nigeria National Petroleum Corporation (NNPC Annual Statistical Bulletin, 2000-2015), the National Bureau of Statistics (NBS) Annual Statistical Bulletin, United Nations Database and the Organization of Petroleum Exporting Countries (OPEC) Annual Statistical Bulletin (2010-2015).

Patterns of data for energy consumption by sector was obtained from the Energy Commission of Nigeria (ECN) and other studies and reports, some of which were national project reports.

Stationary Sources Activities Data: Nigeria is a producer and exporter of crude oil, petroleum products and natural gas. However, in recent years, the country relied more on imports of petroleum products to meet its growing demand especially, with the low performance of the local refineries. The main

secondary sources of liquid, biomass and gaseous fuels are diesel, gasoline, LPG, kerosene, AGO/Diesel, ATK, fuel wood, charcoal, bagasse, natural gas and HHK amongst others. Natural gas is utilized for public power generation with diesel and FO as back-up fuels as well as in industries for heat and own-use power generation. Transport fuels include gasoline & AGO/Diesel for road transportation, inland water navigation and railway, ATK for civil aviation and FO for international water navigation. Fuels consumed in the Commercial/Institutional and Residential sectors include HHK for cooking and lighting, LPG for cooking, gasoline and AGO/Diesel for auto-generation of electricity and other biomass fuels (fuel wood and charcoal). Table 2.10 presents the total consumption of primary and secondary fuels in the country for the period 2000-2015.

Table 2.10 Total fuel consumption for Nigeria (2000-2015) [2]

Year	Total (PJ)	% Share of Solid Fuel	% Share of Liquid Fuel	% Share of Gaseous fuel	% Share of Biomass
2000	3806.183	0.002	8.375	4.077	87.547
2001	4098.358	0.002	10.885	5.130	83.983
2002	4274.336	0.026	10.302	6.499	83.173
2003	4487.013	0.013	11.632	6.304	82.050
2004	4637.612	0.004	9.269	8.657	82.069
2005	5046.191	0.004	9.224	12.542	78.230
2006	5216.018	0.004	7.454	13.962	78.580
2007	5640.187	0.011	6.684	15.305	78.001
2008	5843.239	0.014	7.558	15.889	76.539
2009	5491.859	0.016	7.378	10.222	82.384
2010	6024.828	0.016	4.834	16.175	78.975
2011	6304.760	0.013	4.539	16.209	79.238
2012	6650.274	0.019	3.684	16.537	79.761
2013	6965.385	0.016	10.901	12.795	76.287
2014	7206.488	0.016	11.484	14.941	73.559
2015	7536.847	0.016	9.682	17.867	72.434

2.4.6.1. Detailed Tier 1 Sectoral Fuel Consumption

Energy Industries (1.A.1)

Estimates for the energy industries category comprise emissions resulting from fuel combustion in the main activity electricity generation, fuel combustion for electricity and heat generation in the local petroleum refineries, fuel combustion of solid fuels by manufacturing plants (including fuel wood transformed into charcoal) and fuel consumption in other energy industries (such as natural gas for field use in the Upstream Oil & Gas Sector).

Natural Gas is the major fossil fuel combusted in electricity generating stations in the country, with contribution from residual fuel oil (RFO) and AGO/Diesel (Table 2.11). Substantial gaps existed in the database on the consumption of these fuels in the Power Sector. From the existing data obtained from the ECN and the United Nations (UN) database, calculations were made to determine mean percentage contributions of RFO and AGO/Diesel to fill the data gaps for the years with incomplete data. It was observed that out of the total national consumption of RFO and AGO/Diesel, about 48% and 14.2% respectively were used for public electricity generation for the years 2005-2008. These percentages were adopted wherever actual data were not available on the consumption of these fuels in the power sector. The database for natural gas consumption in the power sector is also very weak. However, existing data from NNPC ASB showed that about 66% of natural gas sold was used for public power

generation while the balance were sold to industries for heat and own-use power generation. These percentages were used to compute the natural gas share for years with missing data.

Table 2.11 Fuel Consumption in Public Electricity Generation Facilities

Year	RFO (Gg)	AGO (Gg)	Natural Gas (Million scm)	Natural Gas (TJ)
2000	97.380	314.876	1245.036607	44821.318
2001	94.999	326.040	1925.407539	69314.671
2002	103.330	342.138	3577.757749	128799.279
2003	692.527	325.603	3779.210307	136051.571
2004	228.620	234.446	5836.733098	210122.392
2005	118.507	289.769	9837.159869	354137.755
2006	63.939	298.911	11767.92094	423645.154
2007	49.511	250.934	14219.28107	511894.119
2008	197.932	274.953	15375.60123	553521.644
2009	150.610	204.820	8634.656975	310847.651
2010	101.735	159.329	16418.50652	591066.235
2011	119.235	177.180	16605.22816	597788.214
2012	154.989	122.613	17712.24294	637640.746
2013	191.412	512.892	13764.7261	495530.140
2014	236.394	583.266	16649.0524	599365.887
2015	21.526	512.892	21508.83756	774318.152

Activity Data for fuel consumption for electricity and heat generation in upstream and downstream sectors of the Oil and Gas Industry obtained directly from the NNPC Annual Statistics Abstract (2000-2015) are given in Table 2.12.

Table 2.12 Fuel consumption for electricity and heat generation in the Oil & Gas Industry

Year	Refinery Fuel Use (Gg)					Upstream Fuel Use	
	AGO/Diesel	RFO	LPG	Petroleum Coke	Refinery Gas	Natural Gas (Million scm)	Natural Ga (TJ)
2000	63.49	217.81	22.20	10.53	125.17	2,220.60	79,941.48
2001	79.88	350.04	33.74	66.11	213.53	2,663.18	95,874.41
2002	88.25	335.99	31.01	89.55	238.72	2,036.08	73,298.96
2003	26.69	261.68	10.17	36.30	135.18	1,875.76	67,527.41
2004	16.44	143.99	5.67	34.30	201.35	2,025.84	72,930.39
2005	18.64	438.52	22.16	42.54	258.02	2,382.79	85,780.36
2006	21.89	226.24	3.34	4.93	100.00	2,174.90	78,296.48
2007	26.69	136.63	2.28	0.10	76.08	2,167.16	78,017.76
2008	29.53	256.20	34.86	6.62	69.40	2,277.01	81,972.51
2009	11.23	160.78	4.67	6.24	35.41	2,281.85	82,146.68
2010	26.93	289.09	11.75	2.81	49.93	2,045.66	73,643.90
2011	45.80	298.34	21.96	1.03	79.30	2,960.61	106,581.89
2012	19.98	316.96	18.96	1.05	65.14	3,275.98	117,935.12
2013	43.86	326.29	32.99	2.14	72.04	3,639.79	131,032.34
2014	24.69	225.93	11.22	9.64	33.89	4,371.78	157,384.00
2015	13.94	122.62	6.88	7.85	16.07	4,508.29	162,298.42

Energy consumption activity data for the manufacture of solid fuels, fuel wood for charcoal manufacturing in this case, obtained from the UN database are presented in Table 2.13.

Table 2.13 Fuel Wood used for Solid Fuel (Charcoal) Manufacturing (10^3 mt)

Year	2000	2001	2002	2003	2004	2005	2006	2007
Wood	8809	9011	9231	9459	9667	10163	23942	33713

Year	2008	2009	2010	2011	2012	2013	2014	2015
Wood	30891	26491	30638	35230	40510	37860	40510	43346

Manufacturing Industries and Construction

The Manufacturing and Construction Industries category consumed fuels (Table 2.14) for electricity generation and heat production for own use in their plants. Available data from the ECN National Energy Balance Studies (2000-2008; 2012-2013) and the IEA (2000-2014) indicate that AGO/Diesel consumption for energy generation in the manufacturing/construction sector was about 3.1% for the years 2000-2005 and about 0.73% between the years 2006-2014, while RFO consumption for energy generation in the manufacturing sector was about 52% of total national RFO consumption. About 1% of this fraction is used for own-use electricity generation while the balance is used in their operating plants. Data for Natural gas used in the Manufacturing and Construction Industries category was obtained by adding values for natural gas fuel sent to the Eleme Petrochemicals Company Limited (EPCL) (NNPC Annual Statistical Abstracts 2000-2015)[3] to values for natural gas sent to the manufacturing sector for own-use electricity generation (IEA, 2000-2014). Data for consumption of coal and other traditional fuels were obtained from ECN and IEA.

Table 2.14 Fuel consumption (Gg) by type in the Manufacturing and Construction Industries

Year	AGO / Diesel	RFO	Other Bituminous Coal	Wood/ Wood Waste	Charcoal	Natural Gas (Dry)	
						MMscm	TJ
2000	68.02	138.73	3.00	6482.25	6.00	844.44	30399.73
2001	70.44	135.34	3.00	7257.75	7.00	1251.28	45046.23
2002	73.91	147.21	43.00	8130.75	8.00	2102.49	75689.81
2003	70.34	986.60	23.00	9080.25	8.00	2202.82	79301.54
2004	50.65	325.70	8.00	10173.00	9.00	3289.42	118419.18
2005	62.60	168.83	8.00	11360.25	10.00	5360.45	192976.08
2006	10.35	91.09	8.00	12681.75	11.00	6286.73	226322.40
2007	8.69	70.54	23.00	14272.50	15.00	7591.79	273304.49
2008	9.52	281.98	32.00	16329.75	13.00	8137.14	292936.96
2009	7.09	214.56	34.00	18245.25	12.00	4677.17	168378.01
2010	5.51	144.93	38.00	20317.50	13.00	8605.41	309794.73
2011	6.13	169.87	32.00	22702.50	15.00	8821.40	317570.40
2012	4.24	220.80	48.00	25330.50	17.00	9559.69	344148.89
2013	17.75	272.69	44.00	24016.50	16.00	7352.04	264673.46
2014	20.19	336.77	46.00	13866.00	16.00	8888.48	319985.12

[3] NNPC Annual Statistical Bulletin (2000-2015)

Year	AGO / Diesel	RFO	Other Bituminous Coal	Wood/ Wood Waste	Charcoal	Natural Gas (Dry)	
						MMscm	TJ
2015	17.75	30.67	48.09	14309.71	16.51	11389.24	410012.47

Transport

In Nigeria, the transport sector comprises civil aviation (domestic & international), road transport, water-borne navigation (IMB and domestic) and rail. There are no formal national reports on the fuel consumption pattern in these transport sub-categories. For the purpose of this inventory, estimates (Table 2.15) of the fuel consumption pattern in these sub-categories were derived from data on national fuel consumption by type reported in the NNPC Annual Statistical Bulletins for the years 2000-2015, results of studies carried out by the ECN for the National Energy Balance[4] as well as results of analyses carried out by the World Bank[5] on fuel consumption in the Nigerian transport sector (2013). The estimates are:

- About 87.2% of total PMS consumed in the country is used in the transport sector of which about 4.2% and 95.8% go to the domestic water navigation and road transport sub-categories respectively.
- 70.35%, 7.47%, 21.78% and 0.4% of the total PMS used for road transport are used in passenger cars, motorcycles, light duty vehicles and buses respectively.
- About 1.74%, 0.95% and 43.78% of national AGO/Diesel consumption are used for domestic water navigation, rail and another road transport respectively.
- About 95% of total ATK is consumed in international aviation activities and the balance used for domestic aviation.

[4] Energy Commission of Nigeria: National Energy Balance 2012-2013, February 2016

[5] R. Cervigni, J. A Rogers, & I. Dvorak,(Editors). A WORLD BANK STUDY: Assessing Low-Carbon Development in Nigeria, pp 352-355. http://dx.doi.org/10.1596/978-0-8213-9973-6, Retrieved February 10th, 2017.

Table 2.15 Fuel Consumption (Gg) by type in the Transport Sector

Year	Civil Aviation		Road Transport						Water-borne Navigation			Rail
	ATK		PMS				AGO/Diesel		AGO/ Diesel	PMS	RFO	AGO/ Diesel
	Aviation Bunkers	Domestic Aviation	Cars	LD Trucks	HD Trucks & Buses	Motor cycles	Cars	HD Trucks & Buses	Domestic Water	Navigation	IMB	
2000	135.47	13.40	2071.07	641.19	11.78	219.91	73.12	1663.83	38.40	129.07	66.81	35.11
2001	231.57	22.90	3107.09	961.94	17.67	329.92	75.71	1722.83	39.76	193.63	13.33	36.35
2002	252.53	24.98	3779.12	1170.00	21.49	401.28	79.45	1807.89	41.73	235.51	0.00	38.15
2003	291.88	28.87	3795.80	1175.16	21.58	403.05	75.61	1720.52	39.71	236.55	0.00	36.30
2004	65.61	6.49	3569.22	1105.01	20.29	378.99	54.44	1238.84	28.59	222.43	0.00	26.14
2005	207.44	20.52	3760.27	1164.16	21.38	399.28	67.29	1531.17	35.34	234.34	0.20	32.31
2006	209.43	20.71	3613.55	1118.74	20.55	383.70	26.12	594.44	24.62	225.19	0.00	13.46
2007	253.09	25.03	3854.03	1193.19	21.91	409.23	21.93	499.03	20.67	240.18	0.00	11.30
2008	774.00	76.55	4132.68	1279.46	23.50	438.82	24.03	546.79	22.65	257.54	0.00	12.39
2009	587.09	58.06	4134.96	1280.16	23.51	439.06	17.90	407.32	16.87	257.69	3343.96	9.23
2010	151.46	14.98	2763.79	855.66	15.71	293.47	13.92	316.85	13.12	172.24	8.88	7.18
2011	168.75	16.69	2474.48	766.09	14.07	262.75	15.48	352.35	14.59	154.21	3.18	7.98
2012`	39.98	3.95	2182.64	675.73	12.41	231.76	10.72	243.84	10.10	136.02	5.49	5.52
2013	314.96	31.15	6914.12	2140.58	39.31	734.16	44.82	1019.98	42.24	430.88	0.00	23.10
2014	280.79	27.77	7568.80	2343.26	43.04	803.68	50.97	1159.93	48.04	471.68	260.00	26.27
2015	314.96	31.15	6914.12	2140.58	39.31	734.16	44.82	1019.98	42.24	430.88	0.00	23.10

Other Sectors – Commercial/Institutional, Residential & Agriculture/Forestry/Fisheries (CRAFF)

Data for fuel consumption in the commercial, residential and agriculture sectors obtained from ECN, IEA and UN databases are presented in Table 2.16. Data gaps were filled by using extrapolation and interpolation methods. In the commercial and residential sectors, PMS and AGO/diesel are consumed for auto-generation of electricity while LPG, fuel wood and charcoal are used for cooking and heating. Existing data from ECN and IEA show that between the years 2000-2005 about 84% of total national LPG consumption was in the residential sector while about 11% was used in the commercial/services sector. Between the years 2006-2015 about 60% and 30% of LPG were used in the residential and commercial/services sectors respectively, while the balance was for non-specified industrial use. In the Agriculture/Forestry/Fisheries sector, diesel is consumed in off-road vehicles such as tractors and other agricultural implements. About 0.4% of total national AGO consumption is used in the Agriculture sector.

Table 2.16 Commercial / Institutional, Residential and Agriculture / Forestry / Fishing (CRAFF) Sectors Fuel Consumption ('000 mt)

Year	Commercial/Institutional Sector					Residential Sector							Agriculture/ Forestry / Fish farms AGO
	PMS	AGO/ Diesel	LPG	Wood/ Wood Waste	Charcoal	PMS	HHK	AGO/ Diesel	LPG	Wood/ Wood Waste	Charcoal	Vegetal wastes	
2000	7.05	5.48	5.48	4357.50	186.00	444.04	865.23	3.29	10.05	87393.75	1026.00	1571622.00	8.78
2001	10.57	5.68	5.68	4103.25	198.00	666.16	1617.78	3.41	11.02	89618.25	1156.00	1611758.00	9.09
2002	12.86	5.96	5.96	3624.00	224.00	810.24	151.69	3.58	18.38	91908.75	1289.00	1653083.00	9.54
2003	12.92	5.67	5.67	3559.50	228.00	813.82	1087.39	3.41	17.21	94273.50	1462.00	1695738.00	9.08
2004	12.15	4.08	4.08	2772.00	292.00	765.24	1106.82	2.45	23.70	96726.00	1596.00	1739890.00	6.53
2005	12.80	5.05	5.05	2495.25	325.00	806.20	1101.30	3.03	6.30	99277.50	1785.00	1785653.00	8.08
2006	12.30	264.19	264.19	2206.50	367.00	774.74	734.65	189.35	10.45	101929.50	1989.00	1833066.00	5.10
2007	13.12	221.78	221.78	2393.25	518.00	826.30	424.34	158.96	2.81	104683.50	2800.00	1882116.00	4.28
2008	14.06	243.01	243.01	2251.50	483.00	886.05	776.56	174.18	5.69	107543.25	2558.00	1932804.00	4.69
2009	14.07	181.03	181.03	2576.25	416.00	886.53	559.60	129.75	14.66	110511.00	2191.00	1985129.00	3.50
2010	9.41	140.82	140.82	4024.50	491.00	592.56	530.17	100.93	11.21	113589.00	2525.00	2039078.00	2.72
2011	8.42	156.60	156.60	4671.75	575.00	530.53	714.28	112.24	14.44	116778.75	2893.00	2094664.00	3.02
2012	7.43	108.37	108.37	8589.00	668.00	467.96	500.36	77.67	7.00	120079.50	3320.00	2151823.00	2.09
2013	23.53	453.31	453.31	6630.00	621.00	1482.39	2112.30	324.90	9.01	123346.50	3106.00	2210364.00	8.75
2014	25.76	515.51	515.51	7609.50	638.00	1622.75	2287.17	369.48	11.61	126671.25	3190.00	2269954.00	9.96
2015	23.53	453.31	453.31	7853.00	658.42	1482.39	2112.30	324.90	15.64	130724.73	3292.08	2331242.76	8.75

Fugitive Emissions

The Primary Energy data for estimating fugitive emissions for the upstream sector in Nigeria was obtained directly from DPR (2013-2015), NNPC (2000-2015)[6], and OPEC (2011-2015). The NNPC Annual Statistical Bulletin (ASB) was the primary source of data for the Oil & Gas category. Where data was incomplete or inconsistent, the DPR ASB and OPEC ASB were consulted for update and corrections made as required.

2.4.7. Emission Factors

The default emission factors (Tier 1) were used in the estimation of GHGs for the energy sector (Table 2.17).

Table 2.17 2006 IPCC Tier 1 default emission factors for the Energy Sector (combustion emissions)

Fuel	Default Emission Factor (kg of GHG per TJ on a Net Calorific Basis)		
	CO_2	CH_4	N_2O
Energy Industries			
Gas/Diesel Oil	74100	3	0.6
Residual Fuel Oil	77400	3	0.6
Liquefied Petroleum Gases	63100	1	0.1
Petroleum Coke	97500	3	0.6
Refinery Gas	57600	1	0.1
Natural Gas	56100	1	0.1
Wood / Wood Waste	112000	30	4
Manufacturing Industries & Construction			
Gas/Diesel Oil	74100	3	0.6
Residual Fuel Oil	77400	3	0.6
Other Bituminous Coal	94600	10	1.5
Natural Gas	56100	1	0.1
Wood / Wood Waste	112000	30	4
Charcoal	112000	200	4
Civil Aviation			
Jet Kerosene	71500	0.5	2
Road Transportation			
Motor Gasoline	69300	33	3.2
Gas/ Diesel Oil	74100	3.9	3.9
Railway			
Gas/ Diesel Oil	74100	4.15	28.6
Water-borne Navigation			
Gasoline	69300	7	2
Gas/Diesel Oil	74100	7	2
Residual Fuel Oil	77400	7	2
Commercial/Institutional Category			
Motor Gasoline	69300	10	0.6
Gas/Diesel Oil	74100	10	0.6
Liquefied Petroleum Gases	63100	5	0.1

[6] NNPC Annual Statistical Bulletin (2000-2015)

Fuel	Default Emission Factor (kg of GHG per TJ on a Net Calorific Basis)		
	CO_2	CH_4	N_2O
Wood / Wood Waste	112 000	300	4
Charcoal	112 000	200	1
Residential & Agriculture/Forestry/Fish Farms			
Motor Gasoline	69 300	10	0.6
Other Kerosene	71 900	10	0.6
Gas/Diesel Oil	74 100	10	0.6
Liquefied Petroleum Gases	63 100	5	0.1
Wood / Wood Waste	112 000	300	4
Other Primary Solid Biomass	100 000	300	4
Charcoal	112 000	200	1

Table 2.18 applies to systems in developing countries and countries with economies in transition where there are much greater amounts of fugitive emissions per unit of activity (often by an order of magnitude or more).

Table 2.18 2006 IPCC Tier 1 default emission factors for the Energy Sector (Fugitive Emissions)

EF for Fugitive Emissions from crude oil systems (Gg / 10^3 m^3)				
Category	**Sub-category**	**CO_2**	**CH_4**	**N_2O**
Venting	Oil Production	0.00215	0.01035	Not determined
	Oil Transport	2.30E-06	2.50E-05	Not determined
Flaring	Oil Production	0.0405	2.50E-05	6.40E-07
	Well drilling	0.0009	0.0002965	Not determined
	Well Servicing	1.70E-05	0.000955	Not determined
	Well testing	0.0795	0.0004505	5.84E-07
Transport	LPG transport	0.00043	Not determined	2.20E-09
	Oil pipeline transport	4.90E-07	5.40E-06	Not determined
Refining		Not determined	2.18E-05	Not determined
Fugitive Emissions from NG systems (Gg / 10^6 m^3)				
Venting	NG processing	0.0675	Not determined	Not determined
	NG Transmission	5.20E-06	0.000392	Not determined
Flaring	NG processing	0.00355	2.40E-06	3.90E-08
	NG production	0.0014	8.80E-07	2.50E-08
	Well drilling	0.0009	0.0002965	Not determined
	Well Servicing	1.70E-05	0.000955	Not determined
	Well testing	0.0795	0.0004505	5.84E-07
NG storage		1.85E-07	4.50E-05	Not determined
NG distribution		9.55E-05	0.0018	Not determined

The IPCC guideline does not provide emission factors for indirect GHGs such as NO_X, CO, NMVOCs and SO_x, but recommends the EMEP/EEA guidebook[7] default Tier 1 emission factors (Table 2.19) for estimating these gases. The Guidebook remains the recommended source of methodology information for preparing emission inventories of

[7] EMEP/EEA Air Pollutant Emission Inventory Guidebook 2016

indirect greenhouse gases. SO_x emissions are directly related to the sulphur content of the fuel. Therefore, it is recommended that where countries have data on the sulphur content of fuels, equation 2.5 should be used to calculate SO_2 emissions. In light of this, the EFs for estimating SO_x emissions for this inventory (Table 2.20) were derived using the sulphur content of Nigerian fuels assuming there is no SO_2 abatement and 100% of the sulphur are converted to SO_2 with no retention in ash.

$$EF\ SO_2 = \{S\} * 20{,}000 / CVnet \quad \text{(eqn 2.5)}$$

Where:

$EF\ SO_2$ is the SO_2 emission factor (kg/TJ

{S} is Sulphur content of the fuel (% w/w)

CVnet is fuel CV (TJ/Gg, net basis)

Table 2.19 EMEP/EEA Default Tier 1 emission factors for NO_X, CO and NMVOCs

Fuel	Default Emission Factor (kg of GHG per TJ on a Net Calorific Basis)		
	NO_X	CO	NMVOC
Energy Industries			
Gas/Diesel Oil	65	16.2	0.8
Residual Fuel Oil	142	15.1	2.3
Liquefied Petroleum Gases	89	39	2.6
Petroleum Coke	142	15.1	2.3
Refinery Gas	89	39	2.6
Natural Gas	89	39	2.6
Wood / Wood Waste	81	90	7.31
Manufacturing Industries & Construction			
Gas/Diesel Oil	513	66	25
Residual Fuel Oil	513	66	25
Other Bituminous Coal	173	931	88.8
Natural Gas	74	29	23
Wood / Wood Waste	91	570	300
Charcoal	91	570	300
Civil Aviation			
Jet Kerosene	NE	NE	NE
Road Transportation: Cars (g/kg fuel)			
Motor Gasoline	8.73	84.7	0.7
Gas/ Diesel Oil	12.96	3.33	0.7
Road Transportation: LCV (g/kg fuel)			
Motor Gasoline	13.22	152.3	14.59
Gas/ Diesel Oil	14.91	7.4	1.54
Road Transportation: HDV (g/kg fuel)			
Gas/ Diesel Oil	33.37	7.58	1.92
Road Transportation: Motorcycles (g/kg fuel)			
Gas/ Diesel Oil	6.64	497.7	131.4
Railway (g/kg fuel)			
Gas/ Diesel Oil	52.4	10.7	4.65
Water-borne Navigation (g/kg fuel)			
Gasoline	9.4	573.9	181.5

Fuel	Default Emission Factor (kg of GHG per TJ on a Net Calorific Basis)		
	NO_X	CO	NMVOC
Gas/Diesel Oil	78.5	7.4	2.8
Residual Fuel Oil	79.3	7.4	2.7
Commercial/Institutional Category			
Motor Gasoline	69 300	10	0.6
Gas/Diesel Oil	74 100	10	0.6
Liquefied Petroleum Gases	63 100	5	0.1
Wood / Wood Waste	112 000	300	4
Charcoal	112 000	200	1
Residential (kg/TJ)			
Motor Gasoline	51	57	0.69
Other Kerosene	51	57	0.69
Gas/Diesel Oil	51	57	0.69
Liquefied Petroleum Gases	51	26	1.9
Wood / Wood Waste	80	4000	600
Other Primary Solid Biomass	80	4000	600
Charcoal	80	4000	600
Agriculture/forestry/fishing: stationary other (kg/TJ)			
Gas/Diesel Oil	74	29	23
Fugitive Emissions: Venting (kg/Mg Oil)			
Oil	NA	NA	0.2
Fugitive Emissions: Venting (g/m3 gas)			
Natural Gas	NA	NA	0.1

Table 2.20 SO_2 emission factors for Nigerian fuels

Fuel type	Sulphur content	Unit	Net Calorific Value (TJ/Gg)	Unit of EF SO_2 (kg/TJ) = [S] * 20,000/Cvnet	Other EMEP/EEA Tier 1 SO_2 EFs
Coal (other bituminous)	0.4-6.2	wt-%	25.8	775.194	
Crude Oil		wt-%			
Heavy Fuel Oi	0.3-3.5	wt-%	42.18	379.327	20 g/kg fuel (Water Navigation)
Gas/Diesel Oil	0.3	wt-%	43	139.535	
Petroleum Coke		wt-%	32.5		
Kerosene		wt-%	43.8		
Motor Gasoline	<0.05	wt-%	44.3	13.544	20 g/kg fuel (Domestic Navigation)
Naphtha		wt-%			
Natural Gas(negligible)	0.0075	g/m3	48	3.125	
LPG		g/m3	47.3		
Refinery Gas		g/m3	49.5	0.281	
Biomass (Wood, Charcoal & other)	<0.03	wt-%			
Charcoal			29.5	20.339	
Fuel wood			15.6	38.4615	
Other primary biomass			11.6	51.7241	

2.4.8. Emissions from the Energy Sector

Total emissions from the energy sector increased from 84815 Gg CO_2-eq in 2000 to 201320 Gg CO_2-eq in 2015. Of the two source categories, Fuel Combustion Activities recorded an increase of 198% compared to 26% for Fugitive Emissions. Out of the 201320 Gg CO_2-eq emissions of 2015, Fuel Combustion Activities contributed 81.5% while 18.5% came from fugitive processes (Figure 2.4).

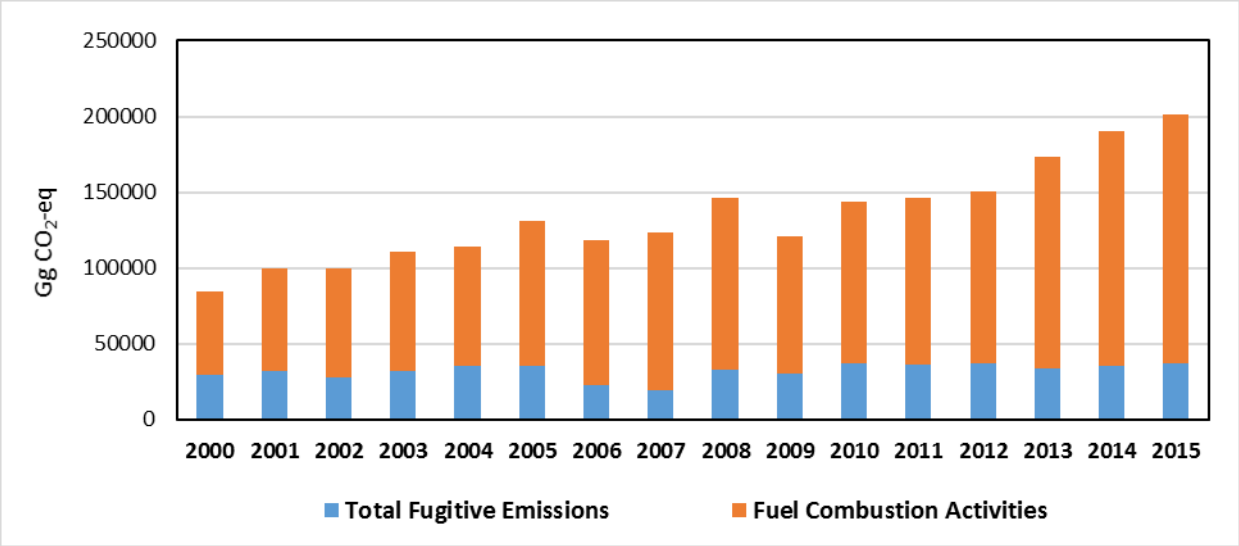

Figure 2.4 Energy Sector GHG emission trends (2000-2015)

On a subcategory basis in 2015 within the Fuel Combustion Category, Energy Industries is the highest contributor with 34.1% of emissions followed by Other Sectors (29.5%), Transport (22.0%) and Manufacturing Industries & Construction (14.5%). From the year 2000 to 2015, emissions increased by 459% for Energy Industries, 827% for Manufacturing Industries and Construction, 132% for Transport and 79% for Other Sectors (Table 2.21).

Table 2.21 Emissions of Fuel Combustion sub-categories for 2000 to 2015

Year	Energy Sector	Fuel Combustion Activities (1.A)	Energy Industries (1.A.1)	Manufacturing Ind & Constr.(1.A.2)	Transport (1.A.3)	Other Sectors (1.A.4)	Fugitive Emissions/ Oil and Gas (1.B/1.B.2)
2000	84815	55137	10020	2557	15534	27026	29677
2001	100047	67964	13291	3399	20609	30664	32083
2002	99797	71998	15610	5292	24052	27045	27799
2003	111075	79148	16583	8096	23836	30632	31927
2004	114421	79399	19125	8151	21023	31100	35022
2005	130993	95691	28988	11919	22982	31803	35301
2006	118683	96258	31130	13419	19059	32650	22425
2007	123314	104123	35788	16079	19850	32406	19190
2008	146241	113206	39290	17930	21485	34501	33035
2009	121053	90577	24643	10768	20940	34225	30477
2010	143589	106812	40208	18556	14079	33969	36777
2011	146530	110254	42879	19128	12860	35386	36277
2012	150320	113301	45771	20891	11071	35568	37019
2013	172968	138950	40002	16585	36022	46340	34018
2014	190359	155004	47182	19609	39555	48658	35355
2015	201320	164043	55991	23714	36022	48315	37277

2.4.8.1. Emission Trends by Gas

Table 2.22 summarizes the emission trends for the period 2000 to 2015. Carbon dioxide was the dominant gas in the energy sector emissions with approximately 76.8% of total emissions in 2015. For the same year, CO_2 is followed by CH_4 (19.6%) and N_2O (3.6%).

In general, there is a steady increase in CO_2 emissions from 54276 Gg in the year 2000 to 154671 Gg in 2015 with dips in a few years, namely 2006, 2007 and 2009. The increase is of the order of 185% from the year 2000 to 2015.

In general, CH_4 emissions increased on the same pattern as CO_2 over the time period from 26178 Gg CO_2-eq in 2000 to 39367 Gg CO_2-eq in 2015 which represented a 50% progression in emissions.

N_2O emissions increased by 67% from 4361 Gg CO_2-eq in 2000 to reach 7283 Gg CO_2-eq in 2015.

Table 2.22 GHG emissions (Gg CO_2-eq) for the Energy Sector category for 2000 to 2015

Year	CO_2	CH_4	N_2O	Total
2000	54276	26178	4361	84815
2001	68039	27432	4576	100047
2002	68003	27053	4741	99797
2003	77469	28690	4916	116349
2004	79481	29906	5035	114421
2005	95221	30549	5223	130993
2006	83487	29844	5352	118683
2007	85455	32139	5720	123314
2008	108059	32337	5844	146241
2009	83088	32059	5906	121053
2010	102933	34559	6097	143589
2011	104724	35443	6363	146530
2012	106750	36862	6709	150320
2013	129231	36640	7097	172968
2014	145327	37909	7123	190359
2015	154671	39367	7283	201320

2.4.8.2. GHG precursors (NO_X, CO, NMVOCs) and SO_2

All three precursors increased during the period 2000 to 2015, NO_X by 89% from 390 Gg to 738 Gg, CO from 12409 Gg to 19515 Gg (57%) and NMVOCs by 56% from 1969 Gg to 3068 Gg. SO_2 also increased, from 61 Gg to 88 Gg representing 44% more emissions in 2015 compared to the year 2000 (Table 2.23).

Table 2.23 Emissions (Gg) of GHGs and its precursors for the period 2000 to 2015

Year	CO_2	CH_4	N_2O	NO_X	CO	NMVOCs	SO_2
2000	54276	1247	14.1	390	12409	1969	61
2001	68039	1306	14.8	429	12929	2049	69
2002	68003	1288	15.3	457	13386	2102	69
2003	77469	1366	15.9	486	13741	2170	91
2004	79481	1424	16.2	466	14042	2227	68
2005	95221	1455	16.8	511	14469	2294	72
2006	83487	1421	17.3	493	14831	2353	62
2007	85455	1530	18.5	527	15352	2436	60
2008	108059	1540	18.9	553	15773	2497	71

Year	CO_2	CH_4	N_2O	NO_X	CO	NMVOCs	SO_2
2009	83088	1527	19.1	518	16133	2549	66
2010	102933	1646	19.7	542	16447	2649	64
2011	104724	1688	20.5	562	16839	2713	66
2012	106750	1755	21.6	585	17336	2702	68
2013	129231	1745	22.9	694	18355	2878	94
2014	145327	1805	23.0	729	19114	2992	100
2015	154671	1875	23.5	738	19515	3068	88

2.4.8.3. Emissions by Activity area within sub-category in 2015

Energy Industries (1.A.1)

Emissions from the Energy Industries activities are presented inTable 2.24. The major contributor was Electricity and Heat Production (Electricity Generation) with 80.7% of total emissions of Energy Industries followed by 18.4% from Manufacture of Solid Fuels and Other Energy Industries. Petroleum Refining was responsible for the remaining 0.9%. CO_2 remained the principal GHG emitted for all activities even if it is reported under AFOLU.

Table 2.24 GHG emissions (Gg CO_2-eq) for Energy Industries for year 2015

Source category	CO_2	CH_4	N_2O	Total
1.A.1 - Energy Industries	54764.77	415.86	810.59	55991.22
1.A.1.a - Main Activity Electricity and Heat Production	45140.79	17.71	28.27	45186.76
1.A.1.a.i - Electricity Generation	45140.79	17.71	28.27	45186.76
1.A.1.b - Petroleum Refining	519.05	0.39	1.12	520.55
1.A.1.c - Manufacture of Solid Fuels and Other Energy Industries	9104.94	397.76	781.20	10283.90
1.A.1.c.i - Manufacture of Solid Fuels		394.35	776.18	1170.53
1.A.1.c.ii - Other Energy Industries	9104.94	3.41	5.02	9113.37

The direct GHGs, precursors and SO_2 for 2015 are given in Table 2.25. For CO_2, Electricity Generation was the main emitter with 45141 Gg followed by Other Energy Industries with 9105 Gg and Petroleum Refining with 519 Gg. Regarding CH_4, Manufacture of Solid Fuels was responsible for 18.78 Gg out of the total of 19.80 Gg. A similar situation is observed for N_2O with Manufacture of Solid Fuels emitting 2.50Gg out of a total of 2.61Gg. For the precursors, Electricity Generation accounted for 51.6% of NO_X emissions and Manufacture of Solid Fuels 37.1%. Conversely, Manufacture of Solid Fuels was responsible for 56.3% of CO emissions and 64.9% of NMVOCs compared to 30.6% and 28.9% of these gases respectively for Electricity Generation.

Table 2.25 Emissions by gas (Gg) for Energy Industries for 2015

Source category	CO_2	CH_4	N_2O	NO_X	CO	NMVOCs	SO_2
1.A.1 - Energy Industries	54764.77	19.80	2.61	136.49	93.37	7.05	5.50
1.A.1.a - Main Activity Electricity and Heat Production	45140.79	0.84	0.09	70.47	30.57	2.03	3.41
1.A.1.a.i - Electricity Generation	45140.79	0.84	0.09	70.47	30.57	2.03	3.41
1.A.1.b - Petroleum Refining	519.05	0.02	0.00	0.88	0.13	0.02	2.09
1.A.1.c - Manufacture of Solid Fuels and Other Energy Industries	9104.94	18.94	2.52	65.14	62.67	5.00	NE
1.A.1.c.i - Manufacture of Solid Fuels		18.78	2.50	50.70	56.34	4.58	NE
1.A.1.c.ii - Other Energy Industries	9104.94	0.16	0.02	14.44	6.33	0.42	NE

Manufacturing Industries and Construction (1.A.2)

Emissions for this category came from fuel combustion activities for electricity and heat generation in the Iron & Steel, Non-Ferrous Metals, Chemicals & Petrochemicals, Pulp, Paper & Print, Non-metallic Minerals, Transport Equipment, Machinery, Mining & Quarrying, Wood & Wood Products, Construction, and Textile & Leather industries. The estimates did not include non-energy use of fuel of these industries. Total emissions from this category increased steadily from 2557 Gg CO_2-eq in year 2000 and peaked at 23714 Gg CO_2-eq in 2015. CO_2 is the dominant gas (Table 2.26) with 98.1% in 2015. CH_4 represented 0.6% and N_2O 1.2%. Further disaggregation of emissions of this category was not possible due to lack of relevant data for the respective subcategories. Emissions estimates of NO_X, CO, NMVOCs in 2015 for the Manufacturing Industries and Construction category were 22.04Gg, 76.26Gg and 40.19Gg respectively. SO_2 emissions stood at 3.56Gg.

Table 2.26 Trends in GHG emissions from the Manufacturing Industries and Construction

Year	CO_2 (Gg CO_2-eq)	CH_4 (Gg CO_2-eq)	N_2O (Gg CO_2-eq)	Total (Gg CO_2-eq)	CH_4 (Gg)	N20 (Gg)
2000	2363.30	65.64	128.18	2557.12	3.13	0.41
2001	3182.05	73.69	143.66	3399.40	3.51	0.46
2002	5046.97	83.30	162.13	5292.40	3.97	0.52
2003	7814.13	94.72	186.65	8095.51	4.51	0.60
2004	7842.68	104.59	203.74	8151.00	4.98	0.66
2005	11572.87	117.71	228.00	11918.58	5.61	0.74
2006	13034.01	131.03	253.59	13418.63	6.24	0.82
2007	15636.75	148.20	294.46	16079.41	7.06	0.95
2008	17423.93	169.17	337.10	17930.20	8.06	1.09
2009	10222.52	185.09	360.67	10768.27	8.81	1.16
2010	17943.01	208.39	404.69	18556.09	9.92	1.31
2011	18444.51	232.27	451.26	19128.04	11.06	1.46
2012	20127.87	259.12	503.55	20890.54	12.34	1.62
2013	15864.83	244.56	476.08	16585.47	11.65	1.54
2014	19180.85	146.14	281.97	19608.96	6.96	0.91
2015	23271.55	151.68	291.07	23714.30	7.22	0.94

Transport (1.A.3)

Aggregated emissions by subcategory within the transport category are given in Table 2.27. Road Transportation emitted the major share of this subcategory with 34322.5 Gg CO_2-eq (95.3%) out of a total of 36022.3 Gg CO_2-eq with cars responsible for 63.8% of this activity area. Domestic Water borne Navigation followed with 1518.2 Gg CO_2-eq (4.2%), Domestic Aviation with 99.1 Gg CO_2-eq (0.3%) and Railways with 82.5 Gg CO_2-eq (0.2%). CO_2 with 35240 Gg CO_2-eq made up for 97.8% of the total emissions of 36022 Gg CO_2-eq. CH_4 represented 0.9% and N_2O 1.3% with emissions of 308.57 Gg CO_2-eq and 474.21 Gg CO_2-eq respectively.

Table 2.27 GHG emissions (Gg CO_2-eq) for Transport category

Category	CO_2	CH_4	N_2O	Total
1.A.3 Transport	35239.57	308.57	474.21	36022.35
1.A.3.a - Civil Aviation	98.22	0.01	0.84	99.07
1.A.3.a.ii - Domestic Aviation	98.22	0.01	0.84	99.07
1.A.3.b - Road Transportation	33565.16	305.47	451.92	34322.55
1.A.3.b.i - Cars	21369.09	212.42	306.19	21887.70
1.A.3.b.ii - Light-duty trucks	6571.56	65.72	94.05	6731.33
1.A.3.b.iii - Heavy-duty trucks and buses	3370.64	4.80	19.41	3394.85
1.A.3.b.iv - Motorcycles	2253.86	22.54	32.27	2308.67
1.A.3.c - Railways	73.60	0.09	8.80	82.49

1.A.3.d - Water-borne Navigation	1502.59	3.00	12.65	1518.24
1.A.3.d.ii - Domestic Water-borne Navigation	1502.59	3.00	12.65	1518.24

Emissions of the direct GHGs, precursors and SO_2 by activity area within the Transport subcategory are given in Table 2.28. Road Transportation was responsible for the highest share of emissions of all gases with 78.4% of NO_X, 97.9% of CO, 93.8% of NMVOCs and 74.7% of SO_2. Except for NMVOCs which stood at 3.6% of emissions under the Road Transportation activity area, cars contributed most with 47.4% of NO_X, 45.4% of CO and 41.9% of SO_2.

Table 2.28 Emissions (Gg) by gas for Transport category for year 2015

Category	CO_2	CH_4	N_2O	NO_X	CO	NMVOCs	SO_2
1.A.3 - Transport	35239.57	14.694	1.530	164.11	1318.60	144.08	14.11
1.A.3.a - Civil Aviation	98.22	0.001	0.003	NE	NE	NE	NE
1.A.3.a.ii - Domestic Aviation	98.22	0.001	0.003	NE	NE	NE	NE
1.A.3.b - Road Transportation	33565.16	14.546	1.458	128.68	1290.92	135.10	10.54
1.A.3.b.i - Cars	6571.56	10.115	0.988	60.94	585.80	4.87	4.42
1.A.3.b.ii - Light-duty trucks	6571.56	3.129	0.303	28.30	326.00	31.23	NE
1.A.3.b.iii - Heavy-duty trucks and buses	3370.64	0.229	0.063	34.56	13.72	2.53	6.12
1.A.3.b.iv - Motorcycles	2253.86	1.073	0.104	4.88	365.40	96.47	NE
1.A.3.c - Railways	73.60	0.004	0.028	1.21	0.25	0.11	0.14
1.A.3.d - Water-borne Navigation	1502.59	0.143	0.041	34.22	27.43	8.87	3.43
1.A.3.d.ii - Domestic Water-borne Navigation	1502.59	0.143	0.041	34.22	27.43	8.87	3.43

Other Sectors (1.A.4)

Table 2.29 summarises emissions for the Other Sectors category which emitted a total of 48315.4 Gg CO_2-eq in 2015. The highest share came from activities in the Residential sector with 94.7% of emissions. Again, this activity area led emissions for all three direct GHGs with 27978.57 Gg CO_2-eq of CH_4, 12284.93 Gg CO_2-eq of CO_2 and 5481.73 Gg CO_2-eq of N_2O. Commercial/Institutional activities came next to Residential with emissions from Agriculture/Forestry/Fishing/Fish Farms being marginal at 0.06% of the total of this subcategory.

Table 2.29 GHG emissions (Gg CO_2-eq) for Other Sectors for 2015

Category	CO_2	CH_4	N_2O	Total
1.A.4 Other sectors	13835.55	28836.35	5643.55	48315.44
1.A.4.a - Commercial/Institutional	1522.74	857.69	161.76	2542.19
1.A.4.b - Residential	12284.93	27978.57	5481.73	45745.23
1.A.4.c - Agriculture/Forestry/Fishing/Fish Farms	27.88	0.08	0.06	28.02
1.A.4.c.ii - Off-road Vehicles and Other Machinery	27.88	0.08	0.06	28.02

The Residential area vastly dominated this subcategory in emissions which stood at 88.8% for CO_2, 97% for CH_4, 97.1% for N_2O, 95.0% for NO_X, 99.5% for CO, 98.4% for NMVOCs and 93.5% for SO_2.

Table 2.30 Emissions by gas (Gg) for the Other Sectors for 2015

Category	CO_2	CH_4	N_2O	NO_X	CO	NMVOCs	SO_2
1.A.4 - Other Sectors	13835.55	1373.16	18.21	385.65	17961.83	2723.60	66.52
1.A.4.a – Commercial / Institutional	1522.74	40.84	0.52	19.15	81.73	42.85	4.31

1.A.4.b - Residential	12284.93	1332.31	17.68	366.20	17880.00	2680.72	62.17
1.A.4.c – Agriculture / Forestry / Fishing / Fish Farms	27.88	0.004	0.0002	0.30	0.10	0.03	0.05
1.A.4.c.ii - Off-road Vehicles and Other Machinery	27.88	0.004	0.0002	0.30	0.10	0.03	0.05

Fugitive Emissions from Fuel (1.B.2) – Oil (1.B.2.a) and Natural Gas (1.B.2.b)

Oil and Natural Gas activities were responsible for total aggregated emissions of 37276.9 Gg CO_2-eq, the Oil industry contributing 52.1% and the Natural Gas industry 47.9% of this total respectively. The main contributor of the Oil industry was Flaring with 19377.1 Gg CO_2-eq which represented 99.8% of this activity while Flaring and Venting emitted respectively 56.4% and 33.6% within the Natural Gas component. On a GHG basis, CO_2 topped the emissions with 73.9% followed by CH_4 with 25.9% and N_2O with 0.2%. Fugitive Emissions from fuel are summarised in Table 2.31.

Table 2.31 GHG emissions (Gg CO_2-eq) for Fugitive Emissions from Fuel category for 2015

Category	CO_2	CH_4	N_2O	Total
1.B.2 Oil and Natural Gas	27559.24	9654.35	63.33	37276.93
1.B.2.a - Oil	14870.70	4501.40	46.66	19418.75
1.B.2.a.i - Venting	0.26	26.76		27.03
1.B.2.a.ii - Flaring	14870.36	4460.11	46.66	19377.12
1.B.2.a.iii - All Other	0.08	14.53	0.00	14.60
1.B.2.a.iii.3 - Transport	0.08	13.95	0.00	14.60
1.B.2.a.iii.4 - Refining	0.00	0.58		0.58
1.B.2.b - Natural Gas	12688.55	5152.95	16.68	17858.17
1.B.2.b.i - Venting	5600.96	396.75		5997.71
1.B.2.b.ii - Flaring	7083.19	2971.35	16.68	10071.22
1.B.2.b.iii - All Other	4.40	1784.85	0.00	1789.25
1.B.2.b.iii.4 - Transmission and Storage	0.01	45.55		
1.B.2.b.iii.5 - Distribution	4.39	1739.30		

Emissions of the direct GHGs, GHG precursors and SO_2 are presented in Table 2.32. Activities from Oil and Natural Gas were quite balanced for CO_2 and CH_4 with Flaring as the main contributing process. Oil operations emitted three times more N_2O than natural gas with still both sources being flared. NO_X and CO emissions were insignificant while NMVOCs were comparable between Oil and Natural Gas operations. SO_2 emissions was either not estimated or marginal when accounted for.

Table 2.32 Emissions (Gg) by gas for Fugitive Emissions from Fuel category for 2015

Category	CO_2	CH_4	N_2O	NO_X	CO	NMVOCs	SO_2
1.B.2 - Oil and Natural Gas	27559.24	459.73	0.20	NE	NE	116.59	NE
1.B.2.a - Oil	14870.70	214.35	0.15	NO	NO	52.97	NE
1.B.2.a.i - Venting	0.26	1.27		NO	NO	52.97	NE
1.B.2.a.ii - Flaring	14870.36	212.39	0.15	NE	NE	NE	0.00
1.B.2.a.iii - All Other	0.08	0.69	0.00				
1.B.2.a.iii.3 - Transport	0.08	0.66	0.00				
1.B.2.a.iii.4 - Refining	0.00	0.03					
1.B.2.b - Natural Gas	12688.55	245.39	0.05	0.00	0.00	63.62	0.00
1.B.2.b.i - Venting	5600.96	18.89		NO	NO	13.12	NE
1.B.2.b.ii - Flaring	7083.19	141.49	0.05	NE	NE	41.49	NE
1.B.2.b.iii - All Other	4.40	84.99				9.01	NE

1.B.2.b.iii.4 - Transmission and Storage	0.01	2.17		4.82	NE
1.B.2.b.iii.5 - Distribution	4.39	82.82		4.19	NE

Memo items

Emissions from fuels used for International aviation and international marine bunkers (IMB) are excluded from the nation's totals and reported as memo items. Fuels for international bunkers (Table 2.9) formed the basis for GHGs emissions calculations for international bunkers. Emissions of CO_2, CH_4 and N_2O from the international bunkers (marine and aviation bunkers) increased from 641.89 Gg CO_2-eq in 2000 to 1,001.88 Gg CO_2-eq in 2015 (Table 2.33). In year 2000, IMB emissions contributed 32.9% to total emissions from International Bunkers, while the balance came from international aviation bunkers. On the other hand, in the year 2015, the international aviation contributed 100% of the emissions from international bunkering as no sales of IMB fuels was recorded for that year.

In order to avoid double counting, CO_2 emissions from biomass combustion for energy production are also reported under the memo items and not included in the Energy sector emissions. They are estimated and reported in the AFOLU sector as part of emissions from Forest land sub-category (3.B.1.a). This includes CO_2 emissions from transformation of fuel wood to charcoal in energy industries, as well as CO_2 emissions from the use of biomass for energy in the residential and commercial/institutional sectors. In the year 2000, CO_2 emissions from this activity amounted to 354345 Gg CO_2, while in 2015, total CO_2 emissions from this activity was 583464 Gg CO_2.

Table 2.33 GHG emissions (CO_2-eq) trend for International Bunkers & Biomass consumption for Energy Production

Year	International Bunkers	International Aviation Bunkers	International Marine Bunkers	CO_2 from biomass combustion for charcoal production
2000	641.89	430.93	210.97	354345.984
2001	778.71	736.62	42.09	366155.882
2002	803.29	803.29	0.00	378334.786
2003	928.45	928.45	0.00	385018.512
2004	208.71	208.71	0.00	405399.133
2005	660.50	659.86	0.64	420706.018
2006	666.18	666.18	0.00	437062.28
2007	805.06	805.06	0.00	470149.032
2008	2462.06	2462.06	0.00	477708.298
2009	12427.55	1867.52	10560.03	482914.858
2010	509.82	481.77	28.04	508439.81
2011	546.85	536.80	10.05	534393.083
2012	144.50	127.18	17.33	568261.818
2013	1001.87	1001.87	0.00	568608.834
2014	1714.25	893.18	821.07	566471.734
2015	1001.88	1001.88	0.00	583463.859

The GHG precursors and SO_2 were computed for IMB when there had been sales of fuel for that activity. Emissions of precursor gases from IMB fuels are presented in Table 2.34. NO_X was the main indirect GHG emitted followed by CO and NMVOCs.

Table 2.34 Precursor gases emissions (Gg) trend for International Marine Bunker fuels

Year	NO_X	CO	NMVOCs	SO_2
2000	5.29765	0.49436	0.18037	1.02378
2001	1.05698	0.09863	0.03599	0.20426
2002	0.00000	0.00000	0.00000	0.00000

2003	0.00000	0.00000	0.00000	0.00000
2004	0.00000	0.00000	0.00000	0.00000
2005	0.01597	0.00149	0.00054	0.00309
2006	0.00000	0.00000	0.00000	0.00000
2007	0.00000	0.00000	0.00000	0.00000
2008	0.00000	0.00000	0.00000	0.00000
2009	265.17566	24.74527	9.02868	51.24544
2010	0.70421	0.06571	0.02398	0.13609
2011	0.25241	0.02355	0.00859	0.04878
2012	0.43506	0.04060	0.01481	0.08408
2013	0.00000	0.00000	0.00000	0.00000
2014	20.61800	1.92400	0.70200	3.98445
2015	0.00000	0.00000	0.00000	0.00000

Under this category, the direct GHGs only were computed in 2015 for International Aviation Bunkering only (Table 2.35). Total aggregated emissions were 1001.88 Gg CO_2-eq with CO_2 contributing 99.13%, CH_4 0.01% and N_2O 0.86% in the year 2015.

Table 2.35 Emissions from International Aviation Bunkers in 2015

Category	CO_2	CH_4 (Gg CO_2-eq)	N_2O (Gg CO_2-eq)	Total	CH_4 (Gg)	N_2O (Gg)
International Bunkers	993.12	0.15	8.62	1001.88	0.007	0.028
1.A.3.a.i - International Aviation (International Bunkers) (1)	993.12	0.15	8.62	1001.88	0.007	0.028

2.4.8.4. Comparison of the IPCC Tier 1 reference and sectoral approaches

The Reference Approach (RA) is a top-down approach which used Nigeria's total energy supply to calculate CO_2 emissions from fuel combustion but does not distinguish between IPCC source categories as obtained when adopting the Sectoral Approach (SA) (bottom-up approach). It is good practice to compare emissions from these two approaches as significant differences may indicate possible inconsistencies with activity data, large statistical differences between energy supply and energy consumption, significant mass imbalances and the approximate net calorific value and carbon content values adopted, unrecorded consumption of fuels, high distribution losses and missing information on stock changes. A relatively small gap (5% or less) is typically expected between the two approaches.

The differences in energy consumption between the RA and SA approaches ranged from -6.4% in 2000 to 11.4% in 2001 when the mass of all fuels is considered. In fact, the differences stemmed from liquid fuels only and stood at -9.8% in 2000 and 16.0% in 2001 as the same data were used for the gaseous and solid fuels. These were due to high statistical differences between the supply and consumption of liquid fuels due to the fact that transformation and distribution losses were not considered in both the RA and SA approaches due to lack of relevant data. Table 2.36 provides a comparison of the reference and sectoral approaches.

Table 2.36 Energy consumption from reference and sectoral approaches (Combustion Activities)

Year	Reference Approach (RA)				Sectoral Approach (SA) (1.A)				RA/SA difference			
	Liquid (TJ)	Gaseous (TJ)	Solid (TJ)	Total (TJ)	Liquid (TJ)	Gaseous (TJ)	Solid (TJ)	Total (TJ)	Liquid (%)	Gaseous (%)	Solid (%)	Total (%)
2000	290390.4	155162.5	77.4	445630.3	318751.6	155162.5	77.4	473991.5	-9.8	0.0	0.0	-6.4
2001	530985.1	210235.3	77.4	741297.8	446108.0	210235.3	77.4	656420.7	16.0	0.0	0.0	11.4
2002	504451.7	277788.1	1109.4	783349.1	440333.5	277788.0	1109.4	719231.0	12.7	0.0	0.0	8.2
2003	508160.6	282880.5	593.4	791634.5	521933.8	282880.5	593.4	805407.7	-2.7	0.0	0.0	-1.7
2004	494827.2	401472.0	206.4	896505.6	429882.1	401472.0	206.4	831560.5	13.1	0.0	0.0	7.2

2005	520113.4	632894.2	206.4	1153214.0	465466.7	632894.2	206.4	1098567.3	10.5	0.0	0.0	4.7
2006	423238.1	728264.0	206.4	1151708.5	388805.7	728264.0	206.4	1117276.1	8.1	0.0	0.0	3.0
2007	373142.6	863216.4	593.4	1236952.3	376962.7	863216.4	593.4	1240772.4	-1.0	0.0	0.0	-0.3
2008	500128.6	928431.1	825.6	1429385.3	441643.2	928431.1	825.6	1370899.9	11.7	0.0	0.0	4.1
2009	425994.1	561372.4	877.2	988243.6	405176.9	561372.3	877.2	967426.4	4.9	0.0	0.0	2.1
2010	305154.8	974504.9	980.4	1280640.1	291228.5	974504.9	980.4	1266713.8	4.6	0.0	0.0	1.1
2011	313306.6	1021940.5	825.6	1336072.7	286198.8	1021940.5	825.6	1308964.9	8.7	0.0	0.0	2.0
2012	279423.4	1099724.8	1238.4	1380386.6	244992.4	1099724.8	1238.4	1345955.5	12.3	0.0	0.0	2.5
2013	790044.6	891235.9	1135.2	1682415.8	759324.1	891235.9	1135.2	1651695.3	3.9	0.0	0.0	1.8
2014	834469.9	1076735.0	1186.8	1912391.7	827573.6	1076735.0	1186.8	1905495.4	0.8	0.0	0.0	0.4
2015	717619.9	1346629.1	1241.0	2065490.0	729702.6	1346629.0	1241.0	2077572.6	-1.7	0.0	0.0	-0.6

The differences in CO_2 emissions between RA and SA ranged from -1.5% in 2000 to 15.1% in 2001 (Table 2.37 and Figure 2.5). Negative values indicate that SA CO_2 emissions/fuel consumption are higher than RA CO_2 emissions/fuel consumption. Emissions from RA were generally higher (based on data for 15 out of the 16 years reviewed in this inventory) than emissions from SA. These results reflect the differences in the energy consumption reported in the previous paragraph and may be due to pipeline losses of liquid petroleum products during distribution which were not recorded in the national energy statistics, in addition to the other explanations provided already.

Table 2.37 Difference between CO_2 emissions from reference approach and sectoral approach

Year	Reference Approach (RA)				Sectoral Approach (SA) (1.A)				RA/SA difference			
	Liquid (TJ)	Gaseous (TJ)	Solid (TJ)	Total (TJ)	Liquid (TJ)	Gaseous (TJ)	Solid (TJ)	Total (TJ)	Liquid (%)	Gaseous (%)	Solid (%)	Total (%)
2000	22274.6	8704.6	7.3	30986.6	22753.3	8704.6	7.3	31465.3	-2.1	0.0	0.0	-1.5
2001	39503.0	11794.2	7.3	51304.5	31735.8	11794.2	7.3	43537.3	19.7	0.0	0.0	15.1
2002	37882.4	15583.9	104.9	53571.3	31206.8	15583.9	104.9	46895.6	17.6	0.0	0.0	12.5
2003	37942.9	15869.6	56.1	53868.6	37396.2	15869.6	56.1	53321.9	1.4	0.0	0.0	1.0
2004	35107.1	22522.6	19.5	57649.2	30434.5	22522.6	19.5	52976.6	13.3	0.0	0.0	8.1
2005	39159.4	35505.4	19.5	74684.3	32967.6	35505.4	19.5	68492.5	15.8	0.0	0.0	8.3
2006	30403.7	40855.6	19.5	71278.8	27437.2	40855.6	19.5	68312.3	9.8	0.0	0.0	4.2
2007	26982.1	48426.4	56.1	75464.6	26510.7	48426.4	56.1	74993.2	1.7	0.0	0.0	0.6
2008	37022.0	52085.0	78.1	89185.1	31221.8	52085.0	78.1	83384.9	15.7	0.0	0.0	6.5
2009	30783.7	31493.0	83.0	62359.7	28553.0	31493.0	83.0	60129.0	7.2	0.0	0.0	3.6
2010	24804.1	54669.7	92.7	79566.6	20581.1	54669.7	92.7	75343.6	17.0	0.0	0.0	5.3
2011	25012.9	57330.9	78.1	82421.8	20265.4	57330.9	78.1	77674.3	19.0	0.0	0.0	5.8
2012	21314.9	61694.6	117.2	83126.6	17368.3	61694.6	117.2	79180.0	18.5	0.0	0.0	4.7
2013	57165.5	49998.3	107.4	107271.2	53665.4	49998.3	107.4	103771.2	6.1	0.0	0.0	3.3
2014	61047.7	60404.8	112.3	121564.8	58524.6	60404.8	112.3	119041.7	4.1	0.0	0.0	2.1
2015	51606.0	75545.9	117.4	127269.3	51448.2	75545.9	117.4	127111.4	0.3	0.0	0.0	0.1

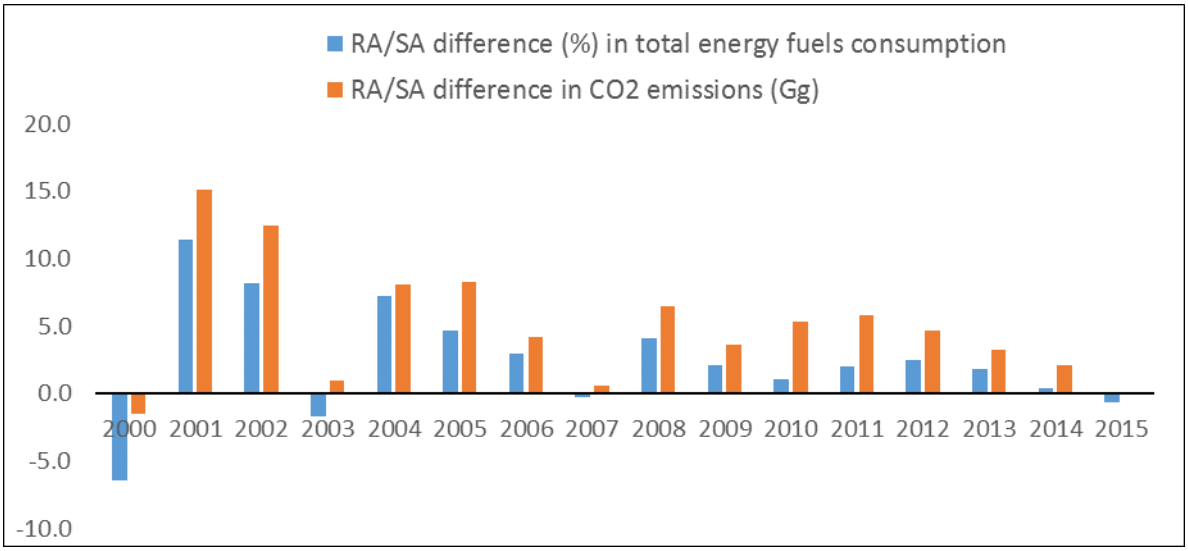

Figure 2.5 Difference (%) between reference and sectoral approaches in total energy consumption and CO_2 emissions for 2000 to 2015

Table 2.38 Energy sectoral table (Inventory Year 2015)

	Emissions (Gg)						
Categories	**CO_2**	**CH_4**	**N_2O**	**NO_X**	**CO**	**NMVOCs**	**SO_2**
1 - Energy	154670.686	1874.61	23.493	738.2	19515	3068.02	87.6661622
1.A - Fuel Combustion Activities	127111.443	1414.879	23.288	738.2	19515	2951.433	87.6661622
1.A.1 - Energy Industries	54764.7747	19.80277	2.6149	136.5	93.37	7.045995	5.49629087
1.A.1.a - Main Activity Electricity and Heat Production	45140.787	0.84309	0.0912	70.47	30.57	2.032871	3.40722788
1.A.1.a.i - Electricity Generation	45140.787	0.84309	0.0912	70.47	30.57	2.032871	3.40722788
1.A.1.a.ii - Combined Heat and Power Generation (CHP)							
1.A.1.a.iii - Heat Plants							
1.A.1.b - Petroleum Refining	519.046329	0.018546	0.0036	0.878	0.132	0.015373	2.08906299
1.A.1.c - Manufacture of Solid Fuels and Other Energy Industries	9104.94136	18.94113	2.5201	65.15	62.67	4.997751	NE
1.A.1.c.i - Manufacture of Solid Fuels		18.77883	2.5038	50.7	56.34	4.575775	NE
1.A.1.c.ii - Other Energy Industries	9104.94136	0.162298	0.0162	14.44	6.33	0.421976	NE
1.A.2 - Manufacturing Industries and Construction	23271.554	7.222795	0.9389	51.94	140.7	76.70611	1.53828645
1.A.2.a - Iron and Steel							
1.A.2.b - Non-Ferrous Metals							
1.A.2.c - Chemicals							
1.A.2.d - Pulp, Paper and Print							
1.A.2.e - Food Processing, Beverages and Tobacco							
1.A.2.f - Non-Metallic Minerals							
1.A.2.g - Transport Equipment							
1.A.2.h - Machinery							
1.A.2.i - Mining (excluding fuels) and Quarrying							
1.A.2.j - Wood and wood products							
1.A.2.k - Construction							
1.A.2.l - Textile and Leather							
1.A.2.m - Non-specified Industry							
1.A.3 - Transport	35239.5689	14.69397	1.5297	164.1	1319	144.0843	14.106032

	Emissions (Gg)						
Categories	**CO_2**	**CH_4**	**N_2O**	**NO_X**	**CO**	**NMVOCs**	**SO_2**
1.A.3.a - Civil Aviation	98.2201831	0.000687	0.0027	NE	NE	NE	NE
1.A.3.a.i - International Aviation (International Bunkers) (1)							
1.A.3.a.ii - Domestic Aviation	98.2201831	0.000687	0.0027	NE	NE	NE	NE
1.A.3.b - Road Transportation	33565.1559	14.54637	1.4578	128.7	1291	135.1034	10.5372818
1.A.3.b.i - Cars	21369.0892	10.11527	0.9877	60.94	585.8	4.87126	4.41741328
1.A.3.b.i.1 - Passenger cars with 3-way catalysts							
1.A.3.b.i.2 - Passenger cars without 3-way catalysts							
1.A.3.b.ii - Light-duty trucks	6571.55919	3.129314	0.3034	28.3	326	31.231	NE
1.A.3.b.ii.1 - Light-duty trucks with 3-way catalysts							
1.A.3.b.ii.2 - Light-duty trucks without 3-way catalysts							
1.A.3.b.iii - Heavy-duty trucks and buses	3370.64358	0.228518	0.0626	34.56	13.72	2.53193	6.11986855
1.A.3.b.iv - Motorcycles	2253.86386	1.073269	0.1041	4.875	365.4	96.4692	NE
1.A.3.b.v - Evaporative emissions from vehicles							
1.A.3.b.vi - Urea-based catalysts							
1.A.3.c - Railways	73.60353	0.004122	0.0284	1.211	0.247	0.10743	0.13861953
1.A.3.d - Water-borne Navigation	1502.58932	0.142794	0.0408	34.22	27.43	8.873474	3.43013064
1.A.3.d.i - International water-borne navigation (International bunkers) (1)							
1.A.3.d.ii - Domestic Water-borne Navigation	1502.58932	0.142794	0.0408	34.22	27.43	8.873474	3.43013064
1.A.3.e - Other Transportation							
1.A.3.e.i - Pipeline Transport							
1.A.3.e.ii - Off-road							
1.A.4 - Other Sectors	13835.5455	1373.159	18.205	385.7	17962	2723.596	66.5255529
1.A.4.a - Commercial/Institutional	1522.73701	40.84255	0.5218	19.15	81.73	42.84617	4.30586188
1.A.4.b - Residential	12284.9284	1332.313	17.683	366.2	17880	2680.719	62.1671615
1.A.4.c - Agriculture/Forestry/Fishing/Fish Farms	27.880125	0.003763	0.0002	0.302	0.1	0.03101	0.05252951
1.A.4.c.i - Stationary							
1.A.4.c.ii - Off-road Vehicles and Other Machinery	27.880125	0.003763	0.0002	0.302	0.1	0.03101	0.05252951
1.A.4.c.iii - Fishing (mobile combustion)							
1.A.5 - Non-Specified	NE	NE	NE	NE	NE	NE	NE
1.A.5.a - Stationary							
1.A.5.b - Mobile							
1.A.5.b.i - Mobile (aviation component)							
1.A.5.b.ii - Mobile (water-borne component)							
1.A.5.b.iii - Mobile (Other)							
1.A.5.c - Multilateral Operations (1)(2)							
1.B - Fugitive emissions from fuels	27559.2431	459.7309	0.2043			116.5869	
1.B.1 - Solid Fuels							
1.B.1.a - Coal mining and handling							
1.B.1.a.i - Underground mines							
1.B.1.a.i.1 - Mining							
1.B.1.a.i.2 - Post-mining seam gas emissions							
1.B.1.a.i.3 - Abandoned underground mines							
1.B.1.a.i.4 - Flaring of drained methane or conversion of methane to CO_2							
1.B.1.a.ii - Surface mines							
1.B.1.a.ii.1 - Mining							
1.B.1.a.ii.2 - Post-mining seam gas emissions							
1.B.1.b - Uncontrolled combustion and burning coal dumps							
1.B.1.c - Solid fuel transformation							
1.B.2 - Oil and Natural Gas	27559.2431	459.7309	0.2043	NE	NE	116.5869	NE

	Emissions (Gg)						
Categories	**CO_2**	**CH_4**	**N_2O**	**NO_X**	**CO**	**NMVOCs**	**SO_2**
1.B.2.a - Oil	14870.696	214.3525	0.1505	NO	NO	52.97136	NE
1.B.2.a.i - Venting	0.26454825	1.274379		NO	NO	52.97136	NE
1.B.2.a.ii - Flaring	14870.3564	212.3863	0.1505	NE	NE	NE	0
1.B.2.a.iii - All Other	0.07509086	0.691792	8E-08				
1.B.2.a.iii.1 - Exploration	0	0					
1.B.2.a.iii.2 - Production and Upgrading							
1.B.2.a.iii.3 - Transport	0.07509086	0.664092	8E-08				
1.B.2.a.iii.4 - Refining	0	0.0277					
1.B.2.a.iii.5 - Distribution of oil products							
1.B.2.a.iii.6 - Other							
1.B.2.b - Natural Gas	12688.5471	245.3784	0.0538	0	0	63.6155	0
1.B.2.b.i - Venting	5600.95632	18.8928		NO	NO	13.11693	NE
1.B.2.b.ii - Flaring	7083.18761	141.4929	0.0538	NE	NE	41.48671	NE
1.B.2.b.iii - All Other	4.40318522	84.99273				9.011852	NE
1.B.2.b.iii.1 - Exploration	0	0					
1.B.2.b.iii.2 - Production							
1.B.2.b.iii.3 - Processing							
1.B.2.b.iii.4 - Transmission and Storage	0.00891625	2.168817				4.819593	NE
1.B.2.b.iii.5 - Distribution	4.39426898	82.82392				4.192259	NE
1.B.2.b.iii.6 - Other							
1.B.3 - Other emissions from Energy Production	NO						
1.C - Carbon Dioxide Transport and Storage							
1.C.1 - Transport of CO_2							
1.C.1.a - Pipelines							
1.C.1.b - Ships							
1.C.1.c - Other (please specify)							
1.C.2 - Injection and Storage	NO						
1.C.2.a - Injection							
1.C.2.b - Storage							
1.C.3 - Other							

	Emissions (Gg)						
Categories	**CO_2**	**CH_4**	**N_2O**	**NO_X**	**CO**	**NMVOCs**	**SO_2**
Memo Items (3)							
International Bunkers	993.116124	0.006945	0.0278	0	0	0	0
1.A.3.a.i - International Aviation (International Bunkers) (1)	993.116124	0.006945	0.0278	0	0	0	0
1.A.3.d.i - International water-borne navigation (International bunkers) (1)	0	0	0	0	0	0	0
1.A.5.c - Multilateral Operations (1)(2)				0	0	0	0
Information Items							
CO_2 from Biomass Combustion for Energy Production	583463.859						

2.5. Industrial Processes and Product Use

The IPPU sector comprises GHG emitted as by-products during industrial processes for the manufacture of new products. Coverage of this sector has improved from the mineral sub-category cement industry only in the SNC to include activities in the metal and chemical sub-categories in this BUR1. Due to data challenges, emissions have not been estimated for some subcategories. Full details on the coverage of the IPPU sector is provided under Completeness in this chapter.

The categories considered are :

- Mineral Industry - Cement Production
- Chemical Industry - Ammonia Production
- Metal Industry - Iron and Steel Production

2.5.1. Methodology

The 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 3 (IPCC, 2006) were used in conjunction with the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2001). The decision tree in each source category was used to determine the tier level to be adopted for computing the GHG emissions. Tier 1 level was adopted due to data scarcity and lack of national emission factors. Hence, IPCC default emission factors were used. Activity data for the industrial processes covered in this inventory were obtained mainly from the National Bureau of Statistics (NBS) supplemented by information from the manufacturers of the products.

The formula used for computing emissions is:

$$\textbf{Emissions} = \sum Aj * Efi$$

Where:

A = Activity = Production Process Input (tonnes/year); J = Industrial Activity;
EF = Emission factor (t/kt) and i = GHG or precursor.

2.5.2. Emissions

Total aggregated emissions for the IPPU sector,

Table 2.39, ranged between 1553.98 Gg CO_2-eq and 13267.14 Gg CO_2-eq during the period 2000 to 2015 with an annual average of 6932 Gg CO_2-eq . While it can be inferred that CO_2 emissions increased by nearly 6 times from 2325 Gg in the year 2000 to 13,255 in 2015 and CH_4 increased 4 times from 3.19 Gg CO_2-eq to 12.22 Gg CO_2-eq over the same time period. Otherwise, CO_2 represents 99.99% of all GHG emissions of the IPPU sector in 2015 with the remaining 0.01% represented by CH_4.

Table 2.39 Emissions of CO_2 and CH_4 (Gg CO_2-eq) for the IPPU sector (2000 to 2015)

Years	CO_2	CH_4	Total
2000	2324.75	3.19	2327.94
2001	1552.32	1.66	1553.98
2002	2658.50	3.91	2662.41
2003	7131.79	12.83	7144.62
2004	3079.83	4.57	3084.40
2005	4768.72	7.59	4776.31
2006	6575.41	10.93	6586.34
2007	6907.29	10.65	6917.94
2008	3112.47	1.97	3114.44
2009	6515.03	3.21	6518.24
2010	8234.40	9.72	8244.12
2011	9113.59	10.22	9123.81
2012	10820.76	10.72	10831.48
2013	12278.73	11.22	12289.95
2014	12452.77	11.72	12464.49
2015	13254.92	12.22	13267.14

Emissions of CO_2 and CH_4 (Gg CO_2-eq) for the IPPU sector (2000 to 2015) are presented in Table 2.40. In 2015, the cement industry was responsible for 53.4% of the aggregated (total) emissions followed by the iron and steel industry with 46.6%. The contribution of the ammonia industry was marginal (Table 2.40).

Table 2.40 Emissions (Gg CO_2-eq) by sub-category for the IPPU sector (2000 to 2015)

Year	Cement (CO_2)	Ammonia (CO_2)	Iron and Steel (CH_4)	Iron and steel (CO_2)	Total
2000	713.60	2.82	3.19	1608.33	2327.94
2001	714.46	1.20	1.66	836.66	1553.98
2002	682.50	2.27	3.91	1973.73	2662.41
2003	652.84	1.66	12.83	6477.29	7144.62
2004	770.16	1.80	4.57	2307.87	3084.40
2005	938.89	1.62	7.59	3828.21	4776.31
2006	1057.53	1.63	10.93	5516.25	6586.34
2007	1529.77	1.63	10.65	5375.89	6917.94
2008	2117.36	1.64	1.97	993.47	3114.44
2009	2621.57	1.65	3.21	3891.81	6518.24
2010	3328.46	1.66	9.72	4904.28	8244.12
2011	3954.53	1.67	10.22	5157.39	9123.81
2012	5408.57	1.68	10.72	5410.51	10831.48
2013	6613.41	1.69	11.22	5663.63	12289.95
2014	6534.32	1.70	11.72	5916.75	12464.49
2015	7083.35	1.71	12.22	6169.86	13267.14

With regards to the GHG precursors CO, NO_x and NMVOCs, the emissions were insignificant during the period under review for the IPPU sector. NMVOC attained a value of 0.87 Gg in 2015 (Table 2.41).

Table 2.41 Emissions of GHG precursors of the IPPU sector (2000 – 2015)

Year	CO (Gg)	NO_x (Gg)	NMVOC (Gg)
2000	0.00008629	0.00086	0.23
2001	0.00003681	0.00037	0.12
2002	0.00006948	0.00070	0.28
2003	0.00005064	0.00051	0.92
2004	0.00005501	0.00055	0.33
2005	0.00004942	0.00049	0.54
2006	0.00004969	0.00050	0.78
2007	0.00004997	0.00050	0.76
2008	0.00005025	0.00050	0.14
2009	0.00005023	0.00051	0.55
2010	0.00005081	0.00051	0.69
2011	0.00005109	0.00051	0.73
2012	0.00005137	0.00051	0.77
2013	0.00005166	0.00052	0.80
2014	0.00005195	0.00052	0.84
2015	0.00005223	0.00052	0.87

2.5.3. Mineral Category (2A) – Cement Production (2.A.1)

Lime is produced by thermal decomposition of limestone, which is mainly calcium carbonate ($CaCO_3$). This process also known as calcination (equation below), produces lime (CaO) and CO_2 as by-product:

$$CaCO_3 + Heat \leftrightarrow CaO + CO_2$$

The CaO then reacts with silica (SiO_2), alumina (Al_2O_3) and iron oxide (Fe_2O_3) as other raw materials to make the clinker minerals (chiefly calcium silicates). This product is finely ground, along with a small proportion of calcium sulfate [gypsum ($CaSO_4 \cdot 2H_2O$) or anhydrite ($CaSO_4$)], into hydraulic (typically portland) cement. CO_2 is the main GHG emitted in cement production and it is emitted during calcination. Based on the decision tree in the IPCC 2006 Guidelines, Tier 1 methodology was used in this estimation due to data constraints.

Data on the production of cement from 2000 to 2015 were collected from Cement Manufacturers Association of Nigeria (CMAN) and presented in Table 2.42. For the period under review, there was no importation or exportation of clinker.

Table 2.42 Production of Cement (tonnes 10^3) from 2000-2015

Year	2000	2001	2002	2003	2004	2005	2006	2007
Production	2165	2168	2071	1981	2337	2849	3209	4642

Year	2008	2009	2010	2011	2012	2013	2014	2014
Production	6425	7955	10100	12001	16412	20068	19828	21494

Source: Cement Manufacturers Association of Nigeria

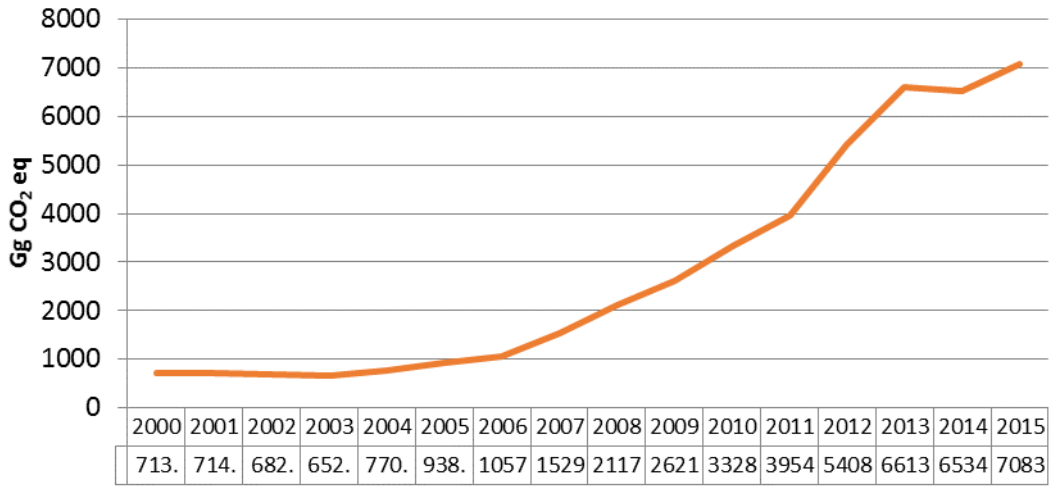

Figure 2.6 CO_2 Emission (Gg) in Cement Production from 2000-2015

The highest emission of 7,083.35 Gg CO_2 for the period under review was recorded in 2015 and was generated from the production of 21,494,000 tonnes of cement (CMAN, 2012). The lowest emission of 652.84 Gg CO_2 was in 2003 from 1,981,000 tonnes of cement (CMAN, 2012).

2.5.4. Chemical Industry (2.B) - Ammonia Production (2.B.1)

Ammonia (NH_3) is produced by catalytic steam reforming of natural gas or other fuels. When natural gas (CH_4) is used as feedstock, nitrogen and hydrogen undergo chemical reaction in the ratio 1:3. CO_2 is the only GHG emitted during ammonia production. The basic equations are:

Overall Reaction: $0.88\ CH_4 + 1.26\ Air + 1.24\ H_2O \rightarrow 0.88\ CO_2 + N_2 + 3H_2$

Ammonia Synthesis: $N_2 + 3H_2 \rightarrow 2NH_3$

Data obtained from the National Bureau of Statistics (NBS) on ammonia production was incomplete for our time series as it only covered from 2000 to 2008. Therefore, we have used a growth rate of 0.55% of the available data (2000-2005) to estimate for years 2006 to 2015. Data on ammonia production used for estimating emissions for the period 2001-2015 are presented in Table 2.43.

Table 2.43 Production of Ammonia (tonnes) during the period 2001-2015

Year	2000	2001	2002	2003	2005	2005	2006	2007
Production	863	368	695	506	550	494	497	500
Year	2008	2009	2010	2011	2012	2013	2014	2014
Production	502	505	508	511	514	517	519	522

Source: National Bureau of Statistics

Based on the decision tree in the IPCC 2006 Guidelines (V3_3_Ch3_p 3.14), due to lack of information on the quantity of fuel required for ammonia production, the Tier 1 methodology was adopted. In this method, it is recommended that the average value of fuel requirement stated in Table 3.1 of *the 2006 IPCC* Guidelines (IPCC, 2006), i.e. 42.5 GJ(NCV)/tonne NH_3) should be used. The corresponding values of carbon content of fuel used for production and carbon oxidation factors of the fuel according to the Tier 1 method are 21kg/GJ and 1 fraction respectively.

The general equation using Tier 1 method used to estimate the emissions associated with ammonia production is:

$$ECO_2 = AP^* FR^* CCF^* COF^*44/12 - RCO_2$$

Where:

ECO_2 = Emission of $C0_2$, kg ;
AP = Ammonia production, tonnes
FR = Fuel requirement per unit of output, GJ/tonne NH_3 produced
CCF = Carbon content factor of the fuel, kg C/GJ;
COF = Carbon oxidation factor of the fuel, fraction
RCO_2 = CO_2 recovered for downstream use (urea production) kg.

2.5.5. Emissions from Ammonia Production for the Period 2000 - 2015

Emissions of the CO_2 and the GHG precursors CO and NO_X emitted during the production of ammonia (NH_3) for 2000-2015 are presented in Table 2.44 . The highest CO_2 emission of 2.82 Gg CO_2 was produced from 863 tonnes of NH_3 in 2000. The year with the least amount of emissions was 2001 with 1.20 Gg of CO_2 emitted as a result of the production of 368 tonnes only. The highest emission of CO obtained was in year 2000 with an emission of 0.0000863 Gg while the lowest emission of 0.0000368 Gg was recorded the year 2001. NO_X emissions followed the same trend as CO with the highest in 2000 with an emission of 0.0008630Gg and the lowest emission of 0.0003680Gg recorded in 2001.

Table 2.44 Emissions of CO_2, CO and NO_X (Gg) for NH3 production (2000 -2015)

Year	CO_2 emissions	CO Emissions	NO_X emssions
2000	2.820	0.0000863	0.0008630
2001	1.200	0.0000368	0.0003680
2002	2.270	0.0000695	0.0006950
2003	1.660	0.0000506	0.0005060
2004	1.800	0.0000550	0.0005500
2005	1.620	0.0000494	0.0004940
2006	1.630	0.0000497	0.0004969
2007	1.630	0.0000500	0.0004997
2008	1.640	0.0000502	0.0005025
2009	1.650	0.0000502	0.0005053
2010	1.660	0.0000508	0.0005081
2011	1.670	0.0000511	0.0005109
2012	1.680	0.0000514	0.0005137
2013	1.690	0.0000517	0.0005166
2014	1.700	0.0000519	0.0005195
2015	1.710	0.0000522	0.0005223

2.5.6. Metal Industry (2.C) - Iron and Steel Production (2.C.1)

Data on iron and steel production between 2000 and 2008 with exception of 2005 was provided by National Bureau of Statistics (NBS). The Good Practice Guidance which offers extrapolation as an appropriate splicing technique for filing out gaps in the time series was consulted. A linear regression equation obtained from the available data was used to determine the activity data for the missing years (Table 2.45). The estimated GHG emissions in iron and steel production was carried out using the data presented in Table 2.46. Iron and steel productions emits three (CO_2, CH_4 and N_2O) GHGs.

Table 2.45 Production of iron and steel (tonnes) for the period 2000-2015

Year	2000	2001	2002	2003	2004	2005	2006	2007
Production	1,517,288	789,300	1,862,006	6,110,651	2,177,235	3,611,523	5,204,007	5,071,596

Year	2008	2009	2010	2011	2012	2013	2014	2015
Production	937,238	3,671,523	4,626,679	4,865,468	5,104,257	5,343,046	5,581,835	5,820,624

Sources: National Bureau of Statistics ***and Extrapolation based on Good Practice Guidance for filling gaps and linear regression equation.***

Three GHGs (CO_2, CH_4 and N_2O) are emitted during iron and steel production but only CO_2 and CH_4 were compiled. Based on the decision tree of the IPCC 2006 Guidelines (V3_4_Ch4_p 4.20), a Tier 1 approach was used due to lack of plant specific data. Use was made of the Global Average Factors (65% BOF, 30% EAF and 5% OHF) for an emission factor of 1.06 to estimate the CO_2 emissions from steelmaking.

In line with the *Good Practice Guidance*, average emission factor of BOF, EAF and OHF was used in the calculation.

Where:

BOF=Basic Oxygen Furnance, EAF=Electric Arc Furnance & OHF=Open hearth Furnance

$$E_{CO_2} = EF * AM_{I\&S}$$

and:

ECO_2 =Emission of CO_2 (Gg); EF=Emission factor (tonne CO_2/tonnes produced)
AM=Amount of iron and steel produced (tonnes)

The 2006 IPCC Guidelines recommend a default emission factor of 0.1 for coke production when adopting Tier 1 estimation method. This emission factor is used in the estimation of CH_4 emission.

The estimation of NMVOC was carried out using one of the methods provided in the 2016 EMEP/EEA . Tier 1 method was chosen for the estimation based on the available information. The 2016 EMEP/EEA recommended default emission factors of 150g/mg for NMVOC in iron and steel was used. The general equation presented below was used to estimate NMVOC emission in iron and steel production:

$$E_{pollutant} = AR_{production} * EF_{pollutant}$$

Where:

$E_{pollutant}$ = The emission of NMVOC
$AR_{production}$ = Amount of iron and steel produced yearly in tonnes
$EF_{pollutant}$ = Emission factor of NMVOC

The highest CO_2 emissions obtained was in the year 2003 with 6477 Gg from production of 6,110,651 tonnes of Iron and Steel. The lowest CO_2 emission of 836.66 Gg CO_2 was recorded in year 2001 from an annual Iron and Steel production of 789,300 tonnes.

CH_4 emissions fluctuated around an average of 0.152 Gg CH_4 equivalent to 0.582 Gg CO_2 annually over the period 2000 to 2015. The highest emitting year was 2003 with an emission of 0.611 Gg of CH_4 (12.83 Gg CO_2-eq), while the lowest emission of 0.079 Gg CH_4 (1.66 Gg CO_2-eq) was recorded in year 2001. NMVOC emissions varied from 0.23 Gg in the year 2000 to 0.87 in 2015.

Table 2.46 Emissions of CO_2 and CH_4 from Iron and Steel Production (2000 – 2015)

Year	CO_2 (Gg)	CH_4 (Gg)	CH_4 (Gg CO_2-eq)	NMVOCs (Gg)
2000	1608.33	0.152	3.19	0.23
2001	836.66	0.079	1.66	0.12
2002	1973.73	0.186	3.91	0.28
2003	6477.29	0.611	12.83	0.92
2004	2307.87	0.218	4.57	0.33
2005	3828.21	0.361	7.59	0.54
2006	5516.25	0.520	10.93	0.78
2007	5375.89	0.507	10.65	0.76
2008	993.47	0.094	1.97	0.14
2009	3891.81	0.153	3.22	0.55
2010	4904.28	0.463	9.72	0.69
2011	5157.39	0.487	10.22	0.73
2012	5410.51	0.510	10.72	0.77
2013	5663.63	0.534	11.22	0.80
2014	5916.75	0.558	11.72	0.84
2015	6169.86	0.582	12.22	0.87

Table 2.47 IPPU sectoral (Inventory Year 2015)

Categories	(Gg)			CO_2 Equivalents (Gg)				(Gg)				
	CO_2	CH_4	N_2O	HFCs	PFCs	SF6	Other halogenated gases with CO_2 equivalent conversion factors (1)	Other halogenated gases without CO_2 equivalent conversion factors (2)	NO_X	CO	NMVOCs	SO_2
2 - Industrial Processes and Product Use	13254.9208	0.5820624	0	0	0	0	0	0	0.00052234	0.000052234	0.87	0
2.A - Mineral Industry	7083.3477	0	0	0	0	0	0	0	0	0	0	0
2.A.1 - Cement production	7083.3477								0	0	0	0
2.A.2 - Lime production	0								0	0	0	0
2.A.3 - Glass Production	0								0	0	0	0
2.A.4 - Other Process Uses of Carbonates	0	0	0	0	0	0	0	0	0	0	0	0
2.A.4.a - Ceramics	0								0	0	0	0
2.A.4.b - Other Uses of Soda Ash	0								0	0	0	0
2.A.4.c - Non Metallurgical Magnesia Production	0								0	0	0	0
2.A.4.d - Other (please specify) (3)	0								0	0	0	0
2.A.5 - Other (please specify) (3)									0	0	0	0
2.B - Chemical Industry	1.70936	0	0	0	0	0	0	0	0.00052234	0.000052234	0	0
2.B.1 - Ammonia Production	1.70936								0.00052234	0.000052234	0	0
2.B.2 - Nitric Acid Production			0						0	0	0	0
2.B.3 - Adipic Acid Production			0						0	0	0	0
2.B.4 - Caprolactam, Glyoxal and Glyoxylic Acid Production			0						0	0	0	0
2.B.5 - Carbide Production	0	0							0	0	0	0
2.B.6 - Titanium Dioxide Production	0								0	0	0	0

Categories	(Gg)			CO_2 Equivalents (Gg)				(Gg)				
	CO_2	CH_4	N_2O	HFCs	PFCs	SF6	Other halogenated gases with CO_2 equivalent conversion factors (1)	Other halogenated gases without CO_2 equivalent conversion factors (2)	NO_X	CO	NMVOCs	SO_2
2.B.7 - Soda Ash Production	0								0	0	0	0
2.B.8 - Petrochemical and Carbon Black Production	0	0	0	0	0	0	0	0	0	0	0	0
2.B.8.a - Methanol	0	0							0	0	0	0
2.B.8.b - Ethylene	0	0							0	0	0	0
2.B.8.c - Ethylene Dichloride and Vinyl Chloride Monomer	0	0							0	0	0	0
2.B.8.d - Ethylene Oxide	0	0							0	0	0	0
2.B.8.e - Acrylonitrile	0	0							0	0	0	0
2.B.8.f - Carbon Black	0	0							0	0	0	0
2.B.9 - Fluorochemical Production	0	0	0	0	0	0	0	0	0	0	0	0
2.B.9.a - By-product emissions (4)				0					0	0	0	0
2.B.9.b - Fugitive Emissions (4)									0	0	0	0
2.B.10 - Other (Please specify) (3)									0	0	0	0
2.C - Metal Industry	6169.86144	0.5820624	0	0	0	0	0	0	0	0	0.87	0
2.C.1 - Iron and Steel Production	6169.86144	0.5820624							0	0	0.87	0
2.C.2 - Ferroalloys Production	0	0							0	0	0	0
2.C.3 - Aluminium production	0				0				0	0	0	0
2.C.4 - Magnesium production (5)	0					0			0	0	0	0
2.C.5 - Lead Production	0								0	0	0	0
2.C.6 - Zinc Production	0								0	0	0	0
2.C.7 - Other (please specify) (3)									0	0	0	0
2.D - Non-Energy Products from Fuels and Solvent Use (6)	0	0	0	0	0	0	0	0	0	0	0	0
2.D.1 - Lubricant Use	0								0	0	0	0
2.D.2 - Paraffin Wax Use	0								0	0	0	0
2.D.3 - Solvent Use (7)									0	0	0	0
2.D.4 - Other (please specify) (3), (8)									0	0	0	0
2.E - Electronics Industry	0	0	0	0	0	0	0	0	0	0	0	0
2.E.1 - Integrated Circuit or Semiconductor (9)				0	0	0		0	0	0	0	0
2.E.2 - TFT Flat Panel Display (9)					0	0		0	0	0	0	0
2.E.3 - Photovoltaics (9)					0				0	0	0	0
2.E.4 - Heat Transfer Fluid (10)					0				0	0	0	0
2.E.5 - Other (please specify) (3)									0	0	0	0
2.F - Product Uses as Substitutes for Ozone Depleting Substances	0	0	0	0	0	0	0	0	0	0	0	0
2.F.1 - Refrigeration and Air Conditioning	0	0	0	0	0	0	0	0	0	0	0	0
2.F.1.a - Refrigeration and Stationary Air Conditioning				0					0	0	0	0
2.F.1.b - Mobile Air Conditioning				0					0	0	0	0
2.F.2 - Foam Blowing Agents				0				0	0	0	0	0
2.F.3 - Fire Protection				0	0				0	0	0	0
2.F.4 - Aerosols				0				0	0	0	0	0
2.F.5 - Solvents				0	0			0	0	0	0	0
2.F.6 - Other Applications (please specify) (3)				0	0			0	0	0	0	0
2.G - Other Product Manufacture and Use	0	0	0	0	0	0	0	0	0	0	0	0

Categories	(Gg)			CO_2 Equivalents (Gg)				(Gg)				
	CO_2	CH_4	N_2O	HFCs	PFCs	SF6	Other halogenated gases with CO_2 equivalent conversion factors (1)	Other halogenated gases without CO_2 equivalent conversion factors (2)	NO_X	CO	NMVOCs	SO_2
2.G.1 - Electrical Equipment	0	0	0	0	0	0	0	0	0	0	0	0
2.G.1.a - Manufacture of Electrical Equipment					0	0			0	0	0	0
2.G.1.b - Use of Electrical Equipment					0	0			0	0	0	0
2.G.1.c - Disposal of Electrical Equipment					0	0			0	0	0	0
2.G.2 - SF6 and PFCs from Other Product Uses	0	0	0	0	0	0	0	0	0	0	0	0
2.G.2.a - Military Applications					0	0			0	0	0	0
2.G.2.b - Accelerators					0	0			0	0	0	0
2.G.2.c - Other (please specify) (3)					0	0			0	0	0	0
2.G.3 - N_2O from Product Uses	0	0	0	0	0	0	0	0	0	0	0	0
2.G.3.a - Medical Applications			0						0	0	0	0
2.G.3.b - Propellant for pressure and aerosol products			0						0	0	0	0
2.G.3.c - Other (Please specify) (3)			0						0	0	0	0
2.G.4 - Other (Please specify) (3)									0	0	0	0
2.H - Other	0	0	0	0	0	0	0	0	0	0	0	0
2.H.1 - Pulp and Paper Industry									0	0	0	0
2.H.2 - Food and Beverages Industry									0	0	0	0
2.H.3 - Other (please specify) (3)									0	0	0	0

2.6. Agricuture, Forestry and Other Land Use (AFOLU)

The activities in the AFOLU sector are among the main contributors to emission of greenhouse gases in Nigeria which makes it a key category.

The AFOLU sector comprises four subcategories:

- Livestock (3.A)
- Land (3.B)
- Aggregated sources and non-CO_2 emissions from land (3.C)
- Other (3.D)

For this inventory, livestock (3.A), and Aggregated sources and non-CO_2 emissions from land (3.C) subcategories were fully covered. For land (3.B), emissions from changes within Forestland only was estimated. Under Other (3.D) removals for harvested wood products (HWP) only was estimated.

2.6.1. Data Sources and Methodology

The data needed for this inventory were sourced from different relevant national and international institutions as presented in Table 2.48.

Table 2.48 Data and data sources

Category	Sub-category	Data Type	Data Source	Principal Data Provider
Livestock	Enteric Fermentation	Animal population (Cattle, goats, sheep, asses and mules, camels, swine, horses and poultry	FAOSTAT[8]	FAO
	Manure Management			
Land	Forest Land	Forest area	FAOSTAT	FAO
		Climate zone and soil classification	IPCC software	IPCC
		Biomass estimate for 5 IPCC pools (above-ground biomass, below-ground biomass, deadwood, herb, litter and soil	IPCC software	IPCC
		Harvested Wood Products	FAOSTAT	FAO
		Wood/Fuel wood removal	FAOSTAT	FAO
Aggregated and non-CO_2 emission on land	Biomass burning	Actual mass of savannah and crop residues burnt	FAOSTAT	FAO
	Direct N_2O emission from managed soil	Synthetic fertilizer consumption	FAOSTAT	FAO
	Indirect N_2O emission from managed soil	Crop land area	FORMECU	Forestry Department, Federal Ministry of Agriculture and Rural Department (FMARD)
	Indirect emission from manure management	Animal population (Cattle, goats, sheep, asses and mules, camels, swine, horses and poultry	FAOSTAT	FAO
	Rice cultivation	Area of land cultivated	FAOSTAT	FAO

2.6.2. Filling of Data Gaps

Gaps identified in the inventory were filled using appropriate IPCC methodology for filling of data gaps. The specific method employed in filling the gaps was selected based on the nature and type of gaps. A highlight of the approach adopted is presented in

Table 2.49.

Table 2.49 Data gaps and methods used in filling them

Category	Data gap	Method applied	Justification for method used	Description of approach for filling of gaps
Enteric fermentation and manure management (3.A1	Lack of data on population of all the animals	Extrapolation	Data from FAOSTAT were only available for 2000-2014	The annual average derived from the number of animals from 2014-2009 was added to

[8] http://faostat.fao.org/ (Accessed, February, 2017)

and 3.A2	for 2015			the value of 2014 to generate the 2015 figure for all the animals.
Nitrogen Fertilizers (3.C.4)	Lack of data for 2015	Extrapolation	Data from FAOSTAT were only available for 2000-2014	Data from other years had to be extrapolated based on the mean percentage annual conversion between 2009-2014
Biomass burning in crop land and grassland (3.C.1.b and 3.C.1.c)	Lack of data for 2015	Extrapolation	Data from FAOSTAT were only available for 2000-2014	Data from other years had to be extrapolated based on the mean percentage annual conversion between 2009-2014

2.6.3. Quality Control/Quality Assurance

The QC/QA procedures followed in the AFOLU sector are presented in Table 2.50.

Table 2.50 QC/QA implemented

Data type	QC/QA Procedures	Remarks/examples
Activity data check	Comparison of data from different sources to ensure validity.	No other source for comparison since all the data used for the estimation were from FAOSTAT except that of crop land which was only from Forestry Management and Environmental Coordinating Unit (FORMECU) of the Federal Ministry of Environment
	Check for error transcription, transposition and typographical error	There was cross-checking by other team members before data were used.
	Consistency checks of categories and sub categories with totals	Ensuring that the figures from the sub categories and categories add up to the overall total.
	Document all data sources, data format and assumptions for easy reference	This record helps in easy cross-referencing
	Ensure reduction in data clumsiness or data redundancy.	• For easy understanding and further probing of how the final results would be like in the IPCC software. • Easy cross-referencing to avoid mistakes. • Easy transfer into the IPCC software. • Better interpretation and implication of data used
Calculations by the approved 2006 IPCC software	Cross-checks of all steps involved in the calculations	Ensure that all steps taken to determine, estimate and derive data are accurate, transparent and consistent internally.
	Documentation of sources and correct units	Use of documentation template to record all data sources and assumptions
	Check for error transcription, transposition and typographical error	Check mistakes in impute of data into the software
	Check completeness of data coverage	Ensure all relevant gases for specific activity were covered
Emissions	Identify awkward results	Checking of trends and levels.
Documentation	Assumption and correction of data and sources	Ensure consistency, transparency, facilitate reproducibility and easy retrieval
	Recommendations due to findings	Give adequate attention to priority areas

2.6.4. Methodology

Tier 1 was adopted for the estimation of emissions/removals in the AFOLU sector as there were no reliable country-specific data. Activity data here refers to the intensity, level or quantity of activity that led to emissions/removals of GHGs while emission factor represents the rate at which a particular GHG is emitted or removed as a result of use of,

change of and level of intensity/frequency of use/number of activity will generate/remove GHGs under certain defined conditions. Therefore, the product of activity data and emission factor gives the total GHG emission for a particular activity.

E=AD*EF
Where,
E= Emission; AD= Activity Data; EF= Emission/removal factor.

Extrapolation and interpolation techniques were used in line with IPCC good practice guidance (GPG)[9] to generate missing data of the time series. In cases where there were no data, expert judgment was applied and the assumption was documented.

2.6.5. Emission Trends in the AFOLU Sector

Emissions of the three main GHGs and removals of CO_2 by gas for the period 2000 - 2015 for the AFOLU sector is presented in Table 2.51. Net emissions amounted to 418811 Gg for CO_2, 1660 Gg for CH_4 and 75 Gg for N_2O. CO_2 emissions and removals increased by 25% over this time period while removals through HWPs concurrently regressed by 28%. Both CH_4 and N_2O emissions increased by 37%.

Table 2.51 Emissions and removals (Gg) by gas for the AFOLU sector for the period 2000-2015

Year	CO_2 emissions	CO_2 removals	Net CO_2 emissions	CH_4 emissions	N20 emissions
2000	338092	-3653	334439	1210	55
2001	343605	-3567	340038	1156	55
2002	349240	-3463	345777	1177	55
2003	354999	-3447	351551	1188	56
2004	360883	-3386	357497	1277	57
2005	366895	-3245	363650	1266	61
2006	372450	-3175	369275	1309	62
2007	378112	-3161	374951	1295	60
2008	388475	-3071	385404	1301	62
2009	389791	-3012	386778	1262	63
2010	395807	-2897	392911	1360	69
2011	398926	-3007	395919	1488	72
2012	404533	-2661	401872	1626	74
2013	410153	-2758	407395	1605	81
2014	452701	-2702	449999	1630	78
2015	421434	-2623	418811	1660	75

Aggregated emissions by gas for the AFOLU sector is presented in Table 2.52. In 2015, total AFOLU emissions attained 479571 Gg CO_2-eq with CO_2 contributing 421434 Gg CO_2-eq, CH_4 for 34857 Gg CO_2-eq and N_2O for 23280 Gg CO_2-eq. CO_2 stayed as the main gas emitted over the full period 2000-2015 with about 90% of total annual emissions followed by CH_4 with about 6% and N_2O with about 4%.

[9] Ipcc-nggip.iges.or.jp/public/gp/English/index.html (Accessed March, 2017)

Table 2.52 Aggregated Emissions by Gas (Gg CO_2-eq) for the AFOLU Sector for the period 2000 - 2015

Year	CO_2	CH_4	N_2O	Total
2000	338092	25408	17015	380514
2001	343605	24268	17083	384956
2002	349240	24712	17180	391132
2003	354999	24955	17349	397303
2004	360883	26808	17773	405464
2005	366895	26590	18771	412256
2006	372450	27497	19159	419106
2007	378112	27204	18559	423875
2008	388475	27313	19219	435007
2009	389791	26510	19491	435793
2010	395808	28554	21372	445734
2011	398926	31249	22375	452550
2012	404533	34146	23025	461704
2013	410153	33705	25027	468886
2014	452701	34233	24268	511201
2015	421434	34857	23280	479571

Emissions and removals by source categories of the AFOLU sector is given in Table 2.53. In 2015, net emissions from the AFOLU sector were 476948 Gg CO_2-eq, the highest for the entire period under consideration. Compared to the 2000 emissions (376861 Gg CO_2-eq), those of 2015 represented an increase of about 27%. This increase was attributed to (a) the increase in livestock populations, (b) increased consumption of nitrogen based synthetic fertilizers and (c) forest biomass loss.

Emissions from Forestland remaining Forestland represented 88% of 2015 emissions which amounted to 476947 Gg CO_2-eq. The next contributors were Livestock and Aggregated sources and non-CO_2 emission sources on land with 6% each. Harvested wood products removed 0.5% of emissions.

Table 2.53 Emissions and removals (Gg CO_2-eq) by source categories of the AFOLU sector

Year	Livestock (3A)	Land (3B)	Aggregated sources and non-CO_2 emission sources on land (3C)	Other (3D)	Net emissions
2000	21877	338092	20545	-3653	376861
2001	20908	343605	20444	-3567	381390
2002	21199	349240	20693	-3463	387670
2003	21337	354999	20967	-3447	393856
2004	22985	360883	21595	-3386	402077
2005	22470	366895	22890	-3245	409010
2006	22886	372450	23770	-3175	415931
2007	23262	378112	22502	-3161	420714
2008	23565	388475	22967	-3071	431936
2009	24063	389791	21939	-3012	432780
2010	25401	395807	24526	-2897	442837
2011	28005	398926	25618	-3007	449542
2012	29424	404533	27747	-2661	459043

Year	Livestock (3A)	Land (3B)	Aggregated sources and non-CO_2 emission sources on land (3C)	Other (3D)	Net emissions
2013	29039	410153	29693	-2758	466128
2014	29200	452701	29301	-2702	508500
2015	29375	421434	28762	-2623	476948

2.6.5.1. Livestock (3.A)

Emissions from livestock are generated through enteric fermentation and manure management from domestic animals such as cattle, sheep, goats, horses, swine, donkeys (asses and mules), camels and poultry. Total emissions from livestock increased from 21877 Gg CO_2-eq in 2000. Enteric fermentation constituted an overall average of about 90% of the total emissions from livestock and manure management contributed the remaining 10% (Figure 2.7).

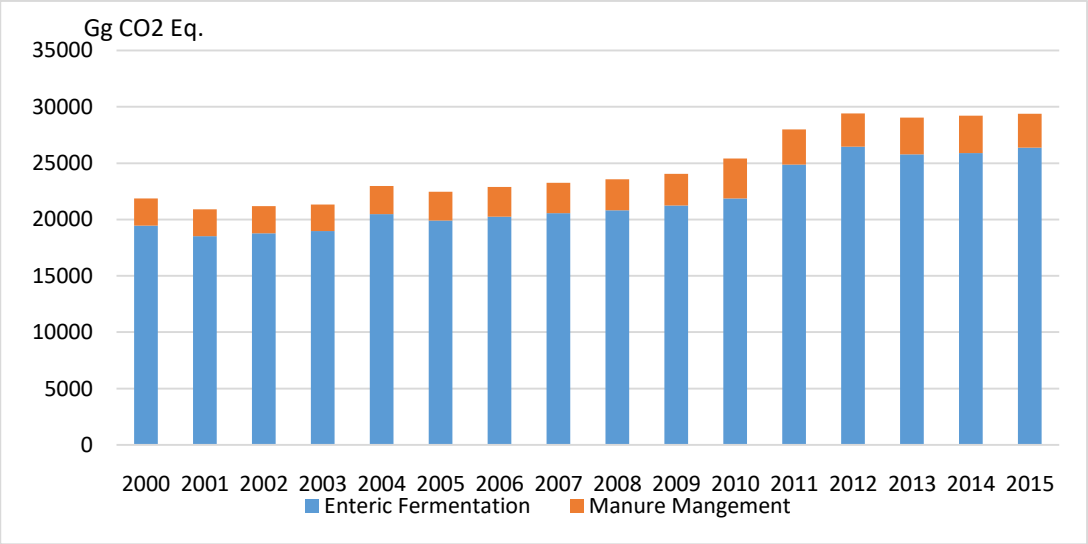

Figure 2.7 Total Emission Trend for Livestock, 2000-2015 and Mode of Generation

Enteric Fermentation (3.A.1)

Significant amounts of CH_4 are produced by herbivores during the normal digestive process as microorganisms break down carbohydrates into simpler molecules for absorption. CH_4 is produced as a by-product. Ruminant animals such as cattle generate the most methane while non-ruminant animals such as swine generate minimal amounts.

Emissions from enteric fermentation were calculated using IPCC Tier 1 methodology and default emission factors. This was done by multiplying the individual animal population with the default emission factor of the respective animal type for the specific activity. Activity data used for computing the emissions for both enteric fermentation and manure management are provided in Table 2.54 above.

The total emissions from enteric fermentation in 2015 was 26379 CO_2-eq making up for about 90% of the total livestock emission for that year. This was about 34% higher than emissions of the year 2000 (Figure 2.8). In 2015, cattle contributed about 52% of the total emissions by enteric fermentation, closely followed by sheep (29%) and goats (17%). Camels, mules, swine and horses made up the remaining 2%.

Table 2.54 : Categorization of Livestock Population (2000 – 2015)

Year	Livestock category (x10³)										
	Dairy cattle	Other cattle	Goat	Sheep	Horses	Asses	Camel	Swine (Breeding)	Swine (Market)	Poultry (broilers)	Poultry (layers)
2000	1587.5	13530.8	42500.0	26000.0	204.0	1000.0	18.0	504.8	4542.9	26200.0	87000.0
2001	1589.0	13544.4	45260.4	28692.6	205.0	1000.0	18.0	525.0	4724. 6	28620.0	96000.0
2002	1666.0	13482.6	46400.0	29400.0	205.0	1000.0	18.0	611. 2	5500.6	33125.0	98000.0
2003	1668.0	13495.7	47551.7	30086.4	205.0	1000.0	18.0	567.8	5110.1	36680.0	101000.0
2004	1727.0	13973.0	48700.0	30800.0	206.0	1050.0	18.0	591.0	5319.0	39500.0	104000.0
2005	1825.7	14049.6	49959.0	31547.9	206.0	1050.0	18.2	614.1	5527.1	40700.0	110000.0
2006	1927.9	14085.5	51208.2	32305.0	207.0	1080.0	18.5	638. 7	5748.2	43400.0	115000.0
2007	1951.0	14201.7	52488.2	33080.4	207.8	1060.0	18.8	664.2	5978.1	45127.0	121000.0
2008	1715.0	14578.2	53800.4	33874.3	208.0	1065.0	19.0	690.8	6217.2	47434.0	127000.0
2009	1968.0	14467.0	55145.4	34687.3	209.0	1065.0	19.2	718.4	6465.9	48156.0	135000.0
2010	2022.3	14556.0	56524.1	35519.8	101.5	1200.0	277.8	747.2	6724.6	56313.0	136000.0
2011	2300.0	16741.3	67292.5	38376.0	101.6	1220.0	278.0	628.3	5654.2	9893.0	139000.0
2012	2350.0	16857.0	68974.9	39335.4	101.7	1250.0	278.3	653.4	5880.4	19254.0	140000.0
2013	2365.0	17009.0	70699.2	40318.8	101.7	1265.0	280.0	679.5	6115.6	28352.0	141706.6
2014	2374.2	17075.7	71000.0	40550.0	101.2	1270.0	285.0	685.0	6165.0	28293.4	142000.0
2015	2447.9	17401.8	73711.9	41869.9	97.7	1292.6	290.1	701.7	6315.7	31119.9	147106.1

Source: FAOSTAT.

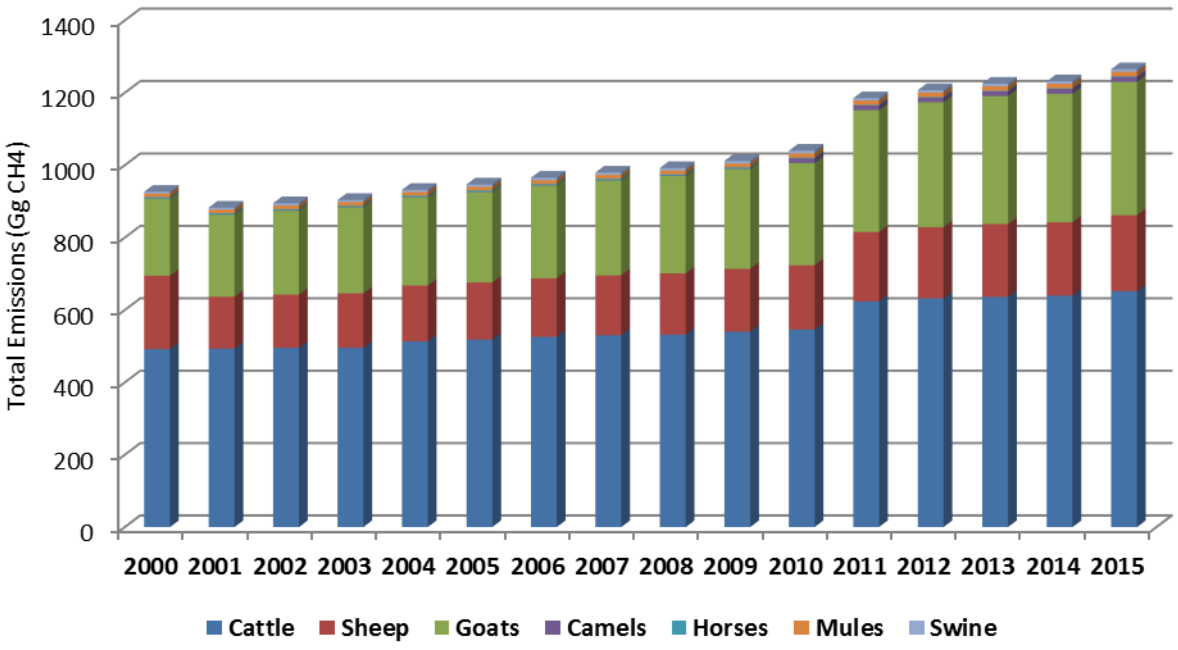

Figure 2.8 Total emission trend through enteric fermentation by livestock

Manure management (3.A.2)

Both CH_4 and N_2O are emitted during handling and storage of livestock manure. The magnitude of emissions depends on the quantity of manure handled, its characteristics, and the manure management system. Generally, poorly aerated manure management systems generate more CH_4 than well-aerated systems. The manure management systems assigned in this inventory are paddock, range and pasture (PRP) and solid storage. All the

animals listed for enteric fermentation plus poultry were considered for estimating emissions for manure management.

Emissions from manure management were calculated using IPCC Tier 1 methodology and default emission factors. This was done by multiplying the individual animal population with the default emission factor of the respective animal type according to manure management system. The fraction of manure treated under the different manure management systems are given in Table 2.55.

Table 2.55 Fraction of manure treated under the different manure management systems applied

Livestock	Manure Management Systems (MMS)		
	PRP	Solid storage	Poultry with litter
Cattle	70%	30%	0%
Sheep	70%	30%	0%
Goats	70%	30%	0%
Camels	90%	10%	0%
Horses	70%	30%	0%
Mules	70%	30%	0%
Swine (market)	60%	40%	0%
Swine (breeding)	0%	100%	0%
Poultry	0%	0%	100%

Total emissions increased from 2419 Gg CO_2-eq in 2000 to 2996 Gg CO_2-eq in 2015 representing an increase of about 24% In 2015, N_2O contributed about 62% of the total aggregated emissions from manure management while the remaining 38% was methane. The emissions of N_2O were highest in 2010 when it represented about 70% of the total of this subcategory (Figure 2.9). These emissions are associated with the peak in animal population that year. In 2015, emissions from cattle made up about 33% of the total emissions from manure management. The contribution of the other animal types were sheep (34%), goats (24%), swine (6%) and poultry (1%). Camels, horses and mules made up the remaining 2%.

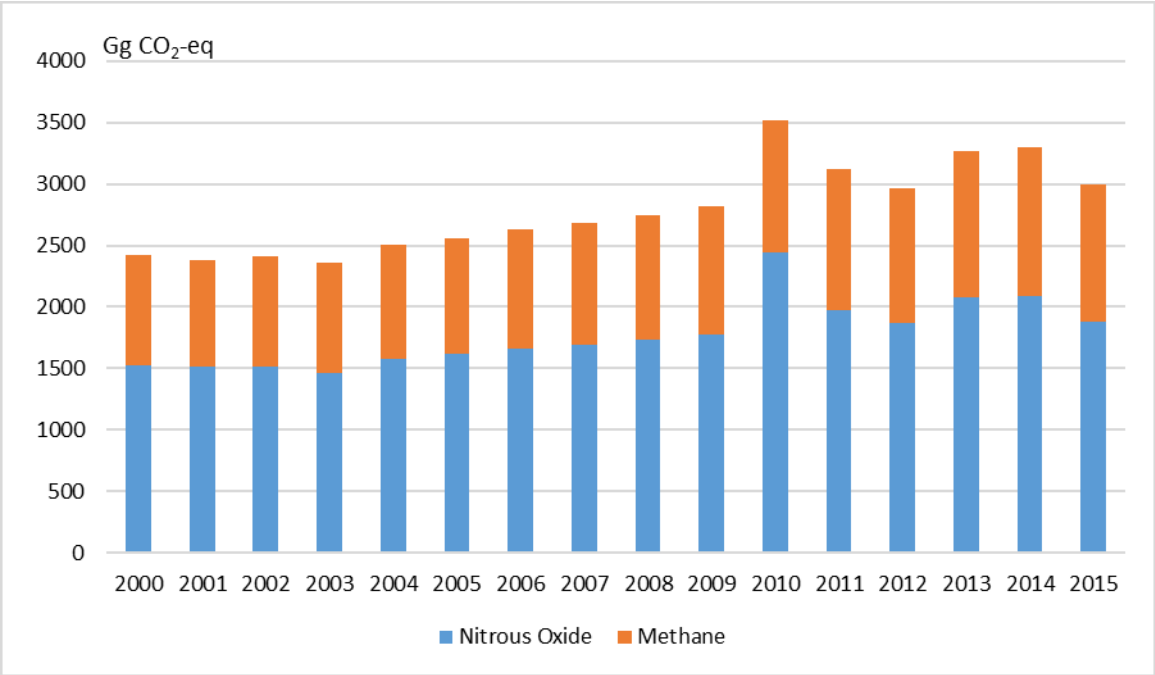

Figure 2.9 Methane and nitrous oxide emissions from manure management

Land (3B)

CO_2 emissions arise from human induced modification of landscapes leading to land use change. The land use change is the result of conversion of land categories amongst the various IPCC land classes, namely (a) Forest land (FL), (b) Crop land, (c) Grassland, (d) Wetlands, (e) Settlements and (f) Other land. Due to data constraints, only activities within FL have been assessed and emissions estimated.

The methods used were as recommended by IPCC 2006 guidelines with Forestland areas and wood removals data obtained from FAOSTAT. These are given in Table 4.7.

Forest areas and wood removals 2000 – 2015

Forestland area regressed from 13137000 ha in 2000 to 6993000 ha Table 2.56 according to FAOSTAT data. Concurrently, wood removals are critical data for assessing the role of forest as a sink or emitter. The data on fuel wood and round wood harvesting were obtained from FAOSTAT. There has been a gradual increase from 68,766,652 m^3yr^{-1} in year 2000 to 75,320,929 m^3yr^{-1} in year 2015 representing an increase of about 8.7% for round wood and from 59,348,650 m^3yr^{-1} in 2000 to 64,678,685 m^3yr^{-1} in 2015 representing about 8.2% for fuel wood (Table 2.56).

Table 2.56 Forest land areas and wood removal

Year	Forestland		Wood removals
	Areas (ha)	Round Wood (m^3)	Fuel wood (m^3)
2000	13137000	68766652	59348650
2001	12727400	69115552	59697550
2002	12317800	69482328	60064330
2003	11908200	69867216	60449220
2004	11498600	70270440	60852440
2005	11089000	70692260	61274260
2006	10679400	71047309	61629310
2007	10269800	71418000	62000000
2008	9860200	71806600	62388600
2009	9450600	72211234	62793230
2010	9041000	72632728	63216730
2011	8631400	73017551	63214730
2012	8221800	73417115	63577583
2013	7812200	73831551	63942518
2014	7402600	74865002	64309548
2015	6993000	75320929	64678685

Source: FAOSTAT

Carbon stock in different land representations

The relevant emission factors under land category were derived from annual biomass increment, biomass stocks in each land representation, the reference soil organic carbon stocks and their stock change factors according to land management. For the biomass stocks, data from IPCC guidelines[10] were used. Carbon stocks for the five biomass pools (above-ground biomass, dead wood, litter, herbs and soils) for the predominant ecological zone was obtained from IPCC as well.

[10] http://www.ipcc-nggip.iges.or.jp/public/2006gl/

The estimated CO_2 emissions from land (FL) was 338092 Gg CO_2 in 2000, 452701 Gg CO_2 in 2014 and 421434 Gg CO_2 in 2015 (Figure 2.10). CO_2 emissions from land contributed about 90% of the total emissions in the AFOLU sector and is the only source of CO_2 emissions. Though FL is a natural sink of CO_2, the situation at the national level is not so as emissions exceeded removals. A general increase in net CO_2 emissions is observed, due to the increase in deforestation rate and wood removals in the existing areas.

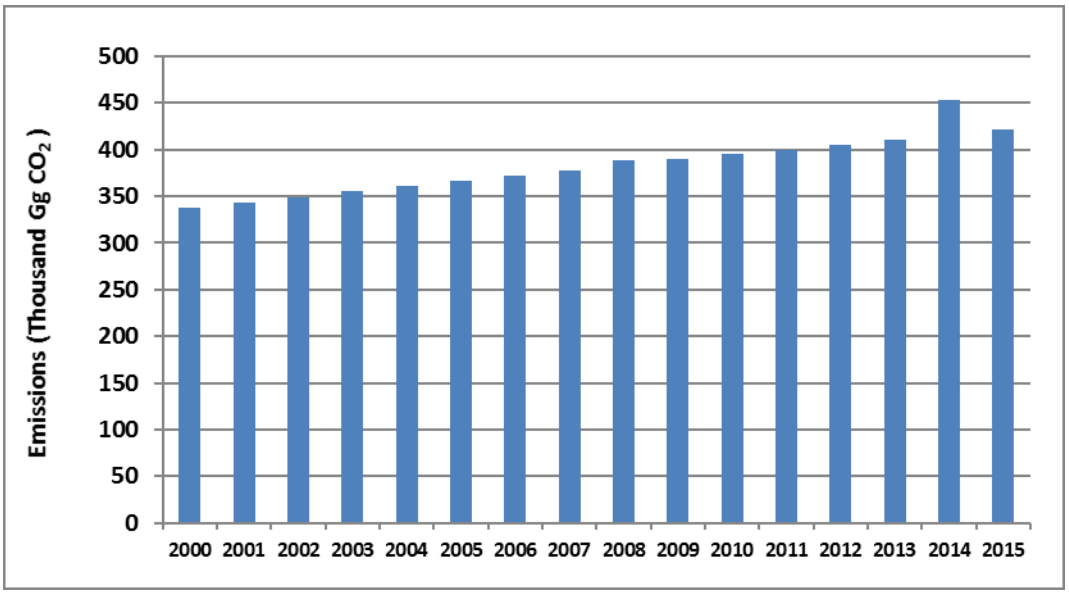

Figure 2.10 Emission trend in forest land

2.6.5.2. Aggregated sources and non-CO_2 emissions from land (3.C)

Generally, CH_4 and N_2O are emitted in this category through biomass burning, direct and indirect emissions of N_2O from managed soils, indirect emissions of N_2O from manure management and CH_4 emissions from rice cultivation. Activity data used for estimating the emissions from all these activities were obtained from the FAOSTAT database and provided in Table 2.57.

Table 2.57 : Synthetic N-fertilisers used, crop residues burned and rice cultivated areas (2000 - 2015)

Year	N fertilisers	Crop residues burned				Rice
	Amount (kg)	Maize (t)	Rice (t)	Sugar cane (t)	Wheat (t)	Area (ha)
2000	105600000	3159000	1209450	15600	20800	2199000
2001	146800000	3283000	1164350	14950	20800	2117000
2002	125131000	3282000	1201750	26000	22000	2185000
2003	167778000	3469000	1215500	27300	22400	2210000
2004	116343000	3479000	1291400	27950	23200	2348000
2005	213221000	3589000	1371700	28600	24000	2494000
2006	216854000	3905000	1498750	30550	25200	2725000
2007	70115000	3944000	1348050	40950	10400	2451000
2008	125033000	3845000	1310100	46729	12800	2382000
2009	99589000	3350560	1010284	47489	19200	1836880
2010	263151000	4149310	1337947	29692	26400	2432630
2011	138428000	5456540	1248176	29900	39600	2269410
2012	262445000	5751300	1575098	30225	36000	2863815
2013	416354000	5762700	1612270	48263	32000	2931400
2014	271875000	5849800	1702690	48750	34000	3095800
2015	336607499	6142007	1759219	54358	36611	3198581

Source: FAOSTAT

The method used for estimating emissions for these sub-categories is as recommended in the 2006 IPCC guidelines using default emission and stock factors.

Emissions

In 2015, the total aggregated emissions amounted to 28762 Gg CO_2-eq, representing about 6% of the total emissions of the AFOLU sector for that year (Table 2.58). Compared to the year 2000 (20545 Gg CO_2-eq), total emissions increased by 40% following increased consumption of nitrogen-based synthetic fertilizers. Direct and indirect emissions of N_2O from managed soils added to indirect emissions from manure management contributed about 74.4% of the overall emissions from this category in 2015. Rice cultivation contributed about 25.6% while the contribution from savannah and crop residues burning was insignificant at less than 0.01%.

Table 2.58 Aggregated sources and non-CO_2 emissions Gg CO_2-eq from land (3.C)

Year	Rice Cultivation	Agricultural soils	Savanna burning	Crop residues burning	Total
2000	5057	15485	2.387	0.343	20545
2001	4869	15572	2.640	0.347	20444
2002	5025	15665	2.382	0.349	20693
2003	5083	15881	2.496	0.362	20967
2004	5400	16193	2.276	0.366	21595
2005	5736	17151	2.599	0.408	22890
2006	6267	17500	2.370	0.433	23770
2007	5637	16862	2.264	0.426	22502
2008	5478	17486	1.848	0.420	22967
2009	4225	17713	1.513	0.345	21939
2010	5595	18929	1.513	0.439	24526
2011	5219	20397	1.296	0.539	25618
2012	6586	21158	1.296	0.573	27747
2013	6742	22950	1.036	0.577	29693
2014	7120	22179	1.182	0.588	29301
2015	7356	21404	1.130	0.640	28762

2.6.5.3. Direct and indirect emission of N_2O from managed soils (3.C.4 and 3.C.5)

Direct N_2O emissions from managed soils, the major share of this sub-category, increased from 11221 Gg CO_2-eq in 2000 to 16682 Gg CO_2-eq before decreasing to 15365 Gg CO_2-eq in 2015 (Figure 2.11).

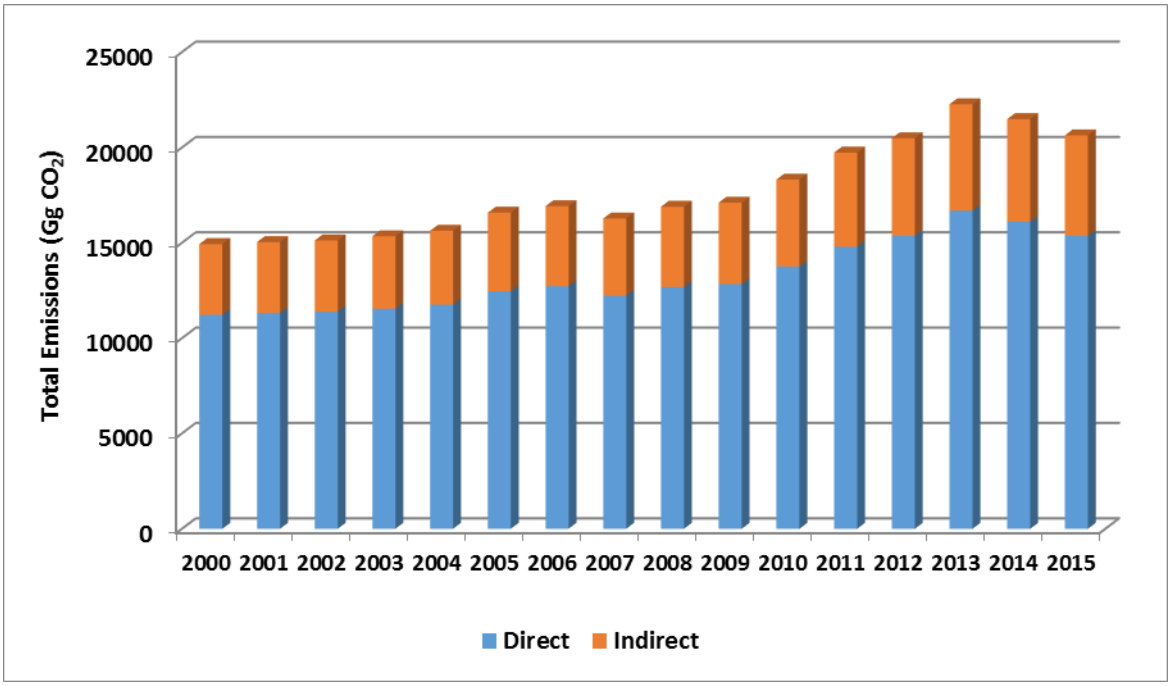

Figure 2.11 Emission trends by direct and indirect emissions of N_2O from soil management

2.6.5.4. Rice Cultivation (3.C.7)

The IPCC Tier 1 methodology and default emission factors for rice cultivation were used. Data were only available for paddy rice fields which were not classified either as rain-fed or irrigated in the FAOSTAT database where the data were sourced.

CH_4 emissions from rice cultivation peaked at 7356 Gg CO_2-eq in 2015 while the lowest emission of 4225 Gg CO_2-eq was recorded in 2009 and is attributed to the lowest area cultivated among all the years under review. Emissions from rice cultivation constituted about 3.8% of the total emissions from aggregated source and non-CO_2 emission from land (3.C) in 2000 and about 2.6% in 2015. Figure 2.12 illustrates emission trends in rice cultivation.

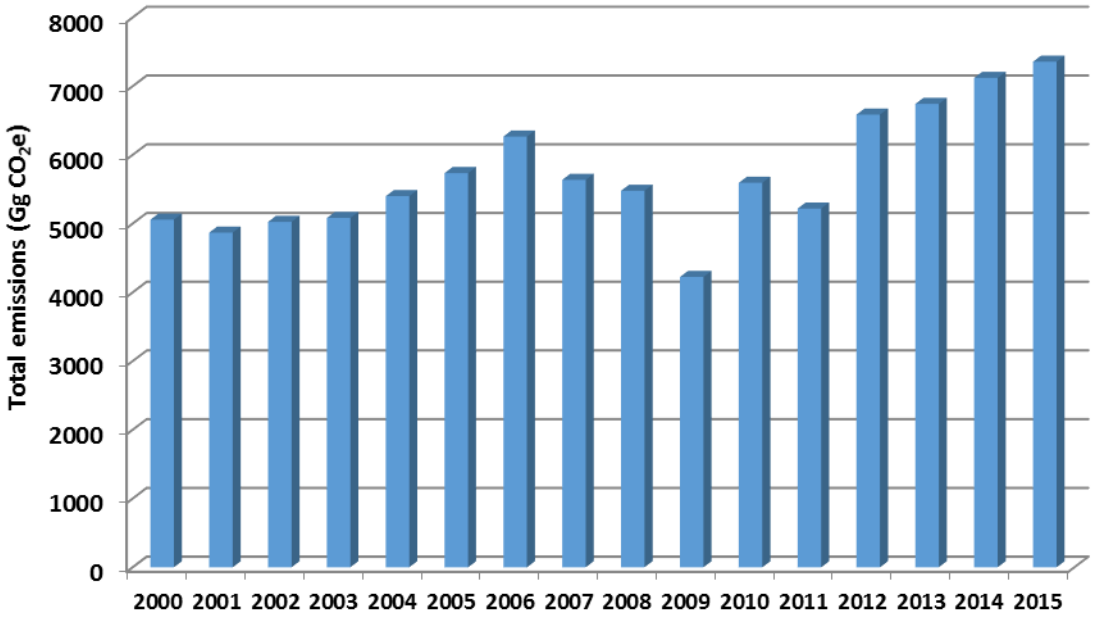

Figure 2.12 Emission trends in rice cultivation

2.6.5.5. Other (3.D) – Harvested Wood Products (3.D.1)

Much of the wood harvested from Forest Land, Cropland and other land categories remain as wood products for differing lengths of time. This constitutes a carbon reservoir. HWP includes all wood (including bark) that leaves harvest sites. Slash and other material left at harvest sites should be regarded as dead organic matter. The time carbon is held in products will vary according to the product and its uses. For example, fuel wood and mill residue may be burned in the year of harvest; many types of paper are likely to have a useful life of less than 5 years which may include recycling of paper; and sawn wood or panels used in buildings may be held for decades to over 100 years.

All the data on production, imports and exports of round-wood, sawn wood, wood based panels, paper and paper board, wood pulp and recycled paper, industrial round-wood, chip and particles, wood charcoal and wood residues were obtained from FAOSTAT database (http://faostat.fao.org/). Most data were available since 1960 but there were some gaps. Import round-wood data for 2000 and 2015 were not available. The import volumes for wood pulp and recovered paper for 2000 – 2006 were not available. The import volume for industrial round-wood was not available. The export volumes for chips and particles for 2000-2007 as well as the import volumes for 2000-2011 were also not available. The import volumes of wood charcoal for 2000-2007 were not available. The export volumes of wood residues for 2000-2009 and import volumes for 2000-2007 were not available. However, for the purpose of this inventory, the initial values for these categories were assumed to be zero. The activity data used for the estimation are provided in Tables

Table 2.59 toTable 2.61.

Table 2.59 Total round wood and sawn wood mass balance (2000 - 2015)

Year	Round wood				Sawn wood	
Year	Production (m^3)	Export (m^3)	Import (m^3)	Production (m^3)	Export (m^3)	Import (m^3)
2000	68,766,652	8,360	0	2000000	54000	900
2001	69,115,552	4,860	500	2000000	38300	1300
2002	69,482,328	3,060	288	2000000	38300	2220
2003	69,867,216	3,179	64	2000000	21779	998
2004	70,270,440	41,060	500	2000000	20710	1616
2005	70,692,260	39,315	723	2002000	39916	335
2006	71,047,309	33,480	60	2002000	26365	680
2007	71,418,000	70,928	742	2002000	24057	122
2008	71,806,600	66,389	1,799	2002000	15677	2918
2009	72,211,234	60,231	1,064	2002000	7561	2751
2010	72,632,728	109,978	488	2002000	11192	2399
2011	73,017,551	106,296	1,925	2002000	5616	4600
2012	73,417,115	108,300	235	2002000	7666	5959
2013	73,831,551	127,650	223	2002000	7226	10132
2014	74,865,002	772,429	1,120	2002000	8586	10287
2015	75,320,929	1,764,330	0	2002000	8586	10287

Source: FAOSTAT

Table 2.60 Paper + paper board, wood pulp + recovered paper and industrial round wood (m^3) (2000 - 2015)

	Paper + Paper Board			Wood Pulp + Recovered Paper		Industrial Round wood		
Year	Production (m^3)	Export (m^3)	Import (m^3)	Export (m^3)	Import (m^3)	Production (m^3)	Export (m^3)	Import (m^3)
2000	18000	1600	72800	2200	0	227900	7300	0
2001	18000	1600	74000	1400	0	227900	3800	500
2002	18000	1600	74000	1400	0	227900	2000	288
2003	18000	1600	112133	1400	0	227900	2119	64
2004	18000	1600	141393	1600	0	227900	4000	500
2005	18000	1600	141393	1600	0	227900	38255	723
2006	18000	1600	141393	1600	0	227900	38240	60
2007	18000	1600	191626	1600	0	227900	69868	742
2008	18000	7798	184129	36688	5319	227900	64506	1365
2009	18000	190	194929	22589	3683	227900	58348	630
2010	18000	208	178745	36288	4266	227900	109950	54
2011	18000	205	299928	26858	2992	227900	106268	1491
2012	18000	171	137205	20271	13308	227900	108226	116
2013	18000	179	225972	18525	22569	227900	12673	810
2014	18000	1130	244004	13897	10069	240000	578017	2144
2015	18000	1130	244004	13897	10069	240000	622017	1007

Source: FAOSTAT

Table 2.61 Chip and Particles, Wood Charcoal and Wood Residues (m3) (2000 - 2015)

	Chip and Particles		Wood Charcoal		Wood Residues	
Year	Export	Import	Export	Import	Export	Import
2000	0	0	28000	0	0	0
2001	0	0	14900	0	0	0
2002	0	0	14900	0	0	0
2003	0	0	14900	0	0	0
2004	0	0	29562	0	0	0
2005	0	0	29562	0	0	0
2006	0	0	29562	0	0	0
2007	0	0	38800	0	0	0
2008	512	0	24312	136	0	5498
2009	104	0	5345	9	0	122
2010	1	0	8119	24	2	25
2011	1	0	8119	16	15	25
2012	1	6409	69877	88	1000	206
2013	150	1246	50141	193	2000	33
2014	81766	1246	15993	346	2000	1
2015	81766	1246	15993	346	2000	1

Source: FAOSTAT

HWPs were considered as a sink of CO_2 which fluctuated during the period 2000 to 2015. The total accumulated sink for the period under review was estimated to be 49828 Gg CO_2 (Figure 2.13). There was an overall decrease between 2000 and 2010 by about 20.7%. The least removal of CO_2 (2661.71 Gg) was recorded in 2012 after which there was an increase of about 1.5% in 2014.

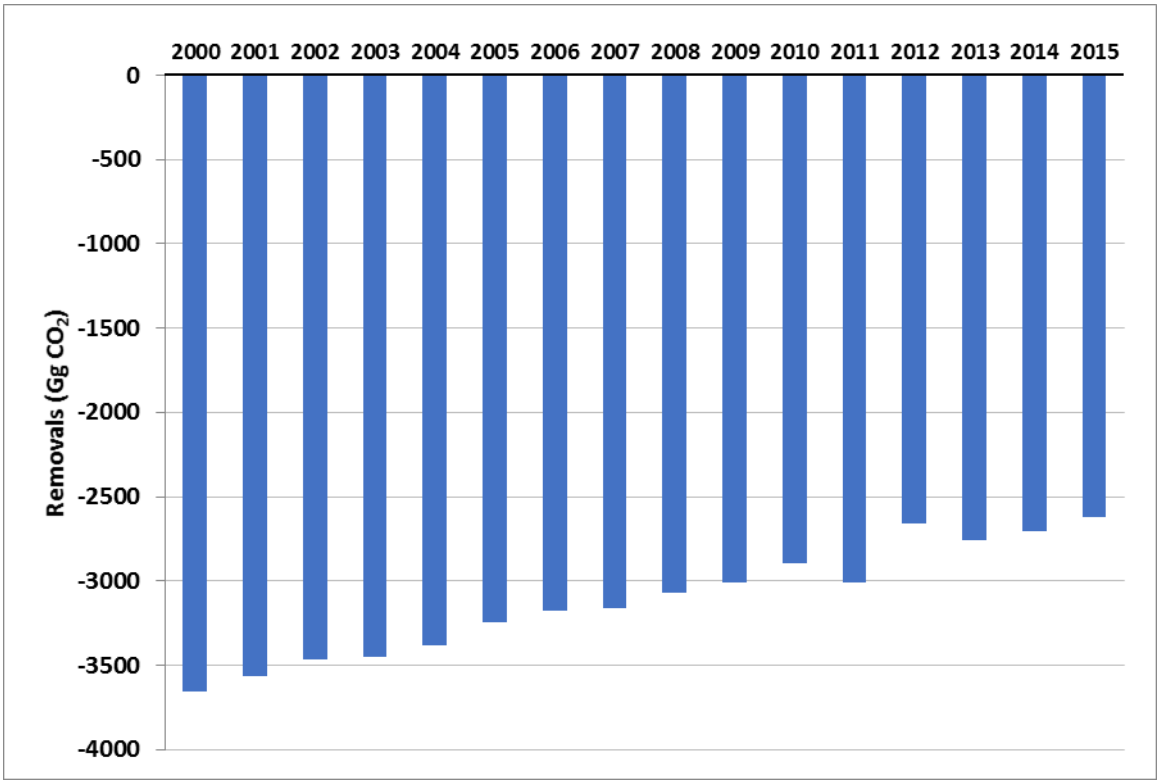

Figure 2.13 CO_2 removed and stored in harvested wood products

Table 2.62 AFOLU sectoral table (Inventory Year 2015)

Categories	Net CO_2 emissions / removals (Gg)	Emissions (Gg)				
		CH_4	N_2O	NO_X	CO	NMVOCs
3 - Agriculture, Forestry, and Other Land Use	418811.0346	1659.842348	75.09766003	0.058608661	1.379084852	0
3.A - Livestock	0	1309.503106	6.048769803	0	0	0
3.A.1 - Enteric Fermentation	0	1256.163715	0	0	0	0
3.A.1.a - Cattle	0	652.06338	0	0	0	0
3.A.1.a.i - Dairy Cows		112.606712		0	0	0
3.A.1.a.ii - Other Cattle		539.456668		0	0	0
3.A.1.b - Buffalo		0		0	0	0
3.A.1.c - Sheep		368.558905		0	0	0
3.A.1.d - Goats		209.349665		0	0	0
3.A.1.e - Camels		4.491256		0	0	0
3.A.1.f - Horses		1.757448		0	0	0
3.A.1.g - Mules and Asses		12.92564		0	0	0
3.A.1.h - Swine		7.017421		0	0	0
3.A.1.j - Other (please specify)		0		0	0	0
3.A.2 - Manure Management (1)	0	53.33939075	6.048769803	0	0	0
3.A.2.a - Cattle	0	19.8498	1.979286549	0	0	0
3.A.2.a.i - Dairy cows		2.447972	0.347511482	0	0	0

Categories	Net CO_2 emissions / removals (Gg)	Emissions (Gg)				
		CH_4	N_2O	NO_X	CO	NMVOCs
3.A.2.a.ii - Other cattle		17.401828	1.631775067	0	0	0
3.A.2.b - Buffalo		0	0	0	0	0
3.A.2.c - Sheep		14.7423562	2.077588661	0	0	0
3.A.2.d - Goats		9.21138526	1.480549243	0	0	0
3.A.2.e - Camels		0.24994816	0.002795021	0	0	0
3.A.2.f - Horses		0.21382284	0.021458547	0	0	0
3.A.2.g - Mules and Asses		1.5510768	0.066501587	0	0	0
3.A.2.h - Swine		7.017421	0.349482022	0	0	0
3.A.2.i - Poultry		0.50358049	0.071108172	0	0	0
3.A.2.j - Other (please specify)		0	0	0	0	0
3.B - Land	421433.8383	0	0	0	0	0
3.B.1 - Forest land	421433.8383	0	0	0	0	0
3.B.1.a - Forest land Remaining Forest land	421433.8383			0	0	0
3.B.1.b - Land Converted to Forest land	0	0	0	0	0	0
3.B.1.b.i - Cropland converted to Forest Land	0			0	0	0
3.B.1.b.ii - Grassland converted to Forest Land	0			0	0	0
3.B.1.b.iii - Wetlands converted to Forest Land	0			0	0	0
3.B.1.b.iv - Settlements converted to Forest Land	0			0	0	0
3.B.1.b.v - Other Land converted to Forest Land	0			0	0	0
3.B.2 - Cropland	0	0	0	0	0	0
3.B.2.a - Cropland Remaining Cropland	0			0	0	0
3.B.2.b - Land Converted to Cropland	0	0	0	0	0	0
3.B.2.b.i - Forest Land converted to Cropland	0			0	0	0
3.B.2.b.ii - Grassland converted to Cropland	0			0	0	0
3.B.2.b.iii - Wetlands converted to Cropland	0			0	0	0
3.B.2.b.iv - Settlements converted to Cropland	0			0	0	0
3.B.2.b.v - Other Land converted to Cropland	0			0	0	0
3.B.3 - Grassland	0	0	0	0	0	0
3.B.3.a - Grassland Remaining Grassland	0			0	0	0
3.B.3.b - Land Converted to Grassland	0	0	0	0	0	0
3.B.3.b.i - Forest Land converted to Grassland	0			0	0	0
3.B.3.b.ii - Cropland converted to Grassland	0			0	0	0
3.B.3.b.iii - Wetlands converted to Grassland	0			0	0	0
3.B.3.b.iv - Settlements converted to Grassland	0			0	0	0
3.B.3.b.v - Other Land	0			0	0	0

Categories	Net CO_2 emissions / removals (Gg)	Emissions (Gg)				
		CH_4	N_2O	NO_X	CO	NMVOCs
converted to Grassland						
3.B.4 - Wetlands	0	0	0	0	0	0
3.B.4.a - Wetlands Remaining Wetlands	0	0	0	0	0	0
3.B.4.a.i - Peatlands remaining peatlands	0		0	0	0	0
3.B.4.a.ii - Flooded land remaining flooded land				0	0	0
3.B.4.b - Land Converted to Wetlands	0	0	0	0	0	0
3.B.4.b.i - Land converted for peat extraction			0	0	0	0
3.B.4.b.ii - Land converted to flooded land	0			0	0	0
3.B.4.b.iii - Land converted to other wetlands				0	0	0
3.B.5 - Settlements	0	0	0	0	0	0
3.B.5.a - Settlements Remaining Settlements	0			0	0	0
3.B.5.b - Land Converted to Settlements	0	0	0	0	0	0
3.B.5.b.i - Forest Land converted to Settlements	0			0	0	0
3.B.5.b.ii - Cropland converted to Settlements	0			0	0	0
3.B.5.b.iii - Grassland converted to Settlements	0			0	0	0
3.B.5.b.iv - Wetlands converted to Settlements	0			0	0	0
3.B.5.b.v - Other Land converted to Settlements	0			0	0	0
3.B.6 - Other Land	0	0	0	0	0	0
3.B.6.a - Other land Remaining Other land				0	0	0
3.B.6.b - Land Converted to Other land	0	0	0	0	0	0
3.B.6.b.i - Forest Land converted to Other Land	0			0	0	0
3.B.6.b.ii - Cropland converted to Other Land	0			0	0	0
3.B.6.b.iii - Grassland converted to Other Land	0			0	0	0
3.B.6.b.iv - Wetlands converted to Other Land	0			0	0	0
3.B.6.b.v - Settlements converted to Other Land	0			0	0	0
3.C - Aggregate sources and non-CO_2 emissions sources on land (2)	0	350.3392419	69.04889023	0.058608661	1.379084852	0
3.C.1 - Emissions from biomass burning	0	0.044359645	0.002639432	0.058608661	1.379084852	0
3.C.1.a - Biomass burning in forest lands		0	0	0	0	0
3.C.1.b - Biomass burning in croplands		0.021578928	0.000559454	0.019980489	0.735281981	0
3.C.1.c - Biomass burning in grasslands		0.022780717	0.002079979	0.038628172	0.643802871	0
3.C.1.d - Biomass burning in all other land		0	0	0	0	0
3.C.2 - Liming	0			0	0	0

Categories	Net CO_2 emissions / removals (Gg)	Emissions (Gg)				
		CH_4	N_2O	NO_X	CO	NMVOCs
3.C.3 - Urea application	0			0	0	0
3.C.4 - Direct N_2O Emissions from managed soils (3)			49.56562346	0	0	0
3.C.5 - Indirect N_2O Emissions from managed soils			16.98521774	0	0	0
3.C.6 - Indirect N_2O Emissions from manure management			2.4954096	0	0	0
3.C.7 - Rice cultivations		350.2948823		0	0	0
3.C.8 - Other (please specify)				0	0	0
3.D - Other	-2622.80366	0	0	0	0	0
3.D.1 - Harvested Wood Products	-2622.80366			0	0	0
3.D.2 - Other (please specify)				0	0	0

2.7. Waste

2.7.1. Overview

GHG emissions from the Waste sector result largely from disposal of solid wastes through landfilling, dumping, incineration, open burning and treatment of domestic and industrial liquid wastes. The emissions from solid waste are predominantly CH_4 and CO_2 from disposal sites. Wastewater can also be a source of methane (CH_4) when treated or disposed of anaerobically as well as nitrous oxide (N_2O) emissions.

The IPCC 2006 Guidelines divide the Waste sector into the following source categories: Solid Waste Disposal (4A), Biological Treatment of solid waste (4B), Incineration and Open Burning (4C) and Wastewater Treatment and Discharge (4D). Each source category is further divided into sub-categories that take into account different waste attributes, management practices and approaches.

Analysis of solid waste disposal led to the choice of two (2) categories for computing emissions of the Waste sector in Nigeria. These are Unmanaged Waste Disposal and Open Burning.

2.7.2. Solid Waste Disposal (4.A)

MSW comprises municipal solid wastes and industrials wastes. Anaerobic decomposition of MSW high in carbon content, emits mainly CH_4 while aerobic treatment and open burning or incineration yields mostly CO_2. In Nigeria, there are no engineered or sanitary landfills. Thus, municipal solid wastes either find their way into managed dump sites where compaction and sand filling of waste occurs or unmanaged ones where non-segregated waste is often heaped and occasionally the waste is burned to reduce the volume. The latter constitutes the majority of dump sites. Solid waste disposal activities are further categorized into: Managed Waste Disposal Sites (4.A.), Unmanaged Waste Disposal Sites (4.A.2) and Uncategorized Waste Disposal Sites (4.A.3).

Unmanaged Waste Disposal Sites (4.A.2)

The available data on the quantity of municipal solid waste (MSW) generated in key cities in Nigeria were utilized together with key socioeconomic data to estimate waste generation during the study period for the national inventory of solid waste. This data and the characteristic property of MSW typically generated in Nigeria were utilized to estimate GHG emissions, using the estimation protocol specified by the IPCC for the unmanaged waste disposal sites.

Open Burning (4.C.2)

Emissions of CO_2 and CH_4 also emanate from open burning of municipal solid wastes which is presently practised in Nigeria due to the inability to collect waste generated, especially in the rural areas, inefficient resources in the urban areas and the inexistence of managed engineered landfill sites.

2.7.3. Wastewater Treatment and Discharge (4D)

Wastewater in Nigeria stems mostly from domestic and industrial sources. Domestic wastewater in Nigeria is yet to be treated efficiently on a municipal scale and often ends up in septic tanks and latrines while a portion is also discharged through closed sewers/channels and into rivers, seas and lakes. Wastewater treatment is divided into Domestic wastewater treatment and discharge (4.D1), and Industrial wastewater treatment and discharge (4.D2). Both situations are encountered in the country. However, due to lack of activity data, Wastewater treatment and Discharge subcategory has not been covered in this inventory.

Domestic Wastewater Treatment and Discharge (4.D.1)

Emissions from Domestic Wastewater Treatment and Discharge (4.D1) emanate from the different means of disposal and treatment of sewage. Information on municipal treatment of wastewater for the time series is not readily available. Domestic wastewater tends to end up in latrines, septic tanks and closed sewers and occasionally in rivers, sea and lagoons.

2.7.4. Methodology

The decision trees of the IPCC 2006 Guidelines were used to choose the most appropriate method for computing emissions of this sector. Availability of activity data for the waste sector are similar to the other sectors. There is a paucity of data on specificity and management of waste, such as annual information on the amount and composition of waste generated, the specifics of waste management practices in both the rural and urban areas of the country, the waste generation rate in the industry and other relevant data. This resulted in the adoption of Tier 1 methodology.

Under this Tier 1 methodology waste emission is computed by the formula:

AD*EF = E,

Where,

AD is the activity data (population, waste generation rate, tonnage)

EF is emission factor (tonne CO_2-eq/tonne waste)

E= emissions (tonne CO_2-eq)

2.7.5. Activity Data

Solid Waste Disposal (4.A) - Unmanaged Waste Disposal Sites (4.A.2)

The main categories of data used in the estimation of GHG emissions from solid waste handling include: national and state population figures; waste generation per capita; solid waste stream characteristics; etc. Sources of these data included the National Bureau of Statistics (NBS), National Population Commission (NPC) for urban and rural population fraction, Central Bank of Nigeria for GDP, Energy Commission of Nigeria (ECN), the Department of Climate Change (DCC) of the Federal Ministry of Environment, Literature, published statistics in national reports and Waste Management Authorities such as the Lagos Waste Management Authority (LAWMA), amongst others. Default data used in the calculation of the GHG contribution from the waste sector include dry matter content, fraction of carbon in dry matter, fraction of fossil carbon and oxidation factor. The assumptions provided in

Table 2.63 were adopted for generating activity data for computing emissions from solid waste.

- Default values for methane generation rate constant k, degradable organic content and other variables are based on default values for a tropical wet climate country in the West Africa region available in the software.
- 100% of collected waste ends up in unmanaged shallow dump with a depth less than 5m.
- Waste generation data is based on the urban waste amount for the state capitals and urban areas for the year 2005.
- The waste generation rate is constant for the entire time series.
- Month when methane reaction starts is based on various findings from literature. Only paper and food waste begin decomposing in the first month and hence only those two are considered in the first year of emission based on software calculations.
- 30% of the rural fraction of the population and 55% of the urban fraction generate the waste that is allowed to decompose at these dump sites.

Table 2.63 MSW generated and treatment data for 2000-2015

Year	Population	Urban fraction of Population	Rural fraction of Population	Total MSW [Gg]	% sent to SWDS	Total MSW sent to unmanaged dumpsites [Gg]
2000	122,880,000	0.4262	0.5738	14625.178	0.4066	59.466
2001	126,010,000	0.4325	0.5675	14997.710	0.408	61.191
2002	129,250,000	0.4398	0.5602	15383.335	0.41	63.072
2003	132,580,000	0.4471	0.5529	15779.672	0.412	65.012
2004	136,030,000	0.4544	0.5456	16190.291	0.413	66.866
2005	139,610,000	0.4617	0.5383	16616.382	0.415	68.958
2006	143,320,000	0.469	0.531	17057.946	0.417	71.132
2007	147,150,000	0.4763	0.5237	17513.793	0.419	73.383
2008	151,120,000	0.4836	0.5164	17986.302	0.421	75.722
2009	155,210,000	0.4909	0.5091	18473.094	0.423	78.141
2010	159,420,000	0.4982	0.5018	18974.168	0.425	80.64
2011	163,770,000	0.5055	0.4945	19491.905	0.426	83.036
2012	168,240,000	0.5128	0.4872	20023.925	0.428	85.702
2013	172,820,000	0.5201	0.4799	20566.656	0.43	88.437
2014	177,480,000	0.5274	0.4726	21123.670	0.432	91.254
2015	182,200,000	0.5347	0.4653	21685.444	0.437	94.765

Another set of assumptions was used to generate industrial waste. These are provided below and the activity data generated from industrial activities is depicted in Table 2.64.

- 90% of the industrial solid decomposable waste makes its way to the unmanaged dump sites with about 10% unaccounted for due to collection inefficiencies.
- Industrial waste generation is about 1/5 of municipal waste generation rate.
- Waste generation rate is calculated as waste (1/5 of municipal) divided by GDP/year in $ millions.
- Industrial solid waste has the same final fate as MSW.

Table 2.64 Industrial solid waste generated for 2000-2015

Year	GDP [$ million]	Waste Generation Rate [Gg/$m GDP/yr]	Total Industrial Waste [Gg]	Total waste sent to SWDS [Gg]
2000	30284.25	0.0966	2925.459	2363.913
2001	31618.09	0.0948	2997.395	2697.655

Year	GDP [$ million]	Waste Generation Rate [Gg/$m GDP/yr]	Total Industrial Waste [Gg]	Total waste sent to SWDS [Gg]
2002	3281.07	0.0937	3074.959	2767.464
2003	36213.46	0.0871	3154.192	2838.773
2004	48429.82	0.0668	3235.112	2911.601
2005	50098.78	0.0663	3321.549	2989.394
2006	54213.55	0.0629	3410.032	3069.029
2007	57913.71	0.0605	3503.779	3153.402
2008	61547.69	0.058	3569.766	3212.789
2009	65815.01	0.056	3685.641	3317.077
2010	70971.33	0.0535	3796.966	3417.27
2011	74447.97	0.0524	3900.759	3510.683
2012	77627.55	0.0516	4005.582	3605.023
2013	81816.98	0.0503	4115.394	3703.855
2014	86979.88	0.0486	4227.222	3804.5
2015	89283.96	0.0486	4339.2	3905.28

Incineration and Open Burning (4.C) - Open Burning of Waste (4.C.2)

The decision tree of the IPCC 2006 GL (Vol 5 Ch5 p5.9) guided the choice of method for estimating emissions from Open Burning. The Tier 1 approach was adopted due to scarcity of activity data and lack of country specific emission factors. Activity data for Open Burning was generated from available information and based on the following assumptions.

- 30% of the urban fraction of the population and 40% of the rural fraction of the population engaged in open burning of waste.
- Fraction of waste burned relative to the amount of waste treated is assumed to be 0.6 for all years. This is based on the example in the 2006 IPCC Guidelines Volume 5, Chapter 5 - Incineration and Open Burning of Waste.

Required information, namely population, fraction of urban and rural population, total MSW generated and the fraction burned are captured in Table 2.65.

Table 2.65 Annual open burning at solid waste disposal sites (fraction of population burning waste) 2000-2015

Year	Population	Urban Fraction of Population	Rural Fraction of population	MSW Waste (Gg/year)	Fraction of population burning waste P_{frac}	Amt of waste open burned (Gg/yr)
2000	122,880,000	0.43	0.5738	14,621.49	0.3574	3134.56
2001	126,010,000	0.43	0.5675	14,993.93	0.35675	3209.9
2002	129,250,000	0.44	0.5602	15,379.46	0.35602	3285.05
2003	132,580,000	0.45	0.5529	15,775.69	0.35529	3363.06
2004	136,030,000	0.45	0.5456	16,186.21	0.35456	3443.78
2005	139,610,000	0.47	0.5383	16,612.19	0.35383	3526.44
2006	143,320,000	0.47	0.531	17,053.65	0.3531	3612.99
2007	147,150,000	0.48	0.5237	17,509.38	0.35237	3702.18
2008	151,120,000	0.48	0.5164	17,981.77	0.35164	3793.43
2009	155,210,000	0.49	0.5091	18,468.44	0.35091	3888.34
2010	159,420,000	0.50	0.5018	18,969.39	0.35018	3985.85
2011	163,770,000	0.51	0.4945	19,486.99	0.34945	4086.42
2012	168,240,000	0.51	0.4872	20,018.88	0.34872	4188.35
2013	172,820,000	0.52	0.4799	20,563.85	0.34799	4293.73

Year	Population	Urban Fraction of Population	Rural Fraction of population	MSW Waste (Gg/year)	Fraction of population burning waste P_{frac}	Amt of waste open burned (Gg/yr)
2014	177,480,000	0.53	0.4726	21,118.35	0.34726	4400.64
2015	182,200,000	0.53	0.4653	21,679.98	0.34653	4507.27

Wastewater Handling (4.D) - Domestic Wastewater Treatment and Discharge (4.D.1)

Domestic wastewater releases CH_4 when organic components in the wastewater anaerobically biodegrade while it releases N_2O as an intermediate product when nitrogen components in wastewater degrade during nitrification (an aerobic process) and denitrification (an anaerobic process). Production of CH_4 associated with wastewater depends primarily on the quantity of degradable organic wastewater, the temperature, and the type of treatment system. It is important to note that wastewater in closed underground sewers is not believed to be a significant source of CH_4.

The decision tree of the IPCC 2006 Guidelines (Vol6 Ch6 p6.10) guided the estimation for the GHG emissions from this subsector. Domestic wastewater in the software is analysed based on three categories of population income: rural, urban low and urban high. A degree of adoption and fraction of population income are applied to generate the organically degradable material in wastewater. Activity data generated on the basis of some assumptions provided below and used in the computation of emissions from wastewater are presented in Table 2.66.

- Domestic wastewater is not efficiently treated at wastewater treatment plants.
- Latrines in Nigeria are mostly communal and ground water table are often higher than latrine. This is in line consistent with the wet climate assumed for the country.
- Treatment methods selected were sea, river and lake discharge, stagnant sewer, latrine (wet climate) and septic system.
- Other unspecified types of methane treatment were assumed to contribute to sea, river and lake discharge.
- Values provided for Nigeria from Table 6.5 of 2006 IPCC Guidelines is sufficient for use for all years in the time series.

Table 2.66 Average organically degradable material in domestic wastewater (Kg BOD/Yr)

Year	Population	Organically degradable material in domestic wastewater (TOW) (kg)
2000	122,880,000	1,659,494,400.00
2001	126,010,000	1,701,765,050.00
2002	129,250,000	1,745,521,250.00
2003	132,580,000	1,790,492,900.00
2004	136,030,000	1,837,085,150.00
2005	139,610,000	1,885,433,050.00
2006	143,320,000	1,935,536,600.00
2007	147,150,000	1,987,260,750.00
2008	151,120,000	2,040,875,600.00
2009	155,210,000	2,096,111,050.00
2010	159,420,000	2,152,967,100.00
2011	163,770,000	2,211,713,850.00
2012	168,240,000	2,272,081,200.00
2013	172,820,000	2,333,934,100.00
2014	177,480,000	2,396,867,400.00
2015	182,200,000	2,460,611,000.00

The computation of emission is based on the available degradable organic component in the wastewater, TOW, which is multiplied by the emission factor according to treatment type. The emissions factors, based on the

maximum methane producing capacity and methane correction factor for each treatment type, are presented in Table 2.67

Table 2.67 Emission factor for domestic wastewater calculations

Type of Treatment /discharge	Maximum Methane producing capacity-BO [kg CH_4/kg BOD]	Methane correction factor for each treatment system - MCFj	Emission Factor [kg CH_4/kg BOD]
Stagnant sewer	0.6	0.5	0.30
Latrine, wet climate	0.6	0.7	0.42
Septic System	0.6	0.5	0.30
Sea, river and lakes	0.6	0.1	0.06

2.7.6. Emissions

Emissions by source category

The annual GHG emissions from the Waste sector for the years 2000 to 2015 are presented in Table 2.68. Total aggregated emissions for the Waste sector was 21103 Gg CO_2-eq in 2015 compared with an estimated 12553 Gg CO_2-eq in 2000. This represents 68.1% increase over the emissions of the year 2000.

Table 2.68 Aggregated emissions (Gg CO_2-eq) of the waste sector

Year	SWDS	Wastewater	Open Burning	Total
2000	3.8	11989.88	559.49	12553.15
2001	179.6	12294.09	572.81	13046.45
2002	331.8	12611.85	586.43	13530.08
2003	464.7	13006.79	600.52	14072.04
2004	581.7	13419.22	614.55	14615.47
2005	685.0	13920.65	629.66	15235.33
2006	777.4	14291.4	644.93	15713.75
2007	860.9	14673.23	660.97	16194.78
2008	936.6	15151.1	677.16	16764.86
2009	1004.64	15643.15	693.92	17341.71
2010	1068.9	16239.28	711.67	18019.85
2011	1130.0	16680.35	729.36	18539.72
2012	1187.8	17135.6	747.59	19070.95
2013	1242.8	17697.4	766.5	19706.68
2014	1295.9	18267.76	785.44	20349.11
2015	1347.6	18950.61	804.59	21102.77

In 2015, emissions from Wastewater handling represented 89.8% (18951 Gg CO_2-eq) of total Waste sector emissions followed by the SWDS category with 6.4% (1348 Gg CO_2-eq) and the remaining 3.8% (805 Gg CO_2-eq) came from open burning (Figure 2.14). From 2014 to 2015, the highest increase in emissions occurred under SWDS with 4.0% followed by 3.7% in Wastewater handling and 2.4% from Open Burning.

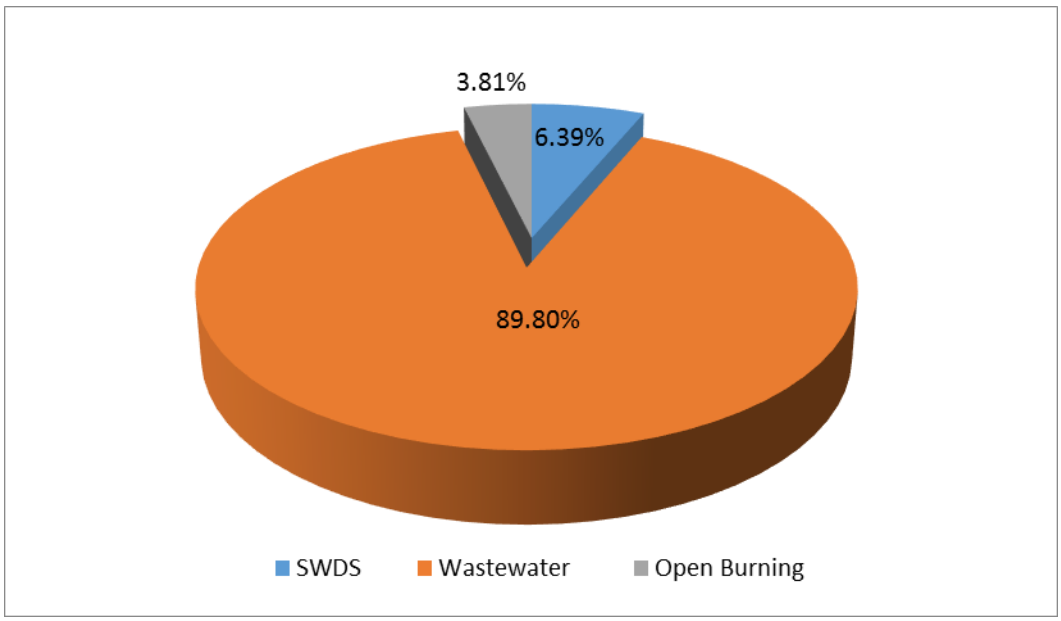

Figure 2.14 Contribution (%) by source category in emissions of the waste sector in 2015

Emissions by gas

Emissions by gas for the contributing source categories of the Waste sector are given in Table 2.69. In 2015, the emissions were 69.94 Gg of CO_2, 670.38 Gg of CH_4 and 22.44 Gg of N_2O compared with 48.64 Gg, 409.63Gg and 12.59 Gg respectively for these three GHGs in 2000. N_2O recorded the highest increase of 78.2% when comparing emissions of 2015 over those of the year 2000. CH_4 emissions increased by 63.7% and CO_2 by 43.8% over the same period.

Table 2.69 Emissions (Gg) by gas and subcategory for the period 2000 to 2015

Year	CO_2	CH_4		N_2O		Total
	(Gg)	(Gg)	(Gg CO_2-eq)	(Gg)	(Gg CO_2-eq)	(Gg CO_2-eq)
2000	48.64	409.63	8602.23	12.588	3902.28	12553.15
2001	49.81	428.40	8996.40	12.904	4000.24	13046.45
2002	50.97	446.40	9374.40	13.241	4104.71	13530.08
2003	52.18	463.78	9739.38	13.808	4280.48	14072.04
2004	53.43	480.80	10096.80	14.404	4465.24	14615.47
2005	54.72	497.59	10449.39	15.262	4731.22	15235.33
2006	56.06	514.30	10800.30	15.669	4857.39	15713.75
2007	57.44	530.97	11150.37	16.087	4986.97	16194.78
2008	58.86	547.76	11502.96	16.784	5203.04	16764.86
2009	60.33	564.56	11855.76	17.502	5425.62	17341.71
2010	61.85	581.59	12213.39	18.531	5744.61	18019.85
2011	63.41	598.92	12577.32	19.029	5898.99	18539.72
2012	64.99	616.48	12946.08	19.548	6059.88	19070.95
2013	66.62	634.29	13320.09	20.387	6319.97	19706.68
2014	68.28	652.27	13697.67	21.236	6583.16	20349.11
2015	69.94	670.38	14077.98	22.435	6954.85	21102.77

When taking into consideration the GWP of CH_4 and N_2O, the aggregated emissions of 2015 were 14078 Gg CO_2-eq and 69.55 Gg CO_2-eq respectively. In 2015 and on the same basis of equivalence, CH_4 topped the emissions with 64.44% followed by N_2O with 35.21% and CO_2 with 0.35% of total aggregated emissions (Figure 2.15).

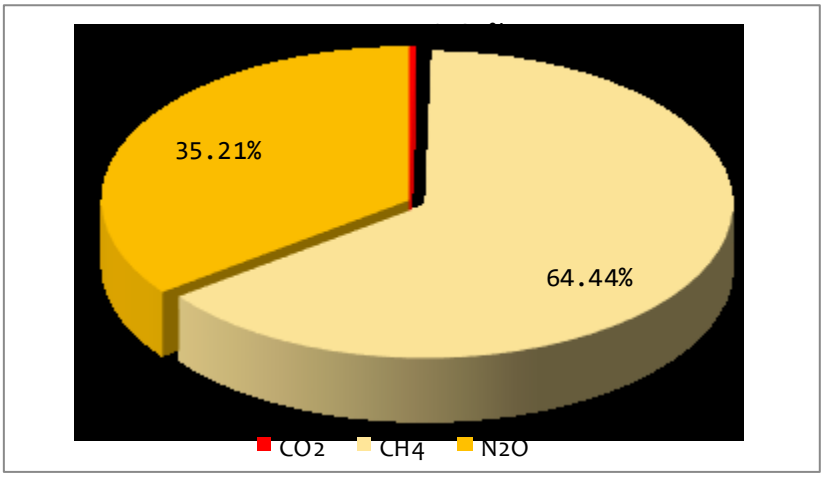

Figure 2.15 Percentage contribution (Gg CO_2-eq) of N_2O, CH_4 and CO_2 to emissions in the waste sector in 2015

2.8. Emission Trend by Categories

2.8.1. Solid Waste Disposal Systems

Solid waste management yields values for the waste not estimated to be burned which will decay based on the carbon content composition of the waste. It also considers the carbon stored in harvested wood products which can be discarded as part of the waste which may emit stored CO_2 during decomposition. The value for 2000 is 0.18 Gg of CH_4 or 3.78 Gg CO_2-eq as very little emission of CH_4 occurs in year 1 based on assumption that only food waste and paper/cardboard waste begin decomposition in the first month to be accounted in the first year. CH_4 emitted in 2015 is 64.17 Gg or 1347.57Gg CO_2-eq. The annual GHG Emissions from SWDS (2000-2015) is presented in Table 2.70.

Table 2.70 Emissions (Gg) from solid waste disposal systems (2000-2015)

Year	CH_4 emissions	CH_4 emissions CO_2
2000	0.18	3.78
2001	8.55	179.55
2002	15.8	331.8
2003	22.13	464.73
2004	27.7	581.7
2005	32.62	685.02
2006	37.02	777.42
2007	40.98	860.58
2008	44.6	936.6
2009	47.84	1004.64
2010	50.9	1068.9
2011	53.81	1130.01
2012	56.56	1187.76
2013	59.18	1242.78
2014	61.71	1295.91
2015	64.17	1347.57

2.8.2. Open Burning

Emissions from open burning comprise CO_2, CH_4 and N_2O. Emissions in the year 2000 were 48.64 Gg of CO_2, 20.37 Gg CH_4 or 427.77 Gg CO_2-eq and 0.268 Gg of N_2O corresponding to 83.08 Gg CO_2-eq. The emissions from 2015 are 69.94 Gg of CO_2, 29.3 Gg CH_4 or 615.3 Gg CO_2-eq and 0.385 Gg N_2O which corresponds to 119.35 Gg CO_2-eq (Table 2.71). All three GHGs increased by about 44% over the period 2000 to 2015. On a comparable basis in CO_2-eq, CH_4 was the major GHG emitted with 76.5%. N_2O and CO_2 emissions represented 14.8% and 8.7% respectively.

Table 2.71 Emissions from open burning (2000-2015)

Year	CO_2 (Gg)	CH_4 (Gg)	CH_4 (Gg CO_2eq)	N_2O (Gg)	N_2O (CO_2-eq)
2000	48.64	20.37	427.77	0.268	83.08
2001	49.81	20.86	438.06	0.274	84.94
2002	50.97	21.35	448.35	0.281	87.11
2003	52.18	21.86	459.06	0.288	89.28
2004	53.43	22.38	469.98	0.294	91.14
2005	54.72	22.92	481.32	0.302	93.62
2006	56.06	23.48	493.08	0.309	95.79
2007	57.44	24.06	505.26	0.317	98.27
2008	58.86	24.66	517.86	0.324	100.44
2009	60.33	25.27	530.67	0.332	102.92
2010	61.85	25.91	544.11	0.341	105.71
2011	63.41	26.56	557.76	0.349	108.19
2012	64.99	27.22	571.62	0.358	110.98
2013	66.62	27.91	586.11	0.367	113.77
2014	68.28	28.6	600.6	0.376	116.56
2015	69.94	29.3	615.3	0.385	119.35

Additionally. Open Burning results in emissions of pre-cursor gases which are depicted in Table 2.72. The methodology for estimation is based on information from Eastern Research Group, 2001. Emissions were marginal at 0.0000098 Gg of SO_2, 0.00084 Gg of CO and 000059 Gg of NO_x in the year 2015.

Table 2.72 Precursor gases from open burning (Gg)

Year	SO_2	CO	NO_X
2000	0.00000664	0.000564	0.0000398
2001	0.00000680	0.000578	0.0000408
2002	0.00000698	0.000593	0.0000419
2003	0.00000716	0.000609	0.0000430
2004	0.00000735	0.000624	0.0000441
2005	0.00000754	0.000641	0.0000452
2006	0.00000774	0.000658	0.0000464
2007	0.00000795	0.000675	0.0000477
2008	0.00000816	0.000694	0.0000490
2009	0.00000838	0.000712	0.0000503
2010	0.00000861	0.000732	0.0000517
2011	0.00000884	0.000752	0.0000531
2012	0.00000909	0.000772	0.0000545
2013	0.00000933	0.000793	0.0000560
2014	0.00000958	0.000815	0.0000575
2015	0.00000984	0.000836	0.0000590

2.8.3. Domestic Wastewater

Domestic Wastewater in Nigeria generates more emissions as CH_4 (63.9%) than N_2O (36.9%) when compared in CO_2-eq. The respective values for CH_4 and N_2O in 2000 were 389.08 Gg of CH_4 which translates to 8170.68 Gg CO_2-eq and 12.32 Gg of N_2O or 3819.2 Gg CO_2-eq. The values for 2015 are 576.91 Gg CH_4 or 12115.11 Gg CO_2-eq and 22.05 Gg of N_2O or 6835.5 Gg of N_2O. The increase over the review period is 79.0% for N_2O and 48.3% for CH_4. The Annual Emissions from Domestic Wastewater (2000-2015) is presented in Table 2.73.

Table 2.73 Emissions from the domestic wastewater sub-category (2000-2015)

Year	CH_4 (Gg)	CH_4 (Gg CO_2-eq)	N_2O (Gg)	N_2O (Gg CO_2-eq)
2000	389.08	8170.68	12.32	3819.2
2001	398.99	8378.79	12.63	3915.3
2002	409.25	8594.25	12.96	4017.6
2003	419.79	8815.59	13.52	4191.2
2004	430.72	9045.12	14.11	4374.1
2005	442.05	9283.05	14.96	4637.6
2006	453.8	9529.8	15.36	4761.6
2007	465.93	9784.53	15.77	4888.7
2008	478.5	10048.5	16.46	5102.6
2009	491.45	10320.45	17.17	5322.7
2010	504.78	10600.38	18.19	5638.9
2011	518.55	10889.55	18.68	5790.8
2012	532.7	11186.7	19.19	5948.9
2013	547.2	11491.2	20.02	6206.2
2014	561.96	11801.16	20.86	6466.6
2015	576.91	12115.11	22.05	6835.5

Table 2.74 Waste sector Sectoral Tables

Category	Emissions (Gg)						
	CO_2	CH_4	N_2O	NO_X	CO	NMVOCs	SO_2
4 - Waste	69.93548255	670.3694085	22.43157136	0.000059	0.000836	0	0.00000984
4.A - Solid Waste Disposal	0	64.16715762	0	0	0	0	0
4.A.1 - Managed Waste Disposal Sites				0	0	0	0
4.A.2 - Unmanaged Waste Disposal Sites				0	0	0	0
4.A.3 - Uncategorised Waste Disposal Sites				0	0	0	0
4.B - Biological Treatment of Solid Waste		0	0	0	0	0	0
4.C - Incineration and Open Burning of Waste	69.93548255	29.29723827	0.385371365	0	0	0	0
4.C.1 - Waste Incineration	0	0	0	0	0	0	0
4.C.2 - Open Burning of Waste	69.93548255	29.29723827	0.385371365	0.000059	0.000836	0	0.00000984
4.D - Wastewater Treatment and Discharge	0	576.9050126	22.0462	0	0	0	0
4.D.1 - Domestic Wastewater Treatment and Discharge		576.9050126	22.0462	0	0	0	0
4.D.2 - Industrial Wastewater Treatment and Discharge		0		0	0	0	0
4.E - Other (please specify)				0	0	0	0

3. Mitigation Actions and their Effects

Nigeria's key emission categories include the energy and AFOLU sectors amongst others. Significant scope exists for mitigation actions in these areas, namely reducing flaring in the oil and gas industry and the use of biomass from forestland. The latter needs to integrate the socio-economic status of the population, particularly the poorer segments. Furthermore, these actions should encompass the needs of a growing urban population.

Nigeria, as per its capabilities as a developing country and also making the most of market mechanisms, has been proactive in implementing mitigation actions across its socio-economic activities. Enhanced commitment is earmarked in the INDC of Nigeria, around which mitigation activities will revolve for the country to meet the targets given the conditional components are supported. Key measures include:

- Work towards ending gas flaring by 2030
- Work towards Off-grid solar PV of 13GW (13000MW)
- Efficient gas generators
- 2% per year energy efficiency (30% by 2030)
- Transport shift car to bus
- Improve electricity grid
- Climate smart agriculture and reforestation

The actions to be implemented unconditionally using national resources, are expected to reduce emissions by 20% from the Business As Usual (BAU) scenario. This reduction may further be increased with external support to 45% of the BAU scenario. With these measures, the country will be able to keep emissions at the current rate of 2 tonnes CO_2-eq per capita in 2030 with an annual economic growth of 5%. Without these measures, the per capita emissions are expected to reach 3 tonnes CO_2-eq per capita.

The estimated emissions avoided upon full implementation of the NDC by activity areas are summarized in Table 3.1.

Table 3.1 Estimated emission reduction by activity area

Measure	Potential GHG reduction (million tonnes per year in 2030)
Economy-wide energy efficiency	179
Work toward ending of gas flaring	64
Climate smart agriculture	74
Reduce transmission losses	26
Efficient gas power stations	102
Renewable energy	31

The different areas of the economy where mitigation potential have been identified and which will be addressed in the NDC are:

1. Energy

- Renewable energy, particularly decentralized
- Multi-cycle power stations
- Scalable power stations of 20-50 MW
- Enforced energy efficiency

- Use of natural gas rather than liquid fuels

2. Oil and Gas

- Improved enforcement of gas flaring restrictions
- Development of Gas-to-Power Plants at Gas Flare Sites (micro grid)
- Blending 10% by volume of Fuel-Ethanol with Gasoline (E10) and 20% by volume of Biodiesel with Petroleum Diesel (B20) for Transportation Fuels.

3. Agriculture and Land Use

- Climate Smart Agriculture
- Stop using charcoal

4. Industry

- Benchmarking against international best practice for industrial energy usage
- Adoption of green technology in industry

5. Transport

- Modal shift from air to high speed rail
- Moving freight to rail
- Upgrading roads
- Urban transit
- Toll roads/ road pricing
- Increasing use of CNG
- Reform petrol/ diesel subsidies

Additionally, Nigeria has implemented various mitigation actions using its own resources and through the Clean Development Mechanism. This chapter provides information about national policies, options and actions adopted by the Nigerian government to mitigate climate change, without compromising opportunities for economic growth and promoting low carbon sustainable development. The mitigation actions implemented by Nigeria have significant sustainable development benefits, in addition to their obvious climate change mitigation effect. Major GHG emitting sectors of the economy falling under all four IPCC sectors : Energy; IPPU, AFOLU and Waste. Detailed information of specific mitigation actions is provided further in this chapter.

The information on mitigation actions and their effects have been reported, to the extent possible, based on the guidelines on BUR as outlined in Decision 2/CP.17, Annex III, Section I V. However, due to the inexistence of an ideal archiving system in the country to track mitigation actions and record the outcomes, including a quantitative estimation of emissions avoided, this latter information has not always been provided. This situation resulted also from the fact that the country still lacks activity data and sufficient knowledge to construct baselines for quantifying emissions at various levels, notably at the facility or plant level. The information is provided in three classes for Nigerian supported activities namely, Estimated Emission by Activity Area (in Table 3.1), Clean Development Mechanism projects (Table 3.2) and Programme of Activities supported by Nigerian stakeholders and/or other partners (Table 3.3) with some of the latter addressing regional mitigation.

For the year 2015 under review, it is estimated that the CDM projects have resulted in an emission reduction of the order of 6967 Gg annually, the POA projects to a reduction of 215 Gg while emissions avoided by the locally funded projects have not been estimated due to the reasons already provided.

3.1.1. Detailed Information on Mitigation Actions

Table 3.2. Mitigation actions implemented or planned funded by Nigerian stakeholders

Name of action	Main objective	Description	Gases	Type	Status	Implementing entity	Progress indicators	Steps taken / envisaged	Methodologies / Assumptions	Outcomes achieved	Co benefits	GHG reductions (Gg)
National Climate Change Policy Response and Strategy (NCCPRS)	Foster low-carbon high economic growth, build climate resilient society Objective: Implement mitigation to promote low carbon sustainable high economic growth; enhance national capacity to adapt to climate change; Increase public awareness; involve private sector to address CC challenges; Strengthen national institutions and mechanisms for a suitable and functional CC Governance framework	The plan includes concrete targets in specific areas - climate change adaptation, afforestation, and energy supply – to help meet challenges	CO_2, CH_4, N_2O	Multi-sectoral	Adopted in 2012	Federal Executive Council	Comprehensive strategy, as well as a number of specific policies adopted	• Comprehensive strategy and several specific policies adopted • Awareness campaigns and public initiatives • CC mitigation efforts considered in policy plans and initiatives championed by several ministries, departments and agencies.	NA	NCCPRS implemented	- Sustainable development - economic growth	NA
The Nigerian National Biofuels Program	A national biofuel program to reduce dependence on imported gasoline **Objective**: - The creation and implementation of a National Biofuel Policy - Implementation of an Industry Biofuel Program	The Bio-fuel program constitutes a major and unique attempt to integrate the agricultural sector of the economy with the downstream petroleum sector	CO_2, CH_4	Energy	Ongoing	NNPC	The National Biofuel Policy and Incentive was born out of this program	• Biofuel Policy approved by Federal Executive Council • ETHANOL: 5 bankable feasibility studies + 3 ESIA studies with favourable economics developed • Confirmed 7 consortia as candidates, 2 MOUs signed BIODIESEL: Initiated feasibility study of oil palm sites	NA	8 projects worked out	Promote job creation, rural and agricultural development and technology acquisition and transfer Attract foreign investment in the biofuels industry	NA

Name of action	Main objective	Description	Gases	Type	Status	Implementing entity	Progress indicators	Steps taken / envisaged	Methodologies / Assumptions	Outcomes achieved	Co benefits	GHG reductions (Gg)
National Energy Policy	Framework for sustainable energy development to provide clean, affordable, adequate and reliable energy with participation of the private sector. **Objective**: - Ensure development of the nation's energy resources, diversify energy options, national energy security and efficient energy delivery with optimal energy mix. - Guarantee adequate, reliable and sustainable energy supply at appropriate costs for various sectors of economic development. - Ensure a comprehensive, integrated and well-informed energy sector plans and programmes for effective development. - Promote R&D in, and adoption of, sustainable low carbon and clean energy technologies to mitigate CC and environmental pollution - Promote efficiency, conservation and carbon management best practices in the energy supply chain - Ensure effective coordination of energy planning, programmes and policy implementation.	Ensure the development of the nation's energy resources, with diversified energy resources option, for the achievement of national energy security and an efficient energy delivery system with an optimal energy resource mix	CO_2	Energy	Draft	The Energy Commission of Nigeria	Policy drafted	Refer to objectives	NA	Draft framework produced	To promote gender sensitivity and special attention to rural energy needs. To ensure effective coordination of national energy planning, programmes and policy implementation. To foster international co-operation in energy trade and projects development	NA

Name of action	Main objective	Description	Gases	Type	Status	Implementing entity	Progress indicators	Steps taken / envisaged	Methodologies / Assumptions	Outcomes achieved	Co benefits	GHG reductions (Gg)
The Sustainable Energy for All (SE4ALL) Action Agenda	The key objectives of the SE4ALL initiative globally are to ensure universal access to modern energy services; doubling the global rate of improvement in energy efficiency; and doubling the share of renewable energy in global energy mix by 2030 compared to 2010	By 2030: 90% of population access electricity; RE contribute about 30% in electricity mix, 20% households use efficient lighting by 2015, 40% by 2020, almost 100% by 2030	CO_2	Energy	2012 - 2030	Inter-ministerial committee on Renewable energy and energy efficiency (ICREEE) National Council on power	Development of SE4ALL Action Agenda Followed by a high-level adoption meeting	In 2030: 90% population access electricity, RE is 30% of electricity mix and 40% households use efficient lighting	NA	Agenda produced	Emissions abated, better standard of living of population, improved health	NA
National Renewable Energy and Energy Efficiency Policy	Overall thrust is to optimize utilization of energy resources for development. Objective: Produce guidelines on all key components of energy efficiency by 2020, Ensure reduction in transmission/ distribution losses from 12-40% to under 10% by 2020, Enactment of all relevant legislation for policy implementation by 2020, Replace 40% (by 2020) and (by 2030) of old and inefficient appliances with energy efficient appliances; Replace all incandescent bulbs with LEDs and other energy saving ones by 2025; Reduce by 2025 energy-related GHG emissions by 15% of 2013 levels	NREEEP seek to achieve a renewable electricity target of 16% by 2030 as opposed to the current 1.3%	CO_2	Energy	Approved	Federal Ministry of Power and Energy Commission	National Renewable Energy Action Plan (NREAP) has been formulated based on the NREEP policy document	• Kick-off Meeting • Steering Committee/ ICREEE Meeting • Inception Meeting with Ministers of Power and PS • Thematic Working Groups Meetings, High Level Kick-Off of the AP and AA, Stakeholder Meeting/ Validation Workshop, Development of Baseline Report, Draft Baseline Report, NREAP, and NEEAP to ECREEE – 2014 • Backstopping Expert Review and Development of SE4ALL Action Agenda, Stakeholder Consultation Meeting • ICREEE adopted the NREAP, NEEAP & SE4ALL AA – 2015 • High Level Adoption/Validation 2016	NA	Policy approved	Security of energy supply Cost competitiveness and environmental protection Increase investment in the Renewable energy sub-sector	NA

Name of action	Main objective	Description	Gases	Type	Status	Implementing entity	Progress indicators	Steps taken / envisaged	Methodologies / Assumptions	Outcomes achieved	Co benefits	GHG reductions (Gg)
The Renewable Energy Master Plan (REMP)	REMP aims to articulate a roadmap for national development through the accelerated development and exploitation of renewable energy.	REMP seeks to increase the supply of RE from 13% of total electricity generation in 2015 to 23% in 2025 and 36% by 2030	CO_2, CH_4	Energy	2012 - yet to be approved	Energy Commission of Nigeria	Target set for power generation using biomass, solar, hydropower, and wind.	Increase RE electricity production from 13% in 2015 to 36% in 2030	NA	Roadmap under approval process	Stimulate economic growth and employment, Raise standard of living, in rural areas, Reduce environment degradation, health risks of vulnerable groups	
Federal Ministry of Power RE projects	Large Scale Hydro Power Projects: Objective Hydropower Development by FMPWH	1 - Zungeru project-700MW	CO2	Energy	Ongoing	Federal Ministry of Power	Federal Ministry of Power is engaged in the 10 MW Katsina Wind Project	6 hydropower stations to be commissioned,	NA	Sites identified and potential estimated	Better standard of living of population, better health through improved environmental quality, job creation	NA
		2 - Mambilla Project-3,050MW										
		3 - Gurara II Project-360MW										
		4 - Gurara I Project-30MW										
		5 - Itisi Project - 40MW										
		6 - Kashimbilla Project-40MW										
	Dam Projects: Construction and rehabilitation dams for hydropower electricity generation	Rehabilitate 33 dams, 27 small earth dams and 19 others with a total capacity of 3,557 MW					7 dams with a capacity of 2,269 million m^3 completed	7 dams rehabilitated or commissioned for a hydropower generation		All sites identified and 7 completed		
Ministry of Environment RE Projects: Biofuels	Biofuel Production	The development of a biofuel production complex in Ekiti state of Nigeria	CO_2	Energy	Planned	Ministry of Environment and Global Biofuels Ltd	Plan similar plants to be established at Ondo, Kwara, Osun, Oyo, Kogi, Kaduna, Kano, Zamfara, Benue Plateau, Nasarawa	11 biofuel plants to be developed	NA	One site identified and potential remaining ones planned	Emissions reduction, job creation, better air quality	NA

Name of action	Main objective	Description	Gases	Type	Status	Implementing entity	Progress indicators	Steps taken / envisaged	Methodologies / Assumptions	Outcomes achieved	Co benefits	GHG reductions (Gg)
Ministry of Environment RE Projects: Biofuels	This initiative is to produce sugar for local use and export, ethanol and ultimately electricity	Develop sugarcane based biofuel plants in Girei and Demsa hectares plantation	CO_2	Energy	Planned	RE Program Office, Adamawa State Government and Green Carbon Africa	This integrated project is being replicated in ten states of the country	12 ethanol and sugar production plants to be developed		2 sites identified and 10 planned	Economic benefit of producing sugar for export, job creation, better air quality	
Ministry of Environment RE Projects: Biofuels	Parties working to establish an integrated Rice Processing and Power Generating Facilitator	Large-scale rice production and self-generated power from rice-husk	CO_2	Energy	Planned	RE Program Office, Carbon Quest and Adamawa State	Project development under way	Establish an integrated rice processing and power plant		State identified for project	Economic benefit from producing rice	
Federal Ministry of Environment (FMENV) RE Projects:	Energy Efficiency: shift from firewood to clean cook stoves	Through the Alliance for Clean Stoves, sensitization to change the mind-set of the average Nigerian about firewood and introduce them cleaner cooking options	CO_2	Energy (Residential)	Ongoing	FME, Federal Ministry of Women Affairs and International Centre for Energy Environment and Development (ICEED)	Awareness campaign started	The alliance is to distribute 30 million clean and energy efficient cook stoves in 5 years	NA	Sensitization partly done	Healthier and cheaper option for clean cook stoves	NA
Federal Ministry of Environment (FMENV) RE Projects	Energy Efficiency	Incorporate micro generation of electricity, mainly solar and Bio-energy in housing schemes	CO_2	Energy (Residential)	Ongoing	FME and Aso savings and loans Plc	One project launched	First project launched in Kaduna with the prospect of containing 2000 Housing Units; other states to roll out similar housing schemes	NA	One project launched	residents get lower electricity bills	NA
Federal Ministry of Environment (FMENV) RE Projects	Energy Efficiency Rural Women Energy Security (RUWES)	Widespread deployment of clean cook stoves and solar lighting systems	CO_2	Energy (Residential)	Ongoing	MDGs and Federal Government of Nigeria's Transformation Agenda	More than 1.3 million women registered with RUWES, small off-grid lighting systems supplied	Small off-grid lighting systems that use light emitting diodes (LEDs) have been supplied to rural women	NA	more than 1.3 million women have registered	Less women and children are exposed to hazardous gases, To empower rural women	NA

Name of action	Main objective	Description	Gases	Type	Status	Implementing entity	Progress indicators	Steps taken / envisaged	Methodologies / Assumptions	Outcomes achieved	Co benefits	GHG reductions (Gg)
Federal Ministry of Environment (FMENV) RE Projects	Solar Power: NAIJA LIGHT Solar Electrification Programme	Federal Ministry of environment has patented products under the RE Access Program (REAP) in partnership with the Indian Government	CO_2	Energy	Ongoing	Federal Ministry of environment	RE products patented	Develop patent and production thereafter	NA	Patent developed	Better quality of life, emission reduction, job creation	NA
Nigeria Feed-in Tariff for Renewable Energy Sourced Electricity	An optimal economic instrument for hydro schemes not exceeding 30MW, all biomass cogeneration power plants, solar and wind-based power plants, irrespective of their sizes	Specific tariff regimes to be formulated by NERC shall be long term, guarantee buyers under standard contract at reasonable rate for return.	CO_2	Energy	Ongoing	Nigerian Electricity Regulatory Commission	Electricity distribution companies (Discos) to source at least 50% of their total procurement from renewables and 50% from the Nigerian Bulk Electricity Trading Company	By 2020, a total of 2,000 MW generated through biomass, small hydro, wind and solar	NA	14 PPAs initiated for about 1,125MW to the grid	Attract international investors	NA
UN-REDD Programme	The countries' efforts to reduce emissions from deforestation and forest degradation, and foster conservation, sustainable management of forests, and enhancement of forest carbon stocks	The Nigeria REDD+ Readiness Program foresees a twin-track approach: (i) the development of institutional and technical capacities at Federal level, and (ii) carrying out intense institutional, strategy-building and demonstration activities in Cross River State.	CO_2	AFOLU	Ongoing	Forestry department (FME) & Cross River State	Two additional states (Nasarawa and Ondo States) have joined the REDD+ programme since its inception in 2009	• Development of a National Strategy on Mitigating deforestation • Creation of a safeguard information Systems to help forest communities • Production of a draft "road map" for development of the National Strategy/Action Plan • Creation of a National Forest Monitoring System to track changes by MRV. Capacities of relevant	NA	Training on Forest monitoring and MRV; Forest Carbon Inventory; Image processing and interpretation of satellite imagery; and GHG Inventory for LULUCF held	Promotion of livelihood	NA

Name of action	Main objective	Description	Gases	Type	Status	Implementing entity	Progress indicators	Steps taken / envisaged	Methodologies / Assumptions	Outcomes achieved	Co benefits	GHG reductions (Gg)
								stakeholders enhanced at both federal and national level through capacity building workshops				
Federal Ministry of Environment : Solid Waste Program Interventions	Construction of Integrated Waste Management Facilities in 11 states	Construction of Integrated Waste Disposal & Management Facility in two other states	CH_4, N_2O	Waste	Ongoing	FMENV in conjunction with municipalities and individual States	Projects for other states in the pipeline	Project partly implemented	NA	Some facilities commissioned	Health benefits associated with Waste Management and disposal	NA
	Establishment of several Recycling interventions	Establish Scrap Metal Recovery Plant; Other Waste Recycling Facility; Multi-Purpose Plastic Recycling Plant; Pure Water Sachet Recycling Plant					Recycling activities promoted in informal sector, formal sector is increasingly becoming interested	Recycling activities identified		Implementation under way		
	Solid and Medical Waste Disposal intervention across the country	Procurement and installation of: Community Based Solid Waste Management Scheme; Hospital waste intervention schemes; Bio-Medical Waste Incinerators; Waste Disposal Trucks	CO_2, CH_4, N_2O	Waste			Draft National Policy on Solid Waste Management	Activities identified		Policy drafted	Benefits associated with Waste Management and disposal	NA

Name of action	Main objective	Description	Gases	Type	Status	Implementing entity	Progress indicators	Steps taken / envisaged	Methodologies / Assumptions	Outcomes achieved	Co benefits	GHG reductions (Gg)
Projects under the Lagos Waste Management Authority (LAWMA)	Integrated Waste Management; Landfill Construction and Management;	All are intended to improve and enhance the achievement of effective and efficient management of solid waste delivered to the population of Lagos.	CH_4, N_2O	Waste	Completed; Ongoing; & Proposed Projects	LAWMA	9 landfills completed; 4 Ongoing; and 4 proposed projects under commission	1. Rehabilitation of infrastructure in landfill Olusosun 2. Rehabilitation and provision of infrastructure at EGBA Solous Abule- 3. Supply and installation of Pollution Control Team -Olushosun Landfill Simpson 4. Renovation and improvement of waste Load Transfer Station 5. Stabilization Ewu-LP landfill road 6. Supply of 3 Tana Landfill Compactors 7. Environmental and social impact assessment of all solid waste landfills and 2 TLS (Olushosun, Abule Egba and Solous)	NA	9 landfills completed projects	Improved health of population, better cleaner environment	NA
Programs Under the Federal Ministry of Agriculture and Rural Development	Manage farm Run-Off water; Harvesting Structures; Sustainable Aquaculture; Develop Jatropha Plantations; Conservation agriculture; Agro-forestry; Improve Soil and Nutrient Management; Urea Deep Placement Technology; Briquet production	Implementation of diverse multi-level Agriculture related programmes	CO_2, CH_4, N_2O	AFOLU	Completed; Ongoing; & proposed Projects	Federal Ministry of Agriculture and Rural Development	All projects are intended to mitigate GHG emission sources in the Agricultural Sector	Some actions implemented and others under way	NA	Project partly implemented	Economic and Social benefits from agricultural projects, Food security, emission reduction	NA

Name of action	Main objective	Description	Gases	Type	Status	Implementing entity	Progress indicators	Steps taken / envisaged	Methodologies / Assumptions	Outcomes achieved	Co benefits	GHG reductions (Gg)
Lagos Bus Rapid Transit (BRT)	Lower bus fares, improved road network, more efficient bus transport system	Provision of affordable transportation, better road network, and public transport with faster and reliable journey times	CO_2	Energy: Transport	Ongoing	Lagos Metropolitan Area Transport Authority (LAMATA)	LAMATA has plans to implement the BRT system strategically along eight different corridors within the metropolis.	Reduce fares by 30% on average and fare stability, 40% in journey time, 35% in average waiting time; Over 400 million passengers carried, Average daily ridership is 180,000 passengers, Average Load factor of 800 passengers daily per bus, Average waiting time is 15 mins; LAMATA plans to implement the BRT system strategically along eight different corridors within the metropolis	NA	Reduced ambient concentration of pollutants, 1000 direct jobs, and over 500,000 indirect jobs	Improved lifestyle of people and businesses along the corridor with good linkage to major activity and recreation centres	NA

Table 3.3 Mitigation actions implemented under the CDM financial mechanism

Name of action	Main objective	Description / Sector	Gases	Type	Status	Implementing entity	Progress indicators	Steps taken / envisaged	Methodologies / Assumptions	Outcomes achieved	Co benefits	GHG reductions/ yr (Gg)
Recovery of associated gas that would otherwise be flared at Kwale oil-gas processing plant, Nigeria	The capture and utilization of majority of associated gas previously sent to flaring at the Kwali Plant (Kwali OGPP).	CDM, project, Energy (Oil and Gas)	CO_2, CH_4	Natural	Ongoing, Registered 9 Nov 2006 ending 2015	Eni Nigeria Agip Oil Company	Project successful	Project completed and extended	AM0009 ver.2	Recovered gas leading to emission reduction	Emissions reduction, better air quality	1497
Pan Ocean Gas Utilization Project	To eliminate gas flaring at the Ovade - Ogharefe and the Obi - Anyima oil fields operated by Pan Ocean oil corporation in a joint venture partnership with NNPC	CDM, project, Energy (Oil and Gas)	CO_2, CH_4	Natural	Ongoing, Registered 01 Feb 2009 ending 2020	NNPC & Pan Ocean Corporation (Nigeria)	Project successful	Project to continue	AM0009 ver.2	GHG emission avoided	Emissions reduction, better air quality	2627

Name of action	Main objective	Description / Sector	Gases	Type	Status	Implementing entity	Progress indicators	Steps taken / envisaged	Methodologies / Assumptions	Outcomes achieved	Co benefits	GHG reductions/ yr (Gg)
Efficient Fuel Wood Stoves for Nigeria	To disseminate up to 12,500 efficient fuel wood stoves (SAVE80) and heat retaining polypropylene boxes in different states located in the Guinea Savannah Zone of Nigeria.	CDM, project, Energy (EE)	CO_2	Natural	Ongoing, Registered 12 Oct 2009 ending 2019	Nigeria Developmental Association for Renewable Energies (DARE), the German NGO Lernen-Helfen-Leben e.V and the German carbon offset organization Atmosfair gGMBh	Project successful	Project to continue	AMS-II.G.	GHG emission avoided	Emissions reduction, better air quality, forest preservation	31
Recovery and marketing of gas that would otherwise be flared at the Asuokpu/Umutu Marginal Field, Nigeria	Recivered gas that is currently and in the future would be flared at the Asuokpu/Umutu Marginal Field in Block OML 38 in Nigeria to deliver it to the domestic market for productive use as an energy product.	CDM, project, Energy (Oil and Gas)	CO_2, CH_4	Natural	Ongoing, Registered 16 Oct 2010 ending 01 May 2021	Platform Petroleum Ltd and Newcross Petroleum Ltd and Carbon Limits AS	Project successful	Project to continue	AM0009 ver.4	GHG emission avoided	Emissions reduction, better air quality	257
Municipal Solid Waste (MSW) Composting Project in Ikorodu, Lagos State	Provision of Environment Friendly waste disposal option and produce high quality compost for use in Nigeria Farms.	CDM, project, Waste	CO_2, CH_4, N20	Natural	Ongoing, Registered 15 Dec 2010 ending 2017	EarthCare Nig Ltd; International Bank for Reconstruction and Development as the trustee for the Carbon Fund for Europe (CFE); Ministry of Sustainable Development and Infrastructure; Department of the Environment, Community and Local Government; Viaamse Gewest; Statkraft Carbon Invest AS	Project successful	Project to continue	AM0025 ver.11	GHG emission avoided	Emissions reduction, better environment	282
LFG project in Nigeria	To build, operate and maintain a landfill gas collection and flaing system on three landfills in Lagos, Nigeria at Abule Egba, Solous & Olushosun.	CDM, project, Waste (waste handling and disposal)	CO_2	Natural	Ongoing, Registered 12 Jul 2012 ending 2023	Lagos Waste Management Authority; & Ably Carbon	Project successful	Project to continue	ACM0001 ver.12	GHG emission avoided		130

Name of action	Main objective	Description / Sector	Gases	Type	Status	Implementing entity	Progress indicators	Steps taken / envisaged	Methodologies / Assumptions	Outcomes achieved	Co benefits	GHG reductions/ yr (Gg)
Afam Combined Cycle Gas Turbine Power Project	To produce a 650MW grid - connected combined - cycle gas turbine CCGT fuelled by natural gas.	CDM, project, Energy (renewable sources	CO_2	Natural	Ongoing, Registered 29 Oct 2012 ending 2022	Shell Petroleum Development Corporation SPDC	Project successful	Project to continue	AM0029 ver.3	GHG emission avoided		550
Lafarge WAPCO Partial Substitution of Alternative Fuels in Cement Facilities Project in Nigeria	To partially replace fossil fuel used in pyro processing with lower carbon alternative fuels, primarily biomass residue, thus resulting in measurable reductions of GHG emissions in Nigeria.	CDM, project, Energy (Manufacturing Industries)	CO_2	Natural	Ongoing, Registered 18 Dec 2012 ending 2022	Larfarge Cement WAPCO Nig Ltd; Carbon Limits Nig. Ltd; & Larfarge S.A.	Project successful	Project to continue	ACM0003 ver.7	GHG emission avoided		167
Recovery and Utilization of Associated Gas from the Obodugwa and neighboring oil fields in Nigeria	To implement the infrastructure to allow for the utilization of the associated gas that is currently flared from two oil fields in OML56 In Delta State Nigeria thereby reducing the flaring of associated gas and thus emission of CO2 into the atmosphere.	CDM, project, Energy (Oil and Gas)	CO_2	Natural	Ongoing, Registered 24 Dec 2012 ending 2024	Xenergi Oilfield Services Limited; Midwestern Oil & Gas Company Plc; & Carbon Limits Nigeria Limited	Project successful	Project to continue	ACM0009. ver 5	GHG emission avoided		288
Kainji Hydropower Rehabilitation Project, Nigeria	Rehabilitation of Kainji Unit 5,6 & 12 to provide additional power supplies to the grid and also to ensure that the incremental power is generated from renewable sources.	CDM, project, Energy industries (renewable)	CO_2	Natural	Ongoing, Registered 28 Dec 2012 ending 2024	PHCN; International Bank for Reconstruction and Development; & Swedish Energy Agency	Project successful	Project to continue	ACM0002 ver.12	Emission Reduction and improved power generation		873
OML58 IPP Gas Fired Generation Project	The construction of a combined cycle, gas powered independent power plant (IIP) in the Niger Delta region in Nigeria to provide sustainable electricity to the Nigerian national grid on an on -going, reliable basis.	CDM, project, Energy industries (energy generation)	CO_2	Natural	Ongoing, Registered 16 Dec 2014 ending 2025	Nigeria National Petroleum Corporation NNPC; & Total E & P Nigeria Ltd	Project successful	Project to continue	AM0029. ver.3	Emission Reduction		265
Total emission reduction from projects/yr												**6967**

Table 3.4 Mitigation actions implemented under the Programme of Activities

Name of action	Description, objective	Sector	Gases	Type	Status	Implementing entity	Progress indicators	Steps taken / envisaged	Methodologies / Assumptions	Outcomes achieved	Co benefits	GHG reductions (Gg)
Cable Propelled Mass Transit Projects in Nigeria	To reduce carbon emissions relative to road transport in heavily trafficked urban areas in Nigeria by the introduction of innovative cable propelled mass transit that reduces CO2 emissions per passenger	Energy (Transport), Nigeria	CO_2	Natural	Ongoing, registered 18 Mar 2016 ending 2041	Ropeways Transport Ltd Nigeria	Project successful	Project to continue	AMS-III.U.	Emission Reduction, improved air quality	Improved air quality, emissions reduction, Health benefits	24
Distribution of Improved Cook Stoves in Sub-Saharan Africa	The promotion and distribution/installation of fuel - efficient cook stoves in different countries in Africa.	Energy (EE) Senegal Ghana, Nigeria	CO_2	Natural	Ongoing, registered 25 Apr 2013 ending 2040	C - Quest Capital Malaysia Global Stoves Limited	Project successful	Project to continue	AMS-II.G. ver.4	Emission Reduction, improved air quality	Improved air quality, emissions reduction, Health benefits	39
EE of Nigeria's Residential Lighting Stock by distributing up to 40 Million Compact Fluorescent Lamps (CFLs) to households	To replace incandescent bulbs with quality long life compact fluorescent lamps used in most grid connected residential households in Nigeria.	Energy (EE), Nigeria	CO_2	Natural	Ongoing, registered 31 Dec 2012 ending 2041	Icimi Ltd	Project successful	Project to continue	AMS-II.J ver.4	Emission reduction, energy efficiency	Improved air quality, emissions reduction, Health benefits	29
African Improved Cooking Stoves POA	The dissemination of improved cooking stoves in the Federal Republic of Nigeria.	Energy (EE), Ghana, Nigeria, Liberia	CO_2	Natural	Ongoing, registered 06 Dec 2012 ending 2039	NA	Project successful	Project to continue	AMS-II.G. ver. 3	Emission Reduction, improved air quality	Improved air quality, emissions reduction, Health benefits	15
Reduction of emission from nonrenewable fuel from cooking at household level	Replace non-renewable fuel with renewable fuel for household cooking that voluntarily want to take part in the CPA project through the lease or buying of an ethanol or biogas stove, household water purifying kit or buying water from community based water purification systems	Energy (EE), Nigeria and 18 other African countries	CO_2	Natural	Ongoing, registered 30 Nov 2012 ending 2040	Green Development AS	Project successful	Project to continue	AMS-I.E. ver.4	Emission Reduction, improved air quality	Improved air quality, emissions reduction, Health benefits	51
Distribution of fuel-efficient improved cooking stoves	To promote, distribute and sell fuel - efficient improved cooking stoves in Nigeria.	Energy (EE), Nigeria	CO_2	Natural	Ongoing, registered 07 Nov 2012 ending 2040	C - Quest Capital LLC	Project successful	Project to continue	AMS-II.G. ver.3	Emission Reduction, improved air quality	Improved air quality, emissions reduction, Health benefits	47

Name of action	Description, objective	Sector	Gases	Type	Status	Implementing entity	Progress indicators	Steps taken / envisaged	Methodologies / Assumptions	Outcomes achieved	Co benefits	GHG reductions (Gg)
Improved Cooking Stoves for Nigeria POA	To enhance the penetration of efficient cooking stoves by offering cost effective efficient stoves.	Energy (EE), Nigeria	CO_2	Natural	Ongoing, registered 10 Nov 2011 ending 2039	Atmosfair GmbH	Project successful	Project to continue	AMS-II.G. ver.3	Emission Reduction, improved air quality	Improved air quality, emissions reduction, Health benefits	9
Total emission reduction from POA/yr												**215**

4. Information on Domestic Measurement Reporting and Verification

4.1. Introduction

The Bali Action Plan introduced the principle of measurement, reporting and verification (MRV) for both developed and developing country Parties towards enhancing action at the international and national levels to mitigate climate change. Decision 1/CP.13 of the Bali Action Plan states, in its operative paragraph 1(b), that "enhanced national/international action on mitigation of climate change" would include consideration of, inter alia for developing country Parties:

"Nationally appropriate mitigation actions by developing country Parties in the context of sustainable development, supported and enabled by technology, financing and capacity-building, in **a measurable, reportable and verifiable** manner;"

Paragraphs 61 and 62 of decision 1/CP.16 make it mandatory for non-Annex I Parties to also Measure, Report and Verify domestically and internationally supported mitigation actions with the latter also subject to international MRV. MRV promotes transparency and accuracy of mitigation information while enabling tracking of emissions reductions and support received and needed for implementing mitigation actions. Hence, the need for non-Annex I Parties to develop and implement a domestic MRV system to honour their commitment under this decision.

4.2. General Procedures, Principles and Requirements for MRV

Under the Convention, Parties are encouraged to establish the following general procedures to optimize limited resources for domestic MRV:

- Designate a single entity responsible for overall coordination of domestic MRV;
- Assign roles and responsibilities for implementation of the domestic MRV system, including identifying entities responsible for collection and management of source/relevant data;
- Construct timelines and work plans that include all stages of MRV and ensure sufficient time and resources are available to enable entities follow best practices;
- Collect sufficient activity data, process information and emission factors, and/or other metrics (source/relevant data) as are necessary to support the quantification of emissions and removals, to track the impact of the implementation of emission reduction activities, and to subsequently verify the method chosen and its reported impact;
- Measure emissions/removals or other performance metrics of nationally appropriate mitigation actions, evaluate progress of those actions and feed back for the development of enhanced mitigation actions and needs of support; and
- Consider ways to improve quality of data and other information, taking into account QA/QC results, and outputs of any analysis processes.

To ensure integrity of the domestic MRV system, the process should be guided by the five reporting principles of the IPCC Good Practice Guidance (GPG), which are consistency, transparency, comparability, completeness and accuracy of information (UNFCCC, 2009). Nigeria intends to align to these principles when developing its domestic MRV system.

4.3. Development of the MRV System of Nigeria

MRV calls for the measurement and reporting of countries' climate mitigation actions. Information helps understand the current emissions profile; enables estimates of emission reductions, allows future emissions to be targeted more effectively and helps responsible ministries and agencies to be accountable to domestic constituencies. Concurrently, MRV demonstrates to donors how cost-effective policies and programmes are and serves to secure their continued support.

The development and establishment of a domestic MRV system represents a serious challenge to non-Annex I countries as it is a new and additional responsibility within the framework of the preparation of BURs. Nigeria has some initiatives and existing capabilities within its present monitoring and evaluation system that can serve as basis for the development of the domestic MRV system after appropriate improvements and modifications. Institutionalization of the MRV will ensure that all resource requirements are considered and accounted for in advance and the necessary mechanisms are put in place to address all issues that may arise on a continuous and systematic way rather than on an ad-hoc basis.

A preliminary analysis, performed in view of the development of the domestic MRV system for tracking emissions, mitigation activities, and support needed and received, revealed the need for completion of the following steps:

- Establishment of baselines or references based on current practices and available information;
- Identification and description of existing institutional arrangements, monitoring and evaluation systems, and current capacity to address the MRV indicators and areas;
- Identification and assessment of the gaps, barriers, and challenges in the development of the MRV system to enable their correction; and
- Identification of existing opportunities that could enhance the MRV capabilities while proposing interlinkages and synergies for the preparation of national reports.

4.4. Proposed Institutional Framework

The MRV system reflects Nigeria's national circumstances with the underpinning legal framework spanning over different administration/government levels. It contains both mandatory and voluntary components. The Federal Ministry of Environment will spearhead the domestic MRV system in collaboration with the other Federal Ministries through the line MDAs and State government representatives in the Inter-Ministerial Committee. The Department of Climate Change of the Federal Ministry of Environment is the focal entity to coordinate and supervise the institutional arrangements through its technical departments, themselves overseeing the more detailed activities of the working groups. The latter will comprise representatives from various line ministries, state and local governments, private sector, civil society organizations, educational and research organizations as appropriate according to specificity of activities. The proposed institutional framework for Nigeria's MRV is depicted in Figure 4.1.

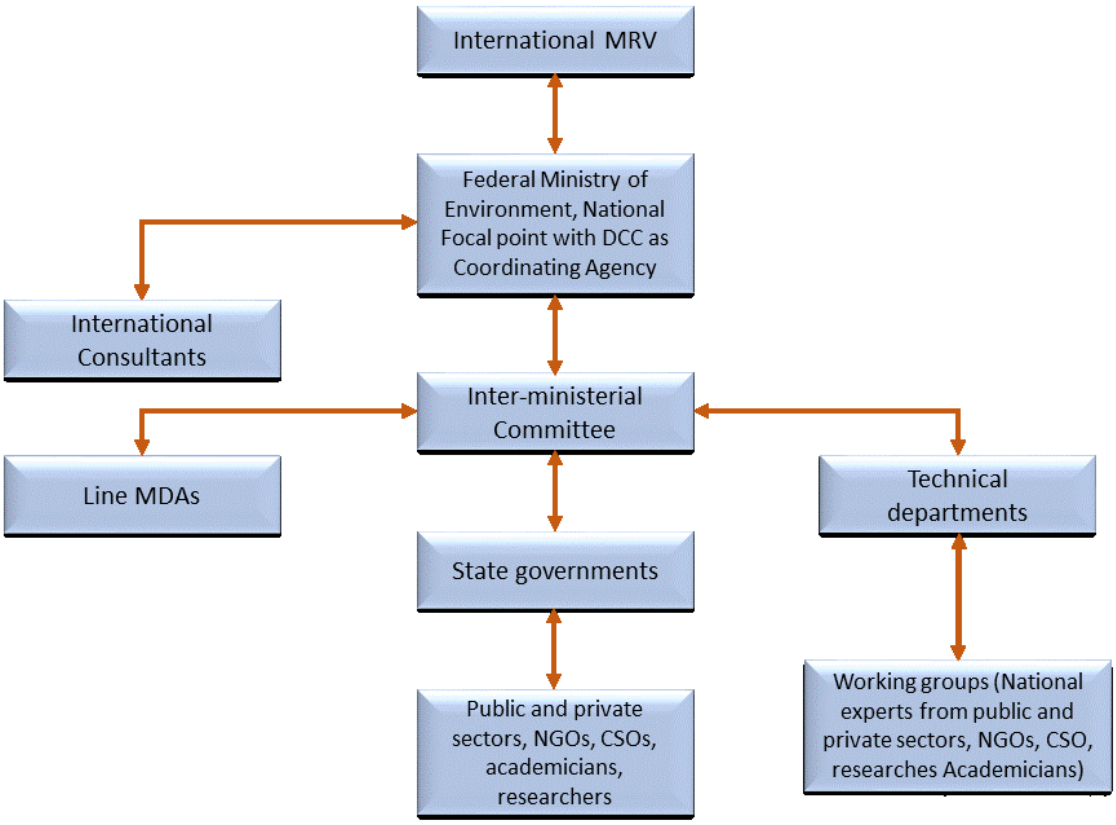

Figure 4.1 Institutional framework for Nigeria's domestic MRV

The Inter-Ministerial Committee provides a common coordination platform to harness the many relevant climate datasets that are available in different government departments and in private organizations. The committee is to meet regularly to receive reports from all line Ministries, Departments and Agencies. The role of the Inter-Ministerial Committee will be to collate and integrate information on implementation of the Climate Convention from all concerned stakeholders, including on emissions, mitigation and support needed and received.

The legal framework underpinning Nigeria's MRV system should consider the following to increase system efficiency:

- It should be devoid of bureaucratic bottlenecks. It must be kept simple!
- The establishment of clear guidelines, deadlines and QA/QC procedures are fully in the system to ensure credibility of the reported information and on-time delivery.
- Companies and industries must be encouraged to provide the data and information needed to support a national MRV system on a voluntary basis.
- Legislations governing confidentiality of data and their capture must be enacted if necessary.
- It is vital to design and implement a proper information management system to monitor, manage and archive MRV data and information over time.

The activities of the different elements of the MRV cycle that will range from planning through to submission of reports are depicted in Table 4.1.

Table 4.1 Activity cycle of the proposed domestic MRV system

Cycle stage	Description
Planning	• Identify contributing organizations, Appoint team members, Establish coordination mechanisms, Agree on the approval process, Plan funding allocation

Cycle stage	Description
	and budget, etc
Preparation	• Hold first coordination meeting, Consult stakeholders, Agree to milestones and timelines, Oversee schedule and milestones, Hold check-in meetings, Collect and validate relevant data
Reporting	• Review first draft, Compile and finalize all information, Edit and create report, prepare for approval process
Documentation and archiving	• Establish procedures to ensure regular and systematic documentation and archiving to enhance transparency and ensure sustainability
Evaluation	• Identify lessons learned, strengths, weaknesses and opportunities for improvement
Consultation process	• Validate reports through consultation with national stakeholders
Approval and submission	• Government authority approves and submits reports to the COP

Source: Adapted from UNFCCC. *Toolkit for Non-Annex I Parties on Establishing and Maintaining Institutional Arrangements for Preparing National Communications and Biennial Update Reports.*

4.5. GHG Inventory Management System

Preparation of the GHG inventory for the First and Second National Communications of Nigeria were mostly led by individuals who worked with government, consultancy firms or freelance consultants. There was no management system to oversee and coordinate the different steps of the inventory cycle for the compilation of a quality inventory. This arrangement suited the ad-hoc preparation of inventories for reporting in the past but no longer fits the present situation for enhanced reporting as per Decision 1/CP16. It is considered not sustainable. Hence, there is need to put in place a National Inventory Management System (NIMS) that guarantees sustainability and quality through effective institutional arrangements to produce inventories that are transparent, complete, consistent, comparable and accurate as per IPCC best practices. Good quality inventories will also serve to support and inform policy decisions with respect to appropriate response measures.

Nigeria has already started developing the NIMS with the creation of a GHG inventory division within the DCC of the Federal Ministry of Environment. This division has the responsibility for producing good quality GHG inventories that are compliant and of the standard required by IPCC. This division operates with two sections, one each for GHG inventory reporting and databasing components. The present network of institutions collaborating in the production of the GHG inventories will be strengthened to be robust enough to deliver on the various components of the NIMS. These components are:

- Institutional Arrangements;
- Method and Data Documentation;
- QA-QC procedures;
- Archiving systems;
- Key Category Analysis; and
- National Inventory Improvement Plan.

It should however be highlighted that this is a major challenge for the country and it will take time to develop and implement the NIMS, make it fully operational and sustainable over time. Hence, capacity building will be an integral part when developing the NIMS including the Institutional Arrangements. Nigeria relies on the support of bilateral and multilateral partners to fully implement its sustainable NIMS. The proposed Institutional Arrangements for GHG inventory is given in Figure 4.2.

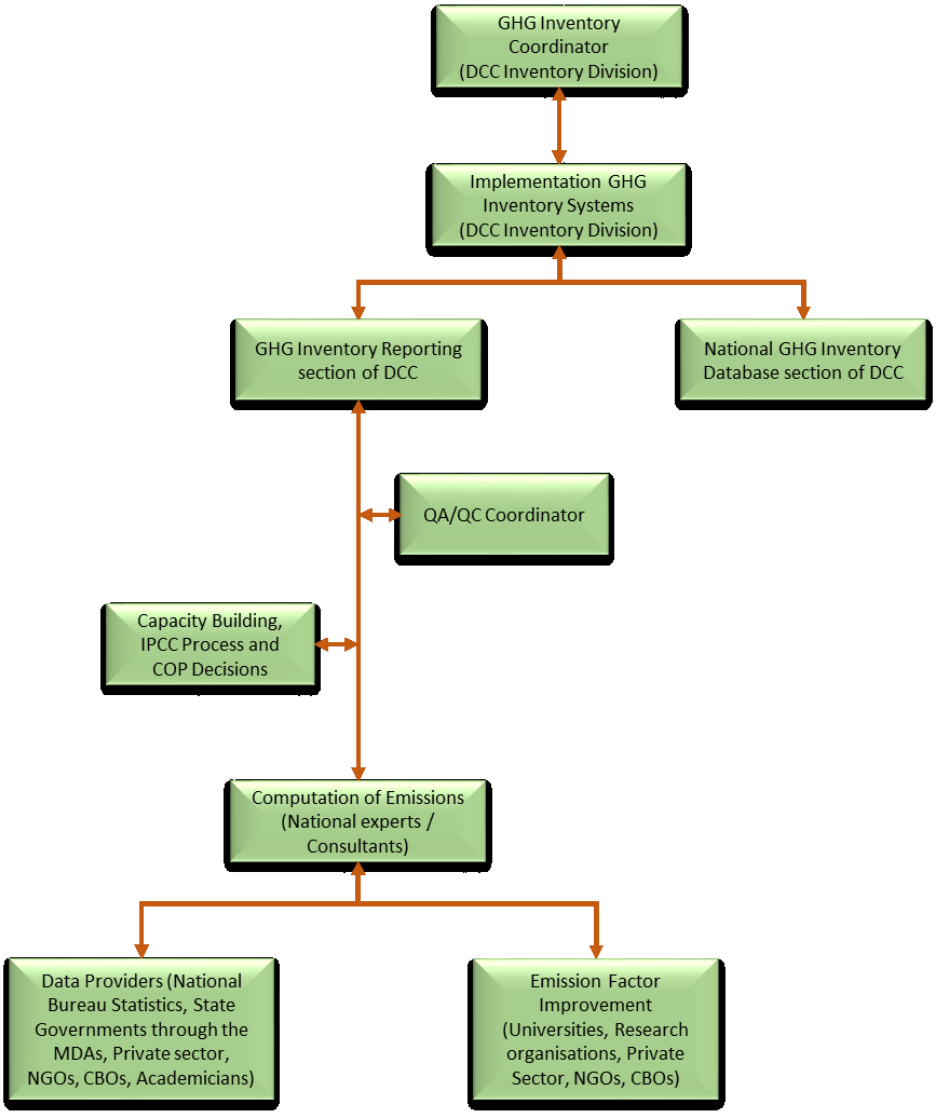

Figure 4.2 Institutional arrangements for GHG inventory preparation

4.6. MRV of Emissions

MRV of emissions seeks to measure, report and verify quantifiable emissions data at national, regional and plant levels for activities falling under the four IPCC sectors. Institutionalization of the MRV system is deemed essential to improve the flow of information, to monitor emissions for primarily meeting the reporting requirements and also to inform and support national planning, implementation and coordination of mitigation activities.

DCC, as focal Department, will be tasked with collating and integrating information on climate change implementation across government departments. Consequently, the GHG Division of the DCC will oversee all activities of the system for MRV of emissions through the two sections described under the Institutional Arrangements for compilation of inventories. The National Bureau of Statistics will be responsible for collecting activity data from public institutions and private sector companies, the various line ministries, State and local governments and the civil society. Research organizations and universities will support in the assessment of the appropriateness of IPCC default emission factors and their improvement to better suit national circumstances where possible. DCC will take charge of preparation of the report, its review by stakeholders, approval and submission to the COP.

There will be continuous assessment and enhancement of institutional arrangements to ensure methodologies and activity data collection, particularly for GHG inventories are up to date for making best estimates of emissions and removals. Current UNFCCC and IPCC mechanisms will be adopted to guarantee a functional system. The MRV of emissions will incorporate best practices from other countries. There will be an inventory improvement plan to ensure continuous improvement of the process (Figure 4.3).

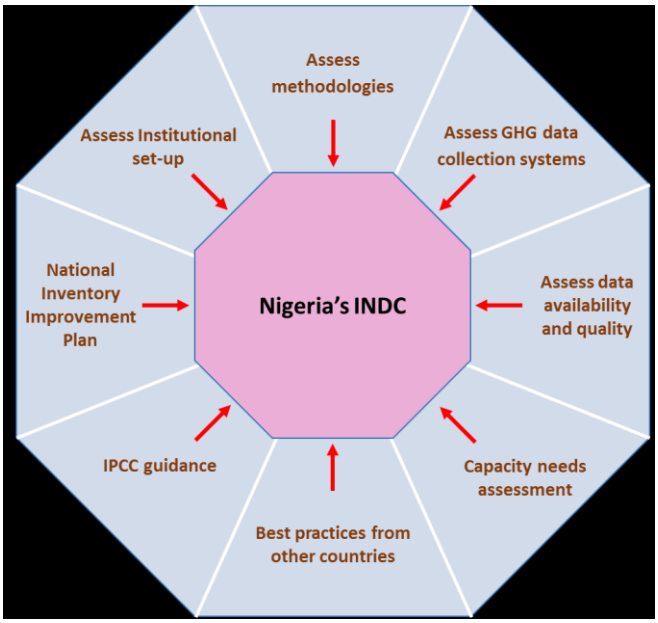

Figure 4.3 Plan for development of MRV for emissions for Nigeria

The major challenges regarding the implementation of the MRV of emissions in Nigeria include inadequate capacity, absence of a legal framework and inadequate understanding of GHG emissions across stakeholders.

4.7. MRV Mitigation Actions including NAMAs

Nationally Appropriate Mitigation Actions (NAMAs) constitute a central instrument to support developing countries' efforts in achieving their GHG emission reduction targets towards a low carbon economy. MRV of NAMAs are essential to track progress and allow for backstopping of mitigation actions. In addition, MRV cycles help to inform, understand and correct deviations between projected and real performance, therefore triggering the necessary learning process.

Measuring for NAMAs should primarily enable the country to compute GHG emissions reductions and removals depending on their nature. As well, measurement is a must to record impacts, ascertain the assumptions adopted in the projects, and compare different mitigation actions. This component will also track and record support received and investments made during implementation of the NAMA or other mitigation action. The framework should also conform with good practices and be flexible enough to accommodate adjustments and changes with time to ensure success of the action.

Reporting for NAMAs is likely to comprise the emission reduction achievements, updated data on baseline(s), and other key performance data related to implementation as well as resources invested. This component may require reporting at different levels depending on the complexity and means of implementation. Supported NAMAs will need detailed reporting, consequently requiring the responsible unit to work closely with the actual implementing entity of the NAMA. Reporting on a NAMA should be

at least annually for all institutions involved. This information would then be integrated every 2 years into the BUR for the UNFCCC.

Verifying NAMAs serves to build trust and confidence among stakeholders involved. In the case of supported NAMAs, it will serve as a safety standard for support provided and received. Verification enables opportunities for improvement on measurement and reporting and will be helpful when comparing different NAMAs. This component will focus on activity data, emission factors, estimated emissions, financial resources, the method and assumptions adopted. In case of supported and credited NAMAs, verification will be expected to comply with international guidelines and standards whereas for unilateral NAMAs, the host country might assign verification to a national body conversant with verification procedures and standards. As far as possible, the frequency of verification of NAMAs should be aligned with the production of the BUR.

The overall responsibility of the MRV system for mitigation, including NAMAs will rest with the Federal Ministry of Environment through the Mitigation Division of the DCC supported by the GHG Inventory Division. The Mitigation Division will track and follow the different steps of the MRV system depicted in Figure 4.4 while estimation of emission reductions stemming from the mitigation activity will be computed by the inventory team of the GHG inventory Division. The Measurement component will be under the responsibility of the Executing Entity (EE) which will also prepare regular monitoring reports and submit to the NAMA implementing Entity for follow-up. The latter will then submit to the NAMA Coordinating Agency, namely the Mitigation Division of the DCC for verification and approval for further transmission to the appropriate authority for verification. Once the latter process is satisfactorily completed, the final report will be commissioned and submitted to the NAMA Donor or other collaborating/supporting partner depending on the type of NAMA. Other mitigation activities will follow a similar process. The implementation details, support received, emission estimates and other benefits derived from the activity will then be included in the next BUR for submission to the UNFCCC.

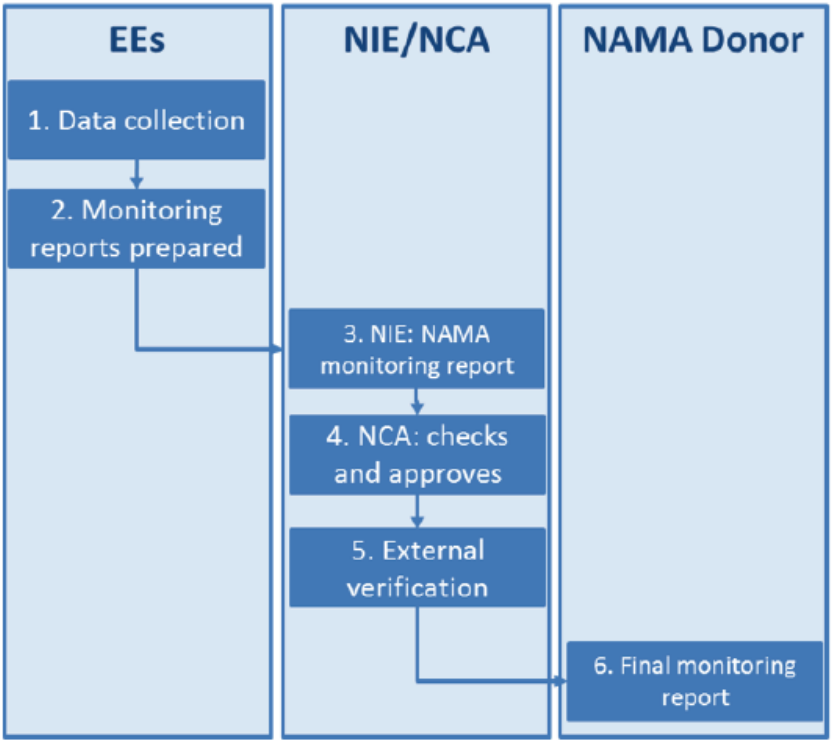

Figure 4.4 NAMA MRV process

Source: UNDP 2015 (EE: Executing Entity; NCA: NAMA Coordinating Agency; NIE: NAMA Implementing Entity)

4.8. Main Gaps and Barriers in MRV of NAMAs and Other Mitigation Actions in Nigeria

Implementation of the MRV for NAMAs in Nigeria faces many gaps and barriers in capacities, technical skills and data availability in all sectors. These gaps and barriers (Table 4.2) must be taken into consideration when developing and implementing the MRV process.

Table 4.2 Identified MRV gaps and barriers in all sectors

Elements	Sectors					
	Environment	Energy	Transport	Industry	LULUCF	Waste
Templates for reporting raw data for GHG estimation	PA	PA	PA	A	PA	A
Templates for reporting GHG emissions	PA	PA	PA	PA	PA	A
Availability of trained staff for activity data collection	PA	A	PA	A	PA	PA
Training of staff for GHG estimation	A	PA	PA	NA	PA	PA
A system for reporting raw data relevant to GHG estimation	PA	PA	PA	A	PA	A
A system for reporting GHG emissions	NA	PA	PA	PA	PA	PA
Availability of procedures for the flow of data	PA	PA	PA	PA	PA	PA
Clear roles and responsibilities of different stakeholders	PA	NA	PA	A	PA	PA
QA/QC system for the reports	PA	PA	PA	A	PA	PA
Documentation of data sources, assumptions and calculation methodologies	PA	PA	PA	A	PA	A
Others						
Social Barrier	Given the socially accepted use of traditional sources of energy consumption, the introduction of new technologies in energy for instance could be a barrier					
Economic Barrier	Any MRV system with a high investment cost and long pay-back period is likely to receive very low buy-in from government and other stakeholders.					
Technology barrier	Very limited technologies exist for setting up innovative MRV system					

(A- Available, PA – Partly Available, NA – Not Available)

Source: Adapted from Mike Bess, Assen Gasharov, 2016: Climate MRV for Africa-Phase 2: Capacity Building Plan for Nigeria. Presented at Inception workshop at Shehu Musa Yar'adua Centre (25/10/2016)

4.9. MRV of Support

Direct support from bilateral and multi-lateral partners for climate change activities can be of financial, technical and technological nature notwithstanding capacity building of national experts on various thematic areas since Nigeria ratified the Convention. Climate Change expenditure has hardly been a dedicated sub-head in the past national budgets, while climate change related activities are generally embedded into other development projects under several MDAs. Similarly, although the Federal Ministry of Environment is the focal point for activities falling under the UNFCCC and the international climate regime, nothing precluded other MDAs from cooperating and receiving support for their mandated activities that are climate related. This creates a situation of multiple inflows in the form of grants to several MDAs without a single centralized tracking system. Even where there are budgetary allocations for climate related activities, the legislative oversight for ensuring monitoring and

accountability are weak because of the lack of capacity and absence of a template for the review of the climate public expenditure.

The Nigerian private sector is quite robust and with the adoption of sustainability principles in critical economic sectors, market-based inflows are soaring, yet without a system to aggregate the inflows. The Ministry for Budget and National Planning coordinates all international development assistance and ought to provide such framework. This situation depicts clearly the absence of a dedicated system to MRV support received. Nigeria will develop and implement an MRV system to track support received. The Federal Ministry of Environment has however provided for the establishment of a Climate Public Expenditure and Institutional Review (CPEIR) in its 2017 budget. The purpose is to develop a framework that would identify, report, monitor, evaluate and account for all climate related financial resources. If this is successfully undertaken, it would address some of the shortcomings indicated above.

Given the new reporting context of the Convention and the need to track and monitor all support received, Nigeria will have to face this new challenge and work on developing and establishing a sustainable system for MRV of support received. Existing institutional arrangements aimed at monitoring climate change activities could be exploited after appropriate improvements to meet the challenges for MRV of support received. The Inter-Ministerial Committee on Climate Change will act as the platform for collating all information pertaining to support for climate change related activities from all Federal Ministries. The latter will itself collect the same information from the State Governments and the private sector. The information provided as per an agreed template will then be processed, documented and archived by the DCC of the Federal Ministry of Environment for retrieval when preparing the Biennial Update Reports.

5. Constraints and Gaps, and Related Financial, Technical and Capacity n Needs, including a Description of Support Needed and Received

5.1. Introduction

As a signatory to the Convention, Nigeria has delivered to the extent it has been capable within the context of its development priorities to meet its obligations to the UNFCCC. As a developing country, Nigeria is still facing poverty and other crucial issues to raise the welfare of its population. While the country recognizes the support received from bilateral and multilateral partners to tackle climate change, it is obvious that the level of support received to-date has not been to the tune to enable Nigeria to actively play its role as required and as it would have wanted. The country is highly vulnerable and the priority has been to invest national resources available for adaptation rather than mitigation to guarantee the minimum well-being of the poorest segments of the population, including the more vulnerable groups and women.

Nigeria is not fully prepared to face all the challenges climate change is posing on the country's development. Government is paving the way for the future to establish the required system for coping with all climate change challenges as reported under institutional arrangements to implement the UNFCCC earlier in this BUR. However, there still exists numerous constraints and gaps of financial, technical and technological nature that the country will have to address in addition to capacity building to be able to face the threats posed by climate change. These constraints, gaps and needs relate to its obligations for reporting and implementing the Convention. In this regard, Nigeria seriously hopes that the Paris Agreement will be fully implemented within the shortest possible time to enable all developing countries implement their NDCs and contribute fully in the achievement of the objectives of the Convention for the benefit of mankind.

5.2. Constraints and Gaps

5.2.1. GHG Inventory

Informing the COP of the best status on country's emissions regularly and sustainably is the backbone for decision-making on curbing GHG emissions towards stabilizing GHG level in the atmosphere to limit global warming and its impacts. Thus, all signatory Parties should be enabled in doing so through the preparation of good quality GHG inventories on a sustainable basis. Nigeria has set up a GHG inventory Division in the DCC but is still struggling to compute good GHG inventories for reporting to the Convention and to also support the development of its low carbon development strategy. A recurring constraint in the estimation of GHGs for the four IPCC sectors is the lack of good quality activity data. Available data are relatively inconsistent in all IPCC sectors. Lack of consistent activity data and process information results in heavy reliance on international data sources, extrapolations and expert judgement to generate missing activity data and fill gaps when estimating GHGs emissions and sinks within the country. This increases the uncertainty level and prevents the adoption of the more precise higher tier levels as there exist no national emission factors more appropriate to suit national circumstances compared to the default IPCC emission factors. Nigeria also lacks a proper GHG inventory management system with robust institutional arrangements for sustainable production of inventories. The situation is exacerbated by the lack of a pool of national experts able to compute GHG inventories on a facility, sectoral, regional, State and national levels.

While the NBS is applauded for their efforts in collecting and archiving data for national statistics to be used to inform decision makers and support the country's development, the current system needs to be hugely improved upon by developing GHG data collection template for the MDAs and other concerned stakeholders for GHG emitting activity areas. In addition, NBS should be empowered to set up a system for adequate QC/QC of activity data to ensure consistency and reliability. In this context, it is planned to further strengthen the unit responsible for databasing on GHG inventories within the GHG Division of DCC to collect and archive all information pertaining to GHG inventories and support NBS in the collection of quality activity data. This unit will also be liaising with GHG compilers to ensure inventories are consistent, credible and reliable while working towards further improvement of future inventories.

5.2.2. Mitigation

Nigeria is geared to continue on the path of mitigation in all areas of its development to meet the objectives of the low carbon strategy it has developed. Already, the country participated in implementing CDM projects and identified and reported clear mitigation opportunities in its NDC. Nigeria is yet to develop its first NAMA due to lack of capacity, a well-computed inventory at facility level with proper baselines due to constraints and gaps reported under GHG inventory. Thus, apart from the CDM projects, mitigation is in its infancy. It is noted that in preparing the section on 'Mitigation Action and Their Effects' for this first BUR, several gaps and constraints were identified. Overall, information on mitigation actions and their effects is very scarce and limited. While there is tremendous effort to mitigate the effects of climate change, this information is either unavailable or in most cases non-existent, as there is no centralized system of reporting or data collection on mitigation in the country. Information on climate change policies and larger national actions are usually available. However, this information only contains the basic details like program name, implementation agency, and objective, with little to no information outlining the effects of the mitigation actions and emissions avoided.

With such an information gap existing in mitigation action and their effects, it is challenging to report on key factors such as: progress indicator, steps taken or envisaged, progress of implementation, and results achieved. Table 5.1 provides an overview of the gaps and constraints in data availability for the information requested in the BUR guidelines outlined in Decision 2/CP.17, Annex III, Section I V.

Table 5.1 Availability of information for reporting on mitigation actions as per Decision 2/CP.17

Information	Multi-Sector	Energy Sector	Forest Sector	Waste Sector	Agriculture Sector	Transport Sector
Name and description of the mitigation action, including information on the nature of the action, coverage (i.e. sectors and gases)	A	A	A	A	A	A
Quantitative goals and progress indicators	NA	PA	NA	NA	NA	A
Methodologies and assumptions	NA	NA	NA	NA	NA	NA
Objectives of the action and steps taken or envisaged to achieve that action	A	A	A	A	PA	A
Progress of implementation of the mitigation actions and the underlying steps taken or envisaged	A	PA	A	PA	NA	A
Results achieved, such as estimated outcomes (metrics depending on type of action) and estimated emission reductions, to the extent possible	NA	NA	NA	NA	NA	PA

A: Available, NA: Not Available, PA: Partly Available

Conscious of the need to improve on reporting and implementation of the Convention, Nigeria has established a Mitigation Division within the DCC but the latter lacks the capabilities and resources to make it fully operational to deliver at the required level. Additionally, there is need to impart sufficient knowledge to a higher number of national experts at facility and State levels to develop and implement mitigation actions widely enough to tap all existing possibilities of the development framework.

5.2.3. Measurement, Reporting and Verification

Measure, Report and Verify is a new concept that Non-Annex I Parties must develop and implement within the framework of reporting for BURs to better track implementation and effects of mitigation actions. Nigeria as most of the developing countries will have to build on existing systems to meet this requirement. MRV needs to be institutionalized for good quality reporting in the future. Usually, measurements and reporting are done on an ad-hoc basis for projects but this is not necessarily suitable for MRV for BURs which should be systematic and sustainable. The most lacking feature of the present monitoring and evaluation systems that is practiced is the absence of regular documentation and archiving. The development and implementation of the domestic MRV system will need to integrate various ministries, other government institutions, the private sector organisations and the civil society. DCC will have the responsibility to develop and establish the domestic MRV system. Additionally, there will be the need to allocate enough human, technical and technological resources required to make the process a success. Nigeria is committed to developing and implementing the domestic MRV and counts on the support of the international community to successfully surmount difficulties in this regard. It is therefore important to address existing constraints and gaps when developing and implementing the system. Capacity building of sufficient national experts will be first and foremost in the development and implementation of the domestic MRV system. The salient challenges and potential solutions are provided in Table 5.2.

Table 5.2 Key gaps and potential solutions

Key Gaps	Key activities to address the Gaps
MRV activities must be aligned across different levels of government institutions/ministries for effective coordination and consolidation	• Department of climate change serving as the DNA will enable better institutional coordination among relevant ministries working on mitigation actions and GHG inventories; • Definition of roles and responsibilities of relevant ministries will contribute to the implementation of MRV in mitigation actions, GHG inventory, and level of support received; • Regular monitoring of government's progress in coordinating and delivering the MRV will enable better MRV performance and result; and • Federal Department of Forestry with its experience in implementing REDD+ MRV activities, will significantly contribute to the development of future MRV of NAMAs and GHG inventory in the Forestry sector.
MRV infrastructure must be established to enable relevant agencies and institutions to pool their resources together	• The experiences with NDC, BUR and NIAF could set the basis for further development and implementation of MRV in Nigeria; and • Establishment of an MRV institution in Nigeria which will be responsible for the development of an overall MRV system.
MRV activities in **GHG inventory** must be established in a robust and sustainable manner	• Institutionalization of GHG inventory instead of preparing as a "project based" activity; • Capacity building for relevant government institutions to prepare GHG inventory in a transparent, accurate, consistent, complete, and comparable manner; and • Securing of finance to prepare and update the GHG inventory as required for Biennial Update Reports, and National Communications.

Key Gaps	Key activities to address the Gaps
MRV activities on **mitigation actions** must be established in a robust and sustainable manner	• The link between MRV of funds and mitigation projects must be further elaborated; • Standardized and commonly agreed methodologies and indicators are needed to monitor and compare mitigation actions; and • Enhancement of institutional capacities in sectoral ministries responsible for monitoring mitigation actions.

5.2.4. Technology Transfer

It is recognized that successful technology transfer is primordial when tackling climate change issues. Nigeria is yet to conduct an in-depth technology assessment and needs to address climate change. Additionally, constraints and gaps relating to technology transfer in the context of Nigeria's need to mitigate and adapt to climate change exist and will have to be addressed. The main features relating to technology transfer along with a few lessons learned are listed below.

- Lack of awareness of the available technologies;
- Limited human and financial capabilities to domesticate new technologies;
- Poor organizational skills and capacities to coordinate, transfer and adopt new technologies;
- Intellectual property rights which often act as both incentives and obstacles to the transfer of technology;
- Tariffs and Tax are often problematic. When import duties on items needed for specific technological development are too high, relevant transfer are inhibited;
- Technology transfer, in the framework of Clean Development Mechanism (CDM) projects, is most successful when a subsidiary of a company from a developed country is involved; and
- Studies of CDM projects also show that technology transfer is more prevalent in some sectors than in others, depends on the domestic availability of certain technologies, and occurs more frequently in large-scale projects than in smaller ones.

5.3. Support Received and Needed

According to the BUR guidelines, countries are required to also provide information:

- To enable enhanced reporting on mitigation actions and their effects, needs and support received, in accordance with their national circumstances, capacities and respective capabilities, and the availability of support;
- To provide policy guidance to an operating entity of the financial mechanism for the timely provision of financial support needed by developing country Parties to meet the agreed full costs of preparing their biennial update reports (to the Global Environment Facility (GEF) in the case of first BUR).

As laid out under MRV in this chapter, Nigeria lacks systematic documentation in most areas including support received. On the other hand, no exhaustive assessments of support needed to implement fully all identified mitigation actions have been made. Thus, this report contains information on the recent climate change financial flows Nigeria has received between 2012 and 2016. They are categorized according to domestic and external contributions, the former consisting primarily of budgetary allocations by the Nigerian Government, and the latter are resources received from external sources including international/multilateral and bilateral partners as well as the GEF. The report further delineates the support received into taxonomies of means and types of implementation including mitigation, adaptation, capacity building and technical assistance amongst others.

Most of the available information relates specifically to financial inflows going to the Federal Government. While disbursements to state governments are not captured due to paucity of information, efforts of more progressive state governments that have committed significant resources to climate related issues are highlighted where such information are available. The data was collected from information available in the public domain including budgets from the website of the Nigerian Budget Office, and from donors. Some information was culled from the main recipients like the Department of Climate Change.

Projects with insufficient details and or inadequate information and those less than $50,000 have been excluded, benchmarking it on the limit set by the GEF Small Grant Projects.

5.3.1. Information on Support Received

According to the Department of Climate Change, cumulatively, so far, Nigeria has leveraged over $800 million of multilateral funds for climate change projects. Historically, billions of Naira have also been allocated to climate change counteraction measures, both explicitly and incidentally. Details of these are categorized and discussed below. Where the purposes are explicit, they have been classified according to whether they are adaptation and mitigation activities. In cases where generic provisions like "preservation of the environment" have been used, those are classified as adaptation activities.

5.3.2. National Budgets

Nigeria's commitment to addressing climate change challenge is demonstrated through the budgetary allocations made on an annual basis to Federal Ministries, Departments and Agencies (MDAs) and in some cases, as counter-part funding of bilateral or multilateral financing. This section will highlight any instances of budgetary allocations directly linked to environmental protection or providing for climate change in Nigerian budgets from 2012 to 2016, notwithstanding those elements that are not clearly defined but could have been reprogrammed for climate change including baseline surveys, data collection and general research. The bulk of allocations during the tracking period went to adaptation activities including building climate efficient infrastructure. These allocations are provided in Table 5.3.

Table 5.3 Summary of bilateral and multilateral financial flows including GEF

Source	Description	Sector	Objective	Duration	Co-funding	Amount
BOI/UNDP	Grant - Development of Renewable Energy	Energy	Mitigation	2011-2013	NA	$4,800,000
Climate Investment Fund (CIF)	Grant – Renewable Energy	Energy	Mitigation	2012	NA	$85m
Sustainable Energy Fund for Africa (SEFA)	Grant - Expansion of Green energy and Biofuels (GEB), Bio-refinery project	Energy	Mitigation	2012	NA	$580,000
International Bank for Reconstruction and Development and other EU Countries	CDM - Kainji Hydropower Rehabilitation Project	Energy	Mitigation	2012	NA	Not specified
French Government	CDM - WAP Partial substitution of alternative fuels in cement facilities	Energy	Mitigation	2012	NA	Not specified
French Government	CDM - LPG project	Energy	Mitigation	2012	NA	NA
African Development Bank	Loan/Grant - Energy efficiency and mass	Energy	Mitigation	2012	Co-finance required	$200,000,000

(AfDB)	transit urban transport					
Central Bank of Nigeria	Loan - Special intervention on power and airline intervention	Power /Transport	Mitigation	2012	Co-funding expected from commercial banks	N300bn
Global Environmental Facility (GEF)	Grant - Improving farming practices	Agriculture	Adaptation	2012	NA	$5,000,000
Global Environmental Facility (GEF)	Co-finance - Improving farming practices	Agriculture	Adaptation	2012	Co-funding expected	$15,000,000
Global Environment Facility (GEF)	Grant - Natural Resources Management	Environment	Mitigation	2012	$31,697,500	$4,141,429
Henrich Boll Stiftung (HBS)	Grant - Capacity Building for energy transition	Energy	Mitigation	2012-2016	NA	EUR 849,019
Henrich Boll Stiftung (HBS)	Grant - Support for various mitigation projects	Energy Future campaign	Mitigation	2012-2016	NA	EUR 637,662
Henrich Boll Stiftung (HBS)	Grant - Various adaptation projects on climate resilience	Climate change	Adaptation	2012-2016	NA	EUR 423,320
World Bank/GEF/Special Climate Change Fund (NEWMAP)	Loan/grant - Addressing erosion challenges in eight states	Energy/agricultur e	Adaptation/ Mitigation	2012-2018	Each state N500m ($1,515,15)	$509,500,000
DFID	Grant	Climate Change	Adaptation /Mitigation	2012-2013	NA	£1,094
DFID	Grant	Climate Change	Adaptation /Mitigation	2013-2014	NA	£1,347
DFID	Grant	Climate Change	Adaptation /Mitigation	2014-2015	NA	£17,000
German Ministry of Cooperation &Development	Grant - Promoting clean energy investment through Ministry of Power and five states (NESP)	Energy	Mitigation	2013-2018	NA	$27,000,000 EUR 24,000,000
Global Environment Facility (GEF)	Grant – Scaling up small hydro power	Energy	Mitigation	2013	$17,200,000	$2,689,680
Global Environment Facility (GEF)	Grant - De-risking Renewable Energy NAMA for the Nigerian Power Sector	NAMA - Energy	Mitigation	2013	$213,550,000	$4,400,000
Climate Investment Funds(CIF)	Grant - Financial intermediation for clean energy through local banks	Energy	Mitigation	2014	NA	$50,000,000
African Development Fund	Loan - Lake Chad Basin development activities	Agriculture	Adaptation	2014	NA	$29,940,000
Canadian Government	Grant - Effective climate change governance through (NEST)	Energy	Adaptation	2009-2014	NA	$3,358,409
Climate Investment Funds(CIF)	Loan- Line of credit for RE and Energy Efficiency	Energy	Mitigation	2014	NA	$25,000,000
Climate Investment	Grant - Utility-scale solar PV Project	Energy	Mitigation	2014	NA	$25,000,000

Funds(CIF)						
DFID	Grant - Support for private sector solar projects	Energy	Mitigation	2014-2020	NA	$22,000,000
Climate Technology Fund(CTF) and AfDB	Multilateral Grant - Bus-based mass transport support for Abuja, Kano and Lagos via Nigeria Urban Transport Project	Transport	Mitigation	2014	NA	$158,000,000 ($50m each from the World Bank &AfDB and additional from the FCTA, Equity and Commercial Bank)
Canadian Government	Grant- Deployment and transfer of low carbon technologies	Energy	Mitigation	2014	NA	$41,000,000
USAID	Grant- Azura Edo Gas turbine power station	Energy	Mitigation	2014	NA	$50,000,000
USAID	Grant - Research and development	Agriculture, health and environment	Mitigation/ Adaptation	2014	NA	$425,000,000
USAID	Loan	Energy	Mitigation	2014	NA	Partial risk guarantee
African Finance Corporation (AFC)	Private sector loans for electricity generation	Energy	Mitigation	2014	NA	$170,000,000
European Development Fund	Grant - Overarching support for national priorities including Vision 2020 via EU/Nigeria National Indicative Program	Energy, Agriculture and water	Mitigation/ Adaptation	2014-2020	NA	$686,000,000
Solar Nigeria	Technical Assistance	Energy	Mitigation	2014-2020	NA	£40,734,781
EU	Assistance	Health, Energy, Governance	Mitigation	2014-2020	NA	£512,000,000
Global Environment Facility (GEF)	Grant - Assessment of organic persistent pollutants	Minamata Convention	Mitigation	2014	$182,000	$1000,000
Global Environment Facility (GEF)	Technical & Financial Support - Preparation Third NC	UNFCCC compliance	Climate change	2014	$8,600,000	$1,850,000
Global Environmental Facility(GEF)	Technical and financial support - Preparation of First BUR	UNFCCC compliance	Climate change	2015	$482,250	$352,000
Global Environmental Facility(GEF)	Grant - Support for various national and regional projects	Energy and agriculture	Adaptation/ mitigation	2015	NA	$374,071,385
Global Environmental Facility(GEF)	Grant - Support for various national and regional projects	Agriculture	Adaptation	2015	NA	$13,407 408
Global Environmental Facility(GEF)	Part Co-financing - Various national projects land degradation	Agriculture, climate change	Adaptation/ mitigation	2015	NA	$85,815,932
Global Environment Facility (GEF)	Grant – Land management	Agriculture	Mitigation/ adaptation	2015	$57,000,000	$7,139,450
NEPAD/German Government	Grant - various national adaptation projects	Agriculture	Adaptation	2015	NA	$110,000 & EUR 100,000
USAID	Investment – Research and Development	Agriculture, Health, Environment &	Mitigation	2015	NA	£425,000,000

		Governance				
IFC/ DFID	Grant - RE generation	Energy	Mitigation	2016	NA	$2,500, 000
The Green Climate Fund	Investment fund- Universal Green Energy Access Program (UGEAP)	Energy	Mitigation	2016	NA	$16,000,000
Global Environment Facility (GEF)	Grant	Mining sector	Mitigation	2016	$373,000	$500,000
Global Environment Facility (GEF)	Grant - Environmental Management	Environment	Mitigation	2016	$34,666,612	$6,930,000
Global Environment Facility (GEF	Grant – Sustainable fuelwood management	Energy	Mitigation	2016	$16,400,000	$4,410,000

5.3.3. Private Sector Funding

Conscious of the importance of all to contribute to the fight against climate change, the Nigerian private sector also has started to provide investment funding to support actions on mitigation. A few of the actions that have been tracked are given in Table 5.4.

Table 5.4 Some examples of private sector funding

Source	Description	Sector	Objective	Duration	Amount
C40 Cities Climate Leadership Group	Grant to Lagos State - Reduce GHG emission	NA	Mitigation	2016	$3,000,000
Fidelity Bank	Loan to Delta State - Climate change projects	Multiple	Mitigation	2016	$1,515,152
World Bank	Grant to Akwa-Ibom State Climate change projects	Multiple	Mitigation	2016	$2,000,000
African Finance Corporation(AFC)	Loan – Electricity generation	Energy	Mitigation	2014	$170,000,000

5.3.4. Information on Support Needed

Details of a comprehensive Nigerian needs assessment with respect to finance, technical assistance, technology transfer and capacity building have not been made and properly documented in any single data source. Where such related support has been received by any Ministry, Department and Agency (MDA), the information is hardly available in the public domain. The difficulty in locating such information is because most of the support is non-monetary and little weight is attached to it for national accounting purposes, resulting in insufficient motivation to record, report and account for them. There exists no efficient system for tracking such support presently. The absence of a duly completed technology needs assessment and financial and capacity building needs assessments also compounds the difficulty in a precise determination of support needed qualitatively and quantitatively.

Although Nigeria has generally not received much support, relative to other African countries, especially for technology transfer and capacity-building, certain forms of support might have been embedded as components of some of the identified financial inflows. That notwithstanding and not being exhaustive,

according to the INDCs[11] and a few other sources, the main areas requiring support are depicted in Table 5.5. The extent of financial assistance required is not provided and it is planned to start work on this aspect and provide the information as far as possible in the next BUR.

Table 5.5 Description of support needed

Description of support	Purpose	Type of support
Diversify the economy	Empower the population to mitigate and adapt through alleviation of high unemployment rates and economic stability	Technical assistance
Develop emissions database	Produce baselines for developing mitigation actions	Financial, Technical assistance and capacity building
Develop a sustainable GHG inventory management system	Improve quality of GHG inventories and quantify emissions avoided	Financial, technical assistance and capacity building
Improve capabilities for reporting to the Convention	Produce quality up to date NCs and BURs	Financial and capacity building
Develop renewable energy technologies	Increase the share of renewable energy, particularly decentralized systems	Financial, technical assistance, technology transfer and capacity building
Improve electricity grid	To increase accessibility to electricity	Financial, technical assistance, technology transfer and capacity building
Promote multi-cycle power stations and scalable power station 20-50 MW	Improve access to electricity	Financial, technical assistance, technology transfer and capacity building
Enforce energy efficiency	Reduce consumption of fossil fuels and emissions	Technical assistance and capacity building
Benchmark industrial energy usage against international best practices	Reduce consumption of fossil fuels and emissions	Technical assistance and capacity building
Adopt green technology in industry	Reduce consumption of fossil fuels and emissions	Technical assistance and capacity building
Promote use of natural gas in lieu of liquid fossil fuels	Reduce emissions, improve quality of environment and life	Financial, technical assistance, technology transfer and capacity building
Improve enforcement of gas flaring restrictions	Reduce emissions	Technical assistance and capacity building
Develop Gas-to-Power Plants at Gas Flare Sites (micro grid)	Improve access to electricity and reduce emissions	Financial, technical assistance, technology transfer and capacity building
Promote blending of transportation fossil fuels with biofuels	Reduce emissions	Financial, technical assistance, technology transfer and capacity building
Stop charcoal use	Reduce deforestation and emissions while increasing sinks	Financial and technical assistance
Promote climate smart agriculture	Avoid emissions, sustainable agricultural production and Food Security	Financial, technical assistance and capacity building
Promote reforestation	Increase sink capacity through sequestration of CO2	Financial, technical assistance, technology transfer and capacity

[11] See generally Nigeria's Intended Nationally Determined Contribution to the UNFCCC, available at<http://www4.unfccc.int/Submissions/INDC/Submission%20Pages/submissions.aspx>

Description of support	Purpose	Type of support
		building
Review and implement the National Forest Policy	Curb deforestation to avoid emissions and increase sink capacity	Financial, technical assistance, technology transfer and capacity building
Promote modal shift from air to high speed rail	Reduce fossil fuel consumption and emissions	Financial, technical assistance, technology transfer and capacity building
Promote moving freight to rail	Reduce fossil fuel consumption and emissions	Financial, technical assistance, technology transfer and capacity building
Upgrade roads	Reduce fossil fuel consumption and emissions	Financial, technical assistance, technology transfer and capacity building
Develop urban transit systems	Reduce fossil fuel consumption and emissions	Financial, technical assistance, technology transfer and capacity building
Promote toll roads/ road pricing	Reduce fossil fuel consumption and emissions	Technical assistance, and capacity building
Increase use of CNG	Reduce liquid fossil fuel consumption and emissions	Financial, technical assistance, technology transfer and capacity building
Reform petrol/ diesel subsidies	Reduce fossil fuel consumption and emissions	Technical assistance, and capacity building

6. Information on the Level of Support Received to Enable the Preparation and Submission of Biennial Update Reports

6.1. Financial

The Global Environment Facility (GEF), through the UNDP Country Office acting as the implementing agency, provided funds to the level of USD 352 000 to support Nigeria prepare its first Biennial Update Reports (BUR1) for the fulfilment of its obligations under the United Nations Framework Convention on Climate Change (UNFCCC). The Federal Government of Nigeria through the DCC of the Federal Ministry of Environment provided in kind support to the value of USD 50 000 to successfully complete the preparation of the BUR1.

6.2. Technical

Capacity to prepare the BUR is low in most Non-Annex I Parties including Nigeria since the BUR is a new requirement and the guidelines on its preparation are not very explicit. There was therefore a need for capacity building and some initiatives, directly or indirectly have partially addressed this shortcoming. These initiatives are described further down in this chapter.

6.2.1. Global Training Workshop on the Preparation of Biennial Update Reports

The training was organized by the Consultative Group of Experts (CGE) on National Communications from Parties not included in Annex I to the Convention , in Bonn, Germany in September 2013. As a part of the provision of technical assistance to non-Annex I Parties, the CGE decided to develop supplementary training materials to facilitate the preparation of BURs, by improving the existing CGE training materials developed to assist non-Annex I Parties in preparing their national communications, to incorporate other elements within the scope of the BUR guidelines (Annex III of 2/CP.17), in particular, the following:

- Institutional arrangements for the preparation of national communications and BURs on a continuous basis;
- Mitigation actions and their effects, including associated methodologies and assumptions;
- Constraints and gaps, and related financial, technical and capacity needs, including a description of support needed and received; and information on the level of support received to enable the preparation and submission of biennial update reports.

6.2.5 Africa Workshop on GHG Inventory Management Systems

This workshop was organised by the UNFCCC in collaboration with the IPCC and the GEF implementing agencies, UNEP and UNDP and took place from 27 - 29 October, 2016 in Windhoek, Namibia. The workshop covered institutional arrangements based on the US-EPA template workbook on developing a national GHG inventory system. This included the different steps to compute a comprehensive good quality GHG inventory using the IPCC 2006 Guidelines and the QA/QC process for the AFOLU sector. Hands-on training on the IPCC 2006 software was also provided to participants. The workshop was attended by some national experts along with other experts from the African region to build capacity on these issues towards the production of good quality GHG inventories.

7. Any Other Information Relevant to the Achievement of the Objective of the Convention and Suitable for Inclusion in its Biennial Update Report

7.1. Introduction

Nigeria has been actively engaged in international climate policy negotiations since it became a Party to the UN Framework Convention on Climate Change (FCCC) in 1994 ratifying its Kyoto Protocol in 2004. Nigeria submitted its First National Communication (FNC) in 2003 and a Second National Communication in February 2014. Nigeria is host to a number of Clean Development Mechanism projects, as well as projects financed by the Adaptation Fund. In September 2012, the Federal Executive Council approved the Nigeria Climate Change Policy Response and Strategy. HE, President Muhammadu Buhari, the President of the Federal Republic of Nigeria approved the INDC of Nigeria on 26 November 2015.

7.2. National Climate Change Development Strategy and Planning

Nigeria's development process has been guided by two strategic documents in the recent past, Vision 2020 and the Transformation Agenda 2011-2015. Vision 2020 recognizes the changing climate as a threat to sustainable growth in the next decade and sees it as a critical challenge globally and, in Nigeria, as a potential driver of damaging and irrecoverable effects on infrastructure, food production and water supplies, in addition to precipitating natural resource conflicts. However, the policy and implementation framework have not addressed climate change issues adequately to-date. To correct this anomaly and integrate the increasing importance of climate change issues in the development agenda of the country, the Federal Executive Council adopted the Nigeria Climate Change Policy Response and Strategy in 2012.

As stated in Nigeria NDC, the strategic goal of the Nigeria Climate Change Policy Response and Strategy is to foster low-carbon, high economic growth development and build a climate resilient society through the achievement of the following objectives:

- Implement mitigation measures that will promote low carbon as well as sustainable and high economic growth;
- Enhance national capacity to adapt to climate change;
- Raise climate change related science, technology and R&D to a new level that will enable the country to better participate in international scientific and technological cooperation on climate change;
- Significantly increase public awareness and involve private sector participation in addressing the challenges of climate change; and
- Strengthen national institutions and mechanisms (policy, legislative and economic) to establish a suitable and functional framework for climate change governance.

7.3. Climate Change Adaptation

7.3.1. Impacts and Vulnerability

Climate change impacts vary in extent, severity and intensity across the country. This has been clearly spelt out in the second national communication, namely that the Southwest and Southeast are relatively less vulnerable than most other parts of the country. The Northeast is the most vulnerable region, this

extreme vulnerability being associated with the decline of socio-economic activities around Lake Chad and the loss of the former flourishing Hadejia-Nguru Wetlands.

The high vulnerability of the country and the need for adaptation in the various sectors of the economy have been highlighted in the first and second national communications. However, consistent in-depth studies to estimate the costs of the impacts on the economy have not been conducted and only approximate evaluations were made within the framework of the preparation of Nigeria's INDC. The summary, adapted from the INDC and presented below gives a clear indication of what is at risk and the level of exposure of the economy:

- **Overall Economy**: According to a 2009 DFID study, it is estimated that between 2-11% of Nigeria's GDP could be lost by 2020 if appropriate adaptation measures are not implemented. The Post Disaster Need Assessment (PDNA) Report to assess impacts of the 2012 Floods revealed that the total damage amounted to $16.9billion, which represent 1.4% of real GDP growth of that year. Climate change is thus regarded as a significant threat to the achievement of development goals, especially those aimed at eradicating poverty and hunger while promoting a sustainable environment.
- **Agriculture and Food Security**: Agriculture is one of the most sensitive sector and agricultural productivity could decline between 10 to 25% by 2080 in the absence of adaptation measures. In some parts of the north, the yield depression under rainfed conditions could reach 50% with a second order impact as much as 4.5% by 2050 on GDP, even though the share of agriculture is expected to decline from 40 to just 15 percent at national level. Furthermore, and if adaptation measures are not adopted, the net import of rice is expected to increase by as much as 40%.
- **Water**: A considerable proportion of the population is at risk of water stress, with less than 40% having direct access to potable water. Increased rainfall variability stemming from climate change may promote flooding in some humid areas in the south of the country while a reduction in precipitation in the savannah north may result in droughts and decrease in surface water resources. Changes in surface runoff and groundwater flows in shallow aquifers can possibly have long-term implications for permanent and seasonal water bodies. The rapid shrinking of Lake Chad from about 45,000 km^2 in 1960 to less than 3,000 km^2 in 2007 is mainly attributed to changes in the climatic conditions in the region. Hydro-electric power generation will also be negatively affected due to lower and irregular inflows in dams.
- **Floods and Droughts**: Climate change is predicted to cause more frequent flooding in many parts of the country, particularly the humid areas, with devastating consequences. Single extreme climate events have the potential to wipe out years of development. For example, the total value of destroyed physical and durable assets caused by the 2012 Floods has been estimated to be N1.48 trillion (US$9.5 billion) or about 2% of the rebased GDP of US$510 billion. On the other hand, reduced rainfall is expected to result in increased drought frequency and decrease in surface water resources in the north, thus increasing the dependency on underground water resources. The increasing aridity in the northeast of the country has drastically reduced opportunities for sustainable agriculture and is considered a contributing factor to the current conflict and high degree of insecurity in the region.
- **Soil Erosion**: Anticipated climate change-related more intense rainfall events will worsen soil erosion that is already creating disastrous conditions in the south of the country. Recent reports indicate an increase in the number of severe landslides in south eastern States of the country and is an attestation of the possible climate change-induced changes in erosion intensity.
- **Sea Level Rise**: Nigeria's coastline is already undergoing pronounced morphological changes as a result of natural extreme events, such as sea surges and tidal waves. Global warming-induced

accelerated sea level rise (ASLR), anticipated to be 0.5 – 1 m this century, would exacerbate the poor condition of the country's coastline. It is estimated that with an ASLR of about 0.5 m, about 35% of the highly-productive Niger Delta could be lost. The loss could reach about 75% of the Delta in case of an ASLR of about 1.0 m by 2100 (French et.al., 1995).

- **Energy**: Climate change, through rising temperatures particularly would result in an increased energy demand for air conditioning, refrigeration and other household users.
- **Tourism**: Tourism, one of Nigeria's fastest growing industries, could be negatively affected as many tourist attractions are located along the coastal zone of the country. Traditional festivals (e.g. the Argungu River Festival in Kebbi State) attracting many tourists may be impacted by reduced river flow.
- **Ecosystems**: Forests and other ecosystems, already under significant pressure, would be adversely affected by climate change. Persistent flooding and water logging could make coastal forest regeneration more difficult. On the other extreme, the savannah biome of northern Nigeria would be very vulnerable to a reduction in rainfall in the region. This could result in degradation of habitats and the intensification of desertification.

The above impacts confirm the high vulnerability of Nigeria to climate change. The 2014 World Climate Change Vulnerability Index, published by the global risk analytics company Verisk Maplecroft, classified Nigeria as one of the ten most vulnerable countries in the world. A recent government study determined vulnerability across Nigeria's geographical regions, focusing on the three principal determinants of vulnerability: adaptive capacity, sensitivity and exposure. A general south-north divide was observed. The three northern zones showed higher vulnerability than those in the south.

7.3.2. Adaptation Policy Framework

Nigeria's response to climate change impacts has focused on increasing resilience and managing the unavoidable impacts. The National Adaptation Strategy and Plan of Action for Climate Change Nigeria (NASPA-CCN), which was developed in 2011 describes our adaptation priorities, bringing together existing initiatives and priorities for future action. The NASPA-CCN Vision is a Nigeria in which climate change adaptation is an integrated component of sustainable development, reducing the vulnerability and enhancing the resilience and adaptive capacity of all economic sectors and of all people, particularly women, children, and resource-poor men, to the adverse impacts of climate change, while also capturing the opportunities that arise as a result of climate change.

To achieve the objectives of the NASPA-CCN, a set of thirteen sector-specific strategies, policies, programmes and measures have been prepared. The objectives of these are to reduce the impacts of climate change through adaptation measures that can be undertaken by the Federal, State and Local governments, the civil society, the private sector, communities and individuals. The main strategies are:

(i) Improve awareness and preparedness for climate change impacts.

(ii) Mobilize communities for climate change adaptation actions.

(iii) Reduce the impacts of climate change on key sectors and vulnerable communities

(iv) Integrate climate change adaptation into national, sectoral, State and Local Government planning and into the plans of universities, research and educational organizations, civil society organizations, the private sector and the media.

In addition to the above-mentioned key climate change related strategies, several other environmental and sectoral policies and plans implicitly address climate change issues. For example, the National Policy on Environment supports "*the prevention and management of natural disasters such as floods, drought, and desertification*" and one of the objectives of Nigeria's Agricultural Policy is to "*protect agricultural land resources from drought, desert encroachment, soil erosion, and floods*". Other examples include Nigeria's Drought Preparedness Plan, National Policy on Erosion and Flood Control, National Water Policy, National Forest Policy, and National Health Policy. The challenge facing the government is sustained and coordinated implementation of policies and measures across a whole range of sectors.

Climate change adaptation affects every aspect of Nigeria's socio-economic development. Adaptation actions are required in every sector to minimize the negative impacts. Many of these actions are on-going as autonomous development initiatives. However, to meet the objectives successfully, adaptation requires much more attention than what is being achieved. The costs are no doubt daunting since most of the adaptation actions are of crucial importance. Inadequate commitment to address the much-needed investment now will transcribe into a dangerous future which will demand for much more resources.

Nigeria is therefore counting on the support of the international community and intends to take advantage of the opportunities offered by the Adaptation Fund under the UNFCCC for its adaptation programme.

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