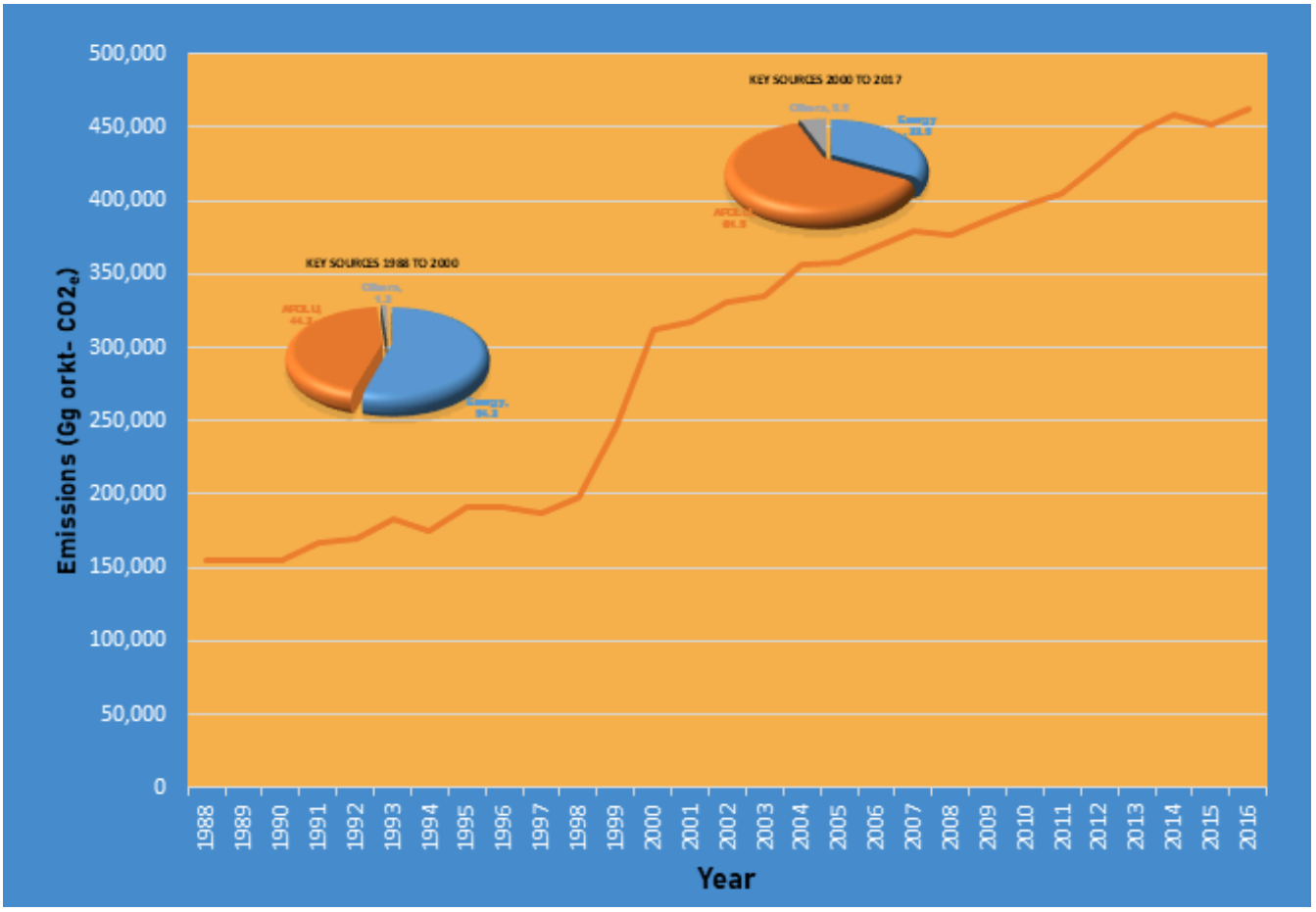
DRAFT FINAL REPORT

FEDERAL REPUBLIC OF NIGERIA:

GUIDEBOOK OF TsHE NATIONAL GREENHOUSE GASES INVENTORIES MANAGEMENT SYSTEM



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Guidebook of the National Greenhouse Gases Inventories Management System

Initiative for Climate Action Transparency – ICAT

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LIST OF ACRONYMS AND SYMBOLS

AD	Activity Data
ADO	Archiving and Documentation Officer
AFOLU	Agriculture, Forestry and Other Land Use Change
AI	Annex I
ARIAL	Atmospheric Research and Information Analysis Laboratory
BAPMON	Background Pollution Monitoring
BTR	Biennial Transparency Report
BUR 1	First Biennial Update Report (to the UNFCCC)
CAP	Criteria Air Pollutants
CAREAIR	Computer aided Analysis of Reduction strategies for Emissions and ambient AIR pollution
CCF	Climate Change Fund
CERD	Centre for Energy Research and Development, OAU. Ile-Ife
CGIAR	Consultative Group on International Agricultural Research
CH_4	Methane
CIDA	Canadian International Development Agency
CITEPA	Centre Interprofessionnel Technique d'Etudes de la Pollution Atmosphérique
CNCCCDP	Canada-Nigeria Climate Change Capacity Development Project
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent Emissions
COP	Conference of Parties
CRF	Common Reporting Format
DA	Data Administrator
DADS	Digital Archiving and Documentation System
DCC	Department of Climate Change (of the Federal Ministry of Environment)
DLB	Digital Logbook
EF	Emission Factors
EFIS	Emission Factors Information System
EPA	Environmental Protection Agency
FEC	Federal Executive Council
FMENV	Federal Ministry of Environment
FORMECU	Forestry Management, Evaluation and Coordinating Unit
GCSI	Global Change Strategies International Inc., Ottawa, Canada
GDP	Gross Domestic Product
GEF	Global Environment Facility
Gg	Giga-grams
Gg	Giga-grams (10^9 grams, or one billion grams)
GHG	Greenhouse Gas
GHGI	Greenhouse Gases Inventories
GHGMI	Greenhouse Gas Management Institute
GPG-LULUCF	Good Practice Guidance for Land Use, Land-Use Change and Forestry
GSCI	Global Change Strategies International (GCSI)
GWP	Global Warming Potential
HAP	Hazardous Air Pollutants
HDADS	Hardcopy Documents Archiving and Documentation System
HFC	Hydro-Fluorocarbons
I/O	Input/output
ICAT	Initiative for Climate Action Transparency
IMIS	Inventory Models Interface System
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Products and Process Use
J	Joule(s)
km	Kilometre
KSA	Key Source Analysis
kt	Kilo-tonnes (1000 metric tonnes)
LCA	Life Cycle Analysis
LDGP	Large Donor Grants Programme
LGA	Local Government Area
LPG	Liquefied Petroleum Gas
MDA	Ministries, Departments and Agencies
MDGP	Medium Donor Grants Programme
MNITL	Meeting of the National Inventory Team Leaders
MPG	Modalities, Procedures and Guidelines established under Article 13 of the Paris 2015 Agreement
MSGP	Medium State Grants Programme
MSITL	Meeting of the State Inventory Team Leaders
MJ	Mega-Joules
MNGP	Medium Federal Grants Programme
MOA	Memorandum of Agreements
MoP	Manual of Procedures
MOU	Memorandum of Understanding
MRV	Measurements, Reporting and Validation
Mt-CO_2e	Million Metric Tonnes of Carbon Dioxide Equivalent

N_2O	Nitrous Oxide
NAI	Non-Annex I (Party to the UNFCCC)
NASS	National Assembly of the Federal Republic of Nigeria
NBS	National Bureau of Statistics
NC	National Communication (to the UNFCCC)
NC1	First National Communication
NCAPC	National climate and Air Pollution Control
NCCC	National Council on Climate Change
NCHIEF-GHG	National Clearing House for Inventories and Emission Factors for Greenhouse Gases
NDC	Nationally Determined Contributions
NEFL	National Emission Factors Listing
NEST	Nigeria Environmental Study/Action Team, Bodija, Ibadan
NF_3	Nitrogen Trifluoride
NGHGI-MS	National Greenhouse Gas Inventory Management System
NGIC	national GHG Inventory Coordinator
NIC	National Inventory Cycle
NIMO	National Inventory Management Office
NIR	National Inventory Report
NIRGE	National Inventory Review Group of Experts
NITSI	National Inventory Technical Support Institution
NITTL	National Inventory Technical Team Leader
NMVOC	Non-Methane Volatile Organic Compounds
N-NIC	Normal National Inventory Cycle
NNPC	Nigerian National Petroleum Corporation
N_2O	Nitrous Oxide
NO	Nitric Oxide
NO_2	Nitrogen Dioxide
NO_x	Oxides of Nitrogen (NO_x = NO + NO_2)
NPA	Nigerian Ports Authority
NPC	National Population Commission
NRC	Nigeria Railway Corporation
NRIER	National Register of Inventory Expert Reviewers
NRT	National Reporting Template
NSI	National Statistical Institutions
NSIT	National Sectoral Inventory Teams
NSITL	National Sectoral Inventory Team Leaders
NSW	National Stakeholders Workshop
O_3	Ozone
OAU	Obafemi Awolowo University, Ile-Ife
PFC	Per-Fluorocarbons
PJ	Peta-Joules (10^{15} Joules or 1000 trillion Joules of energy)
PM	Particulate Matter
QA/QC	Quality Assurance/Quality Control
QUIES	Query, Import and Export System
RISQ	Resource for Inventory Safety and Quality
SA	System Administrator
SAMIS	Sectoral Activities Data and Modelling Indicators System
SCCFI	State Climate Change Focal Institution
SCCU	Special Climate Change Unit (Formerly a Unit of the FMENV)
SCHIEF-GHG	State Clearing House for Inventories and Emission Factors for Greenhouse Gases
SDGP	Small Donor Grants Programme
SEDS	Socio-Economic Data System
SF_6	Sulphur Hexafluoride
SFGP	Small Federal Grants Programme
SHA	State House of Assembly
SIMO	State Inventory Management Office
SIRGE	State Inventory Review Group of Experts
SITSI	State Inventory Technical Support Institution
SITTL	State Inventory Technical Team Leader
SITM	Sectoral Inventory Team Meetings
SLCP	Short Lived Climate Pollutants
SNC	Second National Communication (to the UNFCCC)
SNGP	Small National Grants Programme
S-NIC	Super National Inventory Cycle
SO_2	Sulphur Dioxide
SPI	Source Preparation Instructions
SRIER	State Register of Inventory Expert Reviewers
SSGP	Small State Grant Programme
SSI	State Statistical Institutions
SSIT	State Sectoral Inventory Teams
SSITL	State Sectoral Inventory Team Leaders
t	Metric Tonnes
t-CO_2e	Tonnes of Carbon Dioxide Equivalent
Tg	Tera-grams (10^{12} grams, or one trillion grams)
TJ	Tera-Joules (10^{12} Joules, or one trillion Joules of energy)
TOR	Terms of Reference

TRACCC	Transparency, Reproducibility, Accuracy, Comparability, Consistency, and Completeness,	UNOPS	United Nations Office for Projects and Services
TSP	Total Suspended Particulate	USCSP	United States Country Studies Programme
UNDP	United Nations Development Programme	VKT	Vehicle Kilometres Travelled
		VOC	Volatile Organic Compounds
UNFCCC	United Nations Framework Convention on Climate Change	WMO	World Metrological Organisations

IV. EXECUTIVE SUMMARY

The international community has over the years reached meaningful consensus on many of the issues associated with climate change debate. Among these is the anthropogenic greenhouse gases emissions leading to elevated atmospheric concentrations above pre-industrial revolution levels and resulting in greenhouse effect manifesting as "climate change". There is also the need to project future vulnerabilities and impacts of global, regional, national and local communities to climate change as well as the adaptation options. The major consensus was reached under the UNFCCC when the global community agreed on its ultimate objective.

In terms of emissions, inventory data from 1988 to 2022 show that Nigeria appears to be evolving as a Non-Annex I (NAI) Party from being a low to minimum per capita carbon dioxide equivalent emissions (CO_2e) to a median CO_2e emitting country. Nigeria is one of the NAI Parties whose per capita CO_2e may already have exceeded those of some of the Annex I (AI) Parties. There is a need therefore to understand the emissions profile by undertaking regular GHG inventories to enable Nigeria develop mitigation scenarios, develop and propose strategies for mitigating its emissions and to put in place the GHG Inventories Management System that ensures that inventories are undertaken and recommendations on mitigation actions can be made and carried out by the relevant government and private sector Parties.

Nigeria has conducted annual greenhouse and precursor gases inventories since 1990. However, the transparency of the inventory process remains 'work in progress'. The country is yet to put in place an Inventories Management System that has been formally adopted for implementation by national stakeholders. On this basis, the National Council on Climate Change (NCCC) sought assistance from the Initiative for Climate Action Transparency (ICAT) in 2023 for Phase II ICAT support to the Government of Nigeria to develop and deliver a National Greenhouse Gases Inventories Management System (NGHGI-MS) as part of the Phase II project entitled; "Climate Change Monitoring, Reporting and Verification (MRV)" whose core focus is to review and update sectoral guidelines and other associated activities in the UNFCCC's key emissions and mitigation sectors[1].

This Guidebook is presented as the outcome of the engagement of an expert as the National Consultant to undertake the "Operationalization of the NGHGI-MS" in the letter dated 29th November 2024. The details of the Terms of Reference (TOR) for the engagement include to:

i. Develop and deliver a robust NGHGI-MS for the NCCC Secretariat;
ii. Capacitate NCCC Secretariat team with setting up of an operational NGHGI-MS by providing:
    a. Capacity building on the ETF requirements, available tools for reporting, including using the IPCC software and UNFCCC reporting tools or any other tool useful in reporting,
    b. Recommendations on transparency data system requirements; and
iii. Conduct training workshops for NCCC Secretariat staff and key stakeholders.

The primary aim of developing this Guidebook is therefore to deliver to national stakeholders for adoption, the first version of the comprehensive draft NGHGI-MS document that provides the framework for undertaking sustainable and transparent GHG inventories, systematic updates, building national capacities and undertaking other auxiliary activities that will ensure continuous improvements in the quality of GHG inventories in Nigeria. The specific objectives of preparing and adopting the NGHGI-MS document for use in inventory preparation and updates in Nigeria which are covered in this Guidebook are to:

[1] The IPCC's typology for "sectors" for calculating and presenting greenhouse gas (GHG) data uses Energy (which includes transport), Industrial Processes and Product Use (IPPU), Agriculture, Forestry and Other Land Use (AFOLU) and Waste. These sectors form the typological framework for calculating any and all GHG emissions under the UNFCCC.

i. Propose the legal and policy framework to guide preparation and management of GHG inventories;
ii. Propose the institutional arrangements for compiling, archiving, updating, managing and reporting GHG inventories;
iii. Develop for adoption, a sustainable procedural/operational arrangement process including the National Inventory Cycle (NIC);
iv. Bring up systematic processes and programmes for improving methodologies, activities data and emission factors among other issues; and
v. Propose periodic timelines for the review and update of the NGHGI-MS Guidebook.

The paragraphs below present in brevity, the issues contained in each of the section of the Guidebook.

Section 1 presents an overview of Nigeria's national circumstances under the changing climate regime with a special emphasis on potential future emissions. It also highlights the need for inventory transparency and the importance of having an NGHGI-MS Guidebook to enhance transparency. Section 2 dwells on the historical perspective of attempts made in undertaking national emission inventories from 1988 to 2022, covering a continuous period of 35 years.

The inventories within this period were undertaken by two teams. The first one for 13 years from 1988 to 2000 while the second team undertook from 2000 to 2022. The two range of reports illustrate that the team undertaking inventories for 1988 to 2000 presented the energy sector as the sector with the highest emissions at 52-57%, followed by agriculture with 42-46%. Whereas the team that undertook inventories from 2000 to 2017, i.e. the first Biennial Update Report (BUR1) as an illustration, indicated that AFOLU sector was dominant with gross sectoral emissions of approximately 65%. The two teams' reports show that there are internal inconsistencies in the data, assumptions and decisions used by the two teams to prepare their respective inventory reports. This calls for a systemic review that could identify why the two reports are at variance with one another. It also justifies the need to develop an NGHGI-MS Guidebook to guide these processes.

In Section 3, the aim, objectives and scope for developing the NGHGI_MS is presented and discussed. Section 4 identifies the lack of proper legal framework to support inventory activities in the country and uses the authority in Section 3 of the Climate Change Act to develop policies deemed necessary to support activities under the Act.

Based on this, policies that would ensure that GHG activities migrate from one that is completely ad-hoc to one that is reasonably standardized is presented as part of NGHGI_MS process. Similarly, Section 5 provides the institutional and funding arrangements to support national GHG inventory activities. Institutional arrangements are presented at national and state levels with the Council acting as the apex body to manage these arrangements. The funding arrangement proposes that Nigeria contributes part of its budget to the National Climate Fund, for which the other contributors are international development partners (donors) and others as provided under the Act. In view of the fact that a national inventory cycle of three years is initially proposed in section 6.5 and needs to run smoothly, the Council Secretariat is advised to bring this issue to the Board of the Council and seek approval to operate a three-year composite budget which would start in July of the first year and end in June of the third year to ensure that there are no disruptions in the budget associated with issues that may disrupt free-flow of finance to inventory activities during the National Inventory Cycle.

Section 6 on the other hand, deals with the operational and procedural arrangements for inventories preparation. Sub-sections 6.2 and 6.3 present procedures for inventory planning and how inventory preparation instructions are to be made, leading to the production of the Manual of Procedures (MoP) for inventory preparation for approval by the Meeting of National Inventory Team Leaders (MNITL). In particular, section 6.3.3 directs on how the MoP will be used in inventory preparation and reporting. Here, the snapshot of the National Inventories Cycle which would begin as a three-year cycle and how the cycle would systematically be reduced to one year are presented in section 6.5.

Section 7 is devoted to the various versions of the IPCC Model, Guidelines and Software developed so far to support GHG inventories. It particularly highlights what the existing standalone software for 1996, 2006 and 2019 cover. It then provides the criteria for selection of the Guidelines and Software to be used in any inventory cycle.

The objectives and scope of the research programme to enhance the quality of national GHG inventories are presented in Section 8. This shall among others include measurement and modelling of emission factors, research to improve the quality of activities data across all the sectors of the inventory system as well as other research programmes that directly or indirectly indicate that quality of emission inventories and mitigation activities are improving. The inventories research programme shall have a strategy to ensure advancement to the active phase in the shortest possible time so that as much emission factors as possible are measured or modelled annually to the level that allows migration to higher IPCC tiers within two to three NICs. These emission factors will enable migration from one tier approach to the other until the country is able to migrate all its emission estimates to Tier 3. Funding, being the stimulant for systematic research, shall be made available through a deliberate policy to allocate not less than 25% of the inventory funds to research. Inventories Research funds shall have both national appropriation and donor funding components with funding through annual Federal and State budgets comprising Small and Medium Grant Programmes and donor funding comprising Small, Medium and Large Grant Programmes.

The information in this Guidebook serves as a comprehensive manual to establishing and operationalizing a robust GHG Inventory Management System for Nigeria. If adopted and followed to the letter by the National Council on Climate Change and other national stakeholders, inventories preparation would have evolved from one that is completely ad-hoc to a reasonably standardized process with outputs that could be more reliable and transparent than those of earlier inventories.

1. INTRODUCTION

The international community has over the years now reached meaningful consensus on many of the issues associated with climate change debate, among which are its causes, impacts, mitigation and adaptation strategies. The major consensus was reached under the United Nations Framework Convention on Climate Change (UNFCCC), when the global community agreed on its ultimate objective.

The first segment of that ultimate objective, which is to reduce the atmospheric concentrations of greenhouse gases (GHGs) to a level that would prevent dangerous anthropogenic interference with the climate system. This sign-post the full belief that without reducing anthropogenic greenhouse gas (GHG) emissions, the atmospheric concentration of greenhouse gases would continue to increase with disastrous consequences on global warming and impacts on the climate system, and with spiralling impacts on the earth's life-supporting systems, and the economy. In order to understand subsisting emissions and future emission reduction requirements the UNFCCC further agreed on common but differentiated measures to combat climate change.

Under the Intergovernmental Panel on Climate Change (IPCC) guidelines for national GHG inventories, the emission (E) of greenhouse gases from any activity (A) may be represented by the relation:

$$E_i = \Sigma_j \Sigma_k A_k * EF_{kj} \qquad Equation\ 1.1$$

where E_i is the emission of each GHG or precursor gas i, EF is the emission factor or emissions per unit of activity (A), j represents summation over identified processes/economic sectors contributing to the emission of each GHG or its precursor i; k represents the summation over specific processes or technology types within each major economic sector. In this regard, the total GHG or precursor gas emission may be obtained by summing each GHG or precursor across sectors and processes.

1.1 OVERVIEW OF NIGERIA'S NATIONAL CIRCUMSTANCES UNDER A CHANGING CLIMATE REGIME: THE CASE FOR POTENTIAL FUTURE EMISSIONS

Nigeria currently stands as the 6th most populous nation in the world coming after India, China, United States, Indonesia and Pakistan followed by Brazil (US Census Bureau). According to UN Population Division 2022, Nigeria will displace the United States, Indonesia and Pakistan to become the third most populous country in the world by 2050. If such high population growth rates are associated with increasing per capita emissions, then gross annual GHG emissions from Nigeria could reach unexpectedly high levels.

According to CEIC Data Co. Ltd, Nigeria was by 2023 the 9th largest petroleum exporting country in the world. It's crude oil and natural gas reserves are 37.046 billion barrels and 208.62 trillion standard cubic feet respectively. However, Nigeria is still considered a poor country with highest estimated annual Gross Domestic Product (GDP) ever recorded at USD574.18 billion in 2014 (World Bank, 2025). In recent years, the GDP rose from USD432.2 billion in 2020 to USD477.4 billion in 2022 and dropping to USD187.76 billion in 2024 (World Bank, 2025). These figures would be much less impressive in comparison with similar statistics from other African countries when presented as GDP per capita. Besides the upstream petroleum sector which accounts for the production of natural gas and crude oil from its reserves, the mid-stream and down-stream sectors are also growing in terms of refining and petrochemical industries, liquefied natural gas production, electricity generation from natural gas and refined petroleum products and consumption of petroleum products by other sectors of the economy. Besides the petroleum sector, which is part of the energy sector, Nigeria also generates electricity from mini and large hydro sources as well as an increasing number of sites with solar photovoltaic electricity generation infrastructure. These are both isolated and mini-grid-connected in a growing number of underserved and un-served areas.

In addition to the energy sector, Nigeria has remained a large agrarian country, producing most of the crops and livestock products the country consumes spanning up to five agro-ecological zones between the Gulf of Guinea through the tropical rain forest to the Sahel Savannah zone. The industrial sector in the country is also expanding though not as much as the available potential. As a result of this, major urban centres have evolved over the last hundred years with Lagos already exceeding a population of 20 million people. Urban infrastructure has so far not been growing to meet the rate of rural to urban migration leading to infrastructure deficit in areas like urban transportation, waste management, electricity generation, housing, water supply among others.

In terms of GHG emissions, inventory's data from 1988 to 2022 shows that Nigeria is already growing from a Non-annex I (NAI) country with minimum per capita carbon dioxide equivalent (CO_2e) emissions to becoming a medium per capita CO_2e emitting country (Obioh, 2004, First Biennial Update Report (BUR1) & Biennial Transparency Report (BTR) for Nigeria). With per capita CO_2e emissions systematically increasing and annual population still increasing at about 3% per annum, Nigeria is one of the NAI Parties whose gross CO_2e emissions may exceed those of some of the Annex I (AI) Parties shortly after 2050.

There is therefore need to understand the emissions profile through systematic GHG inventories and mitigation scenarios analyses to enable the country establish by what year it would reach peak CO_2e emissions. Thereafter, cascade to net zero CO_2e emissions by 2060 as proposed by the Federal Government of Nigeria. This requires a combination of strategies for human capacity improvements as well as putting in place a National GHG Inventory Management System (NGHGI-MS) that ensures that inventories are conducted without over or under-estimation as it appears likely the case currently.

1.2 THE NEED FOR INVENTORY TRANSPARENCY AND COMPREHENSIVE MANAGEMENT SYSTEM

Article 4, paragraph 1(a) and Article 12, paragraph 1(a) of the UNFCCC provides that each Party reports their GHG inventories to the Conference of Parties (COP) according to the COP Guidelines. Reporting of GHGs requires a range of activities which includes inventory planning, capacity development, emission factors development and updates, activities data collection by sectors, inventories compilation by sectors, inventories reporting and review, among others. These activities are expected to provide annual emission inventories data that are transparent and reproducible across all sectors. The IPCC which is the lead institution under the UNFCCC for GHG emissions compilation has since 1992 provided guidelines for emissions computation by sector and sub-sectors as well as elements that make for Transparency, Reproducibility, Accuracy, Comparability, Consistency and Completeness, (TRACCC).

The TRACCC criteria makes for transparency and reproducibility of inventories which are required for its accuracy. The NAI Parties lack the experience that many AI Parties already have in utilizing emission inventories and emission trading to enhance metropolitan air quality management for approximately two decades prior to 1990. These measures are still being refined and applied till today by AI Parties as part of their larger air quality management system which are now being applied to GHG inventories. The need for an NGHGI-MS for NAI Parties has become imperative such that participating national or sectoral stakeholders would have the same understanding of the requirements needed to make the inventories meet the TRACCC criteria. While generic guidelines such as Braatz and Doorn (2005) and CGE (2016) have been prepared for utilization by NAI Parties to the convention, each Party is however expected to produce its own NGHGI-MS in form of a guidebook based on its national circumstances.

Similarly, CGE (2016) also indicates that in the context of more frequent reporting of national GHG inventories by NAI Parties, it is imperative that the GHG preparation process shift from a project-based approach to a more internalized and institutionalized approach, which will support the timely delivery of the required information and

more efficient use of available resources by Parties. While some technical experiences exist within NAI Parties, many challenges remain such as: inventories being prepared by small teams with multiple responsibilities, limited resources and sometimes very limited timelines; difficulty in retaining capacity and expertise in the medium to long term; and insufficient or complete lack of documentation of methods and data sources that were used in previous GHG inventories. In order for NAI Parties to be in a position to address the challenges arising from more frequent reporting and enhance the preparation of national GHG inventories, experts posit that the Parties would greatly benefit from the establishment of a sustainable national GHG inventory management system specifically designed to help them deliver taking into account their national circumstances and constraints. Such a system is needed to address key elements of the GHG inventory processes including the required legal and institutional framework, funding, planning, preparation, reporting, documentation and archiving; and inventory improvement strategies. In various countries, these and other relevant issues have been or are being integrated into 'Guidebooks' which are reviewed and adopted by stakeholders for use in-country. The NAI Parties that have already domesticated their inventory management system include Brazil, China, Columbia, Ghana, India, Indonesia, Kenya, Mexico, Philippines, South Africa and Thailand.

1.3 THE NEED FOR A NATIONAL GREENHOUSE GASES INVENTORIES MANGEMENT SYSTEM

Although Nigeria has conducted annual greenhouse and precursor gases inventories since 1990, the transparency of the inventory process still remains 'work in progress' as the country is yet to have an inventory management system that has been formally adopted for implementation by national stakeholders. On the basis of the above, the National Council on Climate Change (NCCC), hoping to reposition the GHG inventories activities sought assistance from the Initiative for Climate Action Transparency (ICAT) to include the development and delivery of a national inventory management system as part of the phase II project entitled; Climate Change Monitoring, Reporting and Verification (MRV) whose core focus is to review and update sectoral guidelines in five key sectors.

This report is presented as a result of the engagement of the experts as the national consultants to undertake the "Operationalization of the National Greenhouse Gas Inventory Management System (NGHGI-MS)" in the letter dated 29th November, 2024. The details of the Terms of Reference (TOR) for the engagement were provided as an Annex and includes to:

i Develop and deliver a robust GHG inventory management system for the NCCC;
ii Capacitate NCCC team with setting up of an operational NGHGI-MS by providing:
   a. Capacity building on the ETF requirements, available tools for reporting, including using the IPCC software, and UNFCCC reporting tools or any other tool useful in reporting,
   b. Recommendations on transparency data system requirements
iii Conduct capacity building training workshops for NCCC staff and key stakeholders.

A more detailed framework for achieving the above tasks is further elucidated as part of the objectives and scope for the engagement in Section 3.

This document forms the first version of the comprehensive NGHGI-MS to be adopted during its presentation to key stakeholders in the course of the NCCC ICAT-Nigeria Phase II project. It shall form the basis for future updates to keep the Guidebook alive as the need for review arises. After every major review is carried out, Version 1.0 shall progressively be updated to Version 2.0, 3.0 and 4.0 etc while minor reviews or sectional reviews shall convert each major review to 1.1, 1.2, 1.3; 2.1, 2.2, 2.3; 3.1, 3.2 and 3.3 among others.

2. FOOTPRINTS OF NATIONAL GHG INVENTORIES AND JUSTIFICATION FOR AN INVENTORY MANAGEMENT SYSTEM

2.1 OUTCOME OF NATIONAL GHG INVENTORIES BETWEEN 1988 AND 2017

The assessment of Nigeria's emissions by sources and removals by sinks of all processes leading to net emissions into the atmosphere has been part of the national air quality research at the Department of Physics and the Centre for Energy Research and Development (CERD) both of Obafemi Awolowo University (OAU), Ile-Ife, since 1990. The first Study was undertaken in 1990 and reported emissions for six trace gases and particulate matter for the year 1988 using the CAREAIR model (Laing and Obioh, 1994). The study was supported under the Environmental Monitoring and Impact Assessment Project funded by the European Economic Community (EEC) under the EEC/ACP Lomé III Agreement. The second Study was supported by the United States Countries Studies Program (USCSP). The Study reported similar trace gases and particular matter as the first report using the IPCC 1994/1995 guidelines (Obioh et al, 1996; Obioh and Adegbulugbe, 1997). The third Study was titled, "Enabling Activities for the Preparation of the First National Communication (NC1) to the UNFCCC for the Federal Republic of Nigeria". This was supported by the Global Environment Facility (GEF) Under the United Nations Development Programme (UNDP) as the implementing agency. Similar trace gases were reported for the year 1994 based on the IPCC 1996 guidelines. It was part of Nigeria's first national report to the UNFCCC.

In 2001, Nigeria received the fourth in the series of supports to prepare its national GHG inventories and mitigation analyses from the Canadian International Development Agency (CIDA) under the Canada-Nigeria Climate Change Capacity Development Project (CN-CCCDP), jointly implemented by Global Change Strategies International (GCSI) Incorporated, Ottawa, Canada and Nigeria Environmental Study/Action Team (NEST), Bodija, Ibadan, Nigeria with the Special Climate Change Unit (SCCU), Federal Ministry of Environment (FMENV) as the beneficiary. The Atmospheric Research and Information Analysis Laboratory (ARIAL), CERD, OAU, Ile-Ife, undertook the inventories for the years 1988 to 2000 based on the IPCC (1996) software.

The next in the series of support for ghg inventories came from UNDP through the Department of Climate Change (DCCC). The Study was undertaken by external consultants using the IPCC (2006) software. These were subsequently used in the preparation of the first Biennial Update Report (BUR1) to the UNFCCC in 2018. The BUR1 provided national GHG and precursor gases emissions from 2000 to 2016. An updated version of the inventory prepared by the external consultants was prepared and submitted to the DCC with emissions extended to the year 2017.

2.2 GHG AND PRECURSOR GASES EMISSION TRENDS AND GAPS ANALYSES

2.2.1 Trends Identify Inconsistencies in GHG Emissions Data Presented by Different Working Teams

The combination of the totality of GHG inventories undertaken under the various donor agencies in sub-section 2.1 stood at about 30 years in 2017. The emission trends for GHGs (CO_2, CH_4 and N_2O) and for the precursor gases (CO, NMVOC, NO_x and SO_2) are presented in Figures 2.1 to 2.3. These figures illustrate inadequate continuity between the datasets before and after the year 2000. While there is a sharp increase in the GHG emission trends after the year 2000, those of precursor gases (indirect GHGs) show sharp decline in emissions after the same year, except for NMVOC trends. These are clear indications of internally unmatched data, which can be addressed through a careful management of the inventory process under a streamlined National GHG Inventory Management System. Such discontinuity challenges could also be traced to the fact that assumptions made by different inventory teams may be highly different, and unless such assumptions are available in the report, especially with regard to how AD and

EF data were chosen, a lot of work becomes necessary to enhance transparency of the report. This makes recalculations compelling with decision jointly agreed across the NGHGI-MS on how to report such assumptions.

Figure 2.1: CO_2, CH_4 and N_2O Emission Trends in Nigeria: 1988 to 2017

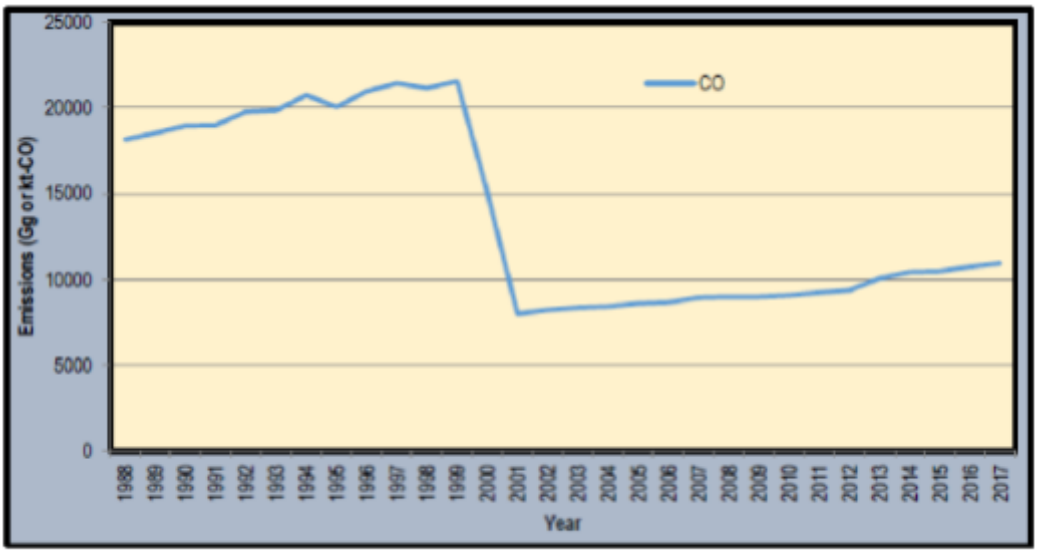

Figure 2. 2: CO Emission Trends in Nigeria: 1988 to 2017

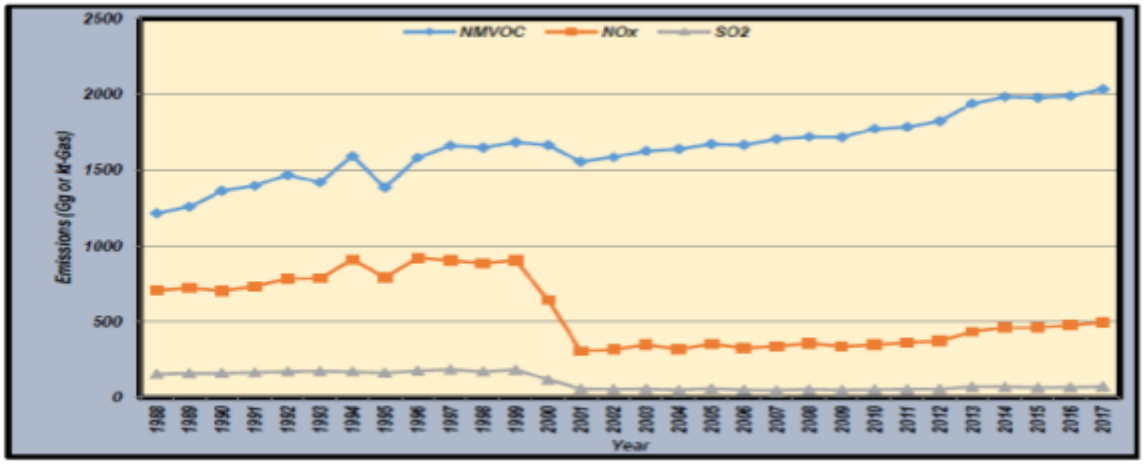

Figure 2.3: NMVOC, NO_x and SO_2 Emission Trends in Nigeria: 1988 to 2017

2.2.2 Gaps in Activities Data Availability

Substantial data gaps have been documented in all inventory reports from 1988 to 2017 which now form the basis for concluding that activity data for estimating GHG emissions maybe grossly inadequate in Nigeria. Some reports have also recommended strategies that could be used to improve the quality of activity data over time. However, these gaps do not appear to be narrowing over time, since there has been little success in the effort to include new data collection details into what the National Statistical Institutions (NSI) have been gathering over the years. For instance, in the downstream energy sector, data is obtained from NNPCL Annual Reports, NBS Annual Abstracts of Statistics, and other reports. These provide among others annual data on petroleum products consumption by the whole country, and for each state of the federation. These reports are lacking on sectoral energy consumption such as gasoline, diesel or other fossils consumptions which are necessary inputs to emission inventories in the energy sector. Some of the basic downstream petroleum products consumption data which are currently lacking include:

i Gasoline, diesel and other petroleum products consumption by road transport, rail transport, inland water ways and other transport sectors, especially navigation;
ii Coal consumption by rail transport, households and industries;
iii Diesel and fuel oil consumptions by industrial boilers;
iv Diesel and gasoline consumptions for power generation in industries;
v Diesel and gasoline consumptions by private electric generators;
vi Diesel consumption by off-road transport sectors, forestry and agriculture, and construction companies;
vii Energy consumption by public and business sector enterprises, including hotels, schools and other institutions; and
viii The partition in the consumption of aviation kerosene between local and international aviation.

Similar gaps in the database are observed in all other emission relevant sectors such as upstream energy sector, Industrial Processes and Products Use (IPPU), Agriculture, Forestry and Other Land Uses (AFOLU), Land Use, Land Use Change and Forestry (LULUCF), and waste. The back-up statistical data, which could have made the estimation of petroleum products consumption in the downstream energy sectors possible, are also currently weak. For instance, there are no statistics in the road transportation sector, regarding:

i The standard Nigerian vehicle fleet, which forms the basis for reporting
ii The total vehicles in Nigeria from year to year by fleet category
iii Total vehicle kilometres travelled by fleet category
iv Vehicle fuel consumption data per 100 km by fleet category

v Vehicle survival statistics by age and fleet, among others.

Similar backup statistical data for other transportation sectors such as inland waterways, air transportation, rail transportation, and marine transportation are also lacking.

Similar backup statistical data are also required in other key sectors and subsectors such as IPPU, AFOLU and waste. If these find their way into the NSI databases, and published annually, they would be used to build up a wider range of national statistics needed for emission inventories, and other useful economic production and consumption analyses.

Apart from a few national emission factors measurement undertaken in respect of gas flares, gas fired power plants and oil field facilities such as turbines, pumps and heaters in the early to mid-1990s, the majority of emission factors used in the national inventory are obtained from literature. The largest source of data has been the different IPCC Reference Manuals over the years. The emissions from earlier years also relied strongly on earlier reported EF values from the United States Environmental Protection Agency (EPA) especially the AP-42 document and OECD/IEA/IPCC (1991 to 1994) reference manuals. The question is how to validate whether or not these data are adequate representation of the national emission relevant technologies, which they represent. This forms the basis of the level of uncertainty currently associated with the emission estimates. The quantification of such uncertainties is yet to be undertaken.

A number of barriers are identified as militating against having a systematic and sustainable process for implementing GHG inventory activities in Nigeria, in line with the adopted inventory cycle:

i Inadequate spread of human resources. The inventories so far carried out may be linked to a handful of persons located in not more than 2 to 3 institutions. Some of the old-hands are no longer actively involved in GHG inventories, while adequate number of new generations of inventory experts are not systematically trained, and many of those trained are not active in inventory preparation. As a result of this, Nigeria in the last decade or so, had resorted to inviting foreign experts to assist in inventory preparation which is not sustainable and with consequences on the quality of inventories.

ii Lack of coordination for data collection and data archival, and restricted access to raw data files of relevant statistical institutions collecting emissions relevant data that could reduce current high uncertainties.

iii Lack of a network of institutions either established with the mandate or with adequate human capacity and experience and working collaboratively with the NCCC to undertake national GHG inventories and delivering data to NCCC.

iv Lack of back up data sources that are needed to improve downstream energy consumption data, land use change data, agricultural and industrial database, etc.

v Most of the studies carried out for other purposes that could have provided backup data are already obsolete, as some of these studies have not been repeated for more than two decades. These studies need periodic updates to provide back-up data sustainably.

vi There is also a problem concerning the use of offshore data which provides no transparency on where the data they are publishing were collected from and how primary data were converted to secondary data. For instance, Nigerian statistical institutions do not publish data on sectoral consumption of petroleum products but some offshore sources appear to publish data on gasoline consumption by road transport and generators, among others. Similarly, most LULUCF data are lacking from the NSIs but are published by FFO and other offshore sources without transparency on the sources where such data were obtained especially where they conflict with national data. Such transparency questions have to be addressed if offshore data used is to be encouraged by the National Inventory Management System.

vii Inadequate local financial resource commitments and budget for inventories and mitigation by NCCC and/or the institutions that preceded it, despite the value of GHG inventories and mitigation options assessment data to national economy planning. It is observed that all GHG inventories so far undertaken have been supported

by externally sourced funds. The non-continuity of such funds has always hampered the sustainability of inventories activity and the associated mitigation analysis activities. Hence, even if an inventory cycle is defined today, without local funding the country may not be able to provide continuous unhindered inventories if funding must always be sourced offshore.

viii The non-availability of electronic data archival and retrieval systems for activity data, emission factors and previous emission estimates makes update of GHG inventories and mitigation options analysis, as well as access to GHG inventories data and information on potential mitigation option technologies, least-cost economic scenarios and potential support policies difficult.

2.3 PAST EFFORT AT DEVELOPING THE FRAMEWORK FOR IMPROVING THE QUALITY OF GREENHOUSE GAS INVENTORIES AND JUSTIFICATION FOR THIS DOCUMENT

In order to commence the process of bridging the gaps identified in sub-section 2.2.2 as well as in the legal and institutional arrangements to support NGHGI-MS, the United Nations Development Programme (UNDP) in 2005 approved the Project, “Capacity Building for Improving the Quality of Greenhouse Gas Inventories in West and Francophone Central Africa (Project No.: RAF/02/G31)”. The project was implemented in the Federal Republic of Nigeria by the Special Climate Change Unit of the then Federal Ministry of Environment, Housing and Urban Development in collaboration with United Nations Office for Project Services (UNOPS), and UNDP National Office, being supported financially by the Global Environment Facility (GEF). The Regional Project Office, who acted as management focal point, was hosted by the UNOPS Office in Dakar, Senegal.

Besides building the initial capacity for improving the quality of GHG inventories, one of the key activities of the Project was to develop the manual of procedures (MoP) for National Inventories Management in the beneficiary countries. Among other activities implemented under the Project, the Procedures Manual for Nigeria was developed and submitted by Obioh (2008) as part of the outputs of the Nigerian activities. The MoP provided recommended inventory cycles activities, institutional arrangements for managing GHG inventories as well as procedures for undertaking data collection, emissions calculation on a sector-by-sector basis. However, this was not adopted and therefore could not become part of the national inventory procedures even with the inadequacies associated with it at the times.

3 OBJECTIVE AND SCOPE OF DESIGNING THE NATIONAL GHG INVENTORIES MANAGEMENT SYSTEM AND ASSOCIATED ACTIVITIES

3.1 WHAT CONSTITUTES A GHG INVENTORIES MANAGEMENT SYSTEM

According to Braatz and Doorn (2005) and UNFCCC (2018), the National GHG Inventories Management System provides the strategy for organizing and structuring all the steps and elements needed to estimate anthropogenic emissions by sources and removal by sinks of greenhouse gases not included in the Montreal Protocol, and to report, review, archive, and improve estimates of GHG emissions and removals. It includes the legal, institutional, and procedural arrangements, and other related support activities that facilitate management of key inventory tasks during the inventory compilation process, as well as to improve inventories quality in general. This at the least includes planning, collecting and documenting data, documenting steps, reviewing, reporting, archiving, and planning improvements. This sets the stage for establishing the objectives and scope of the development of the NGHGI-MS as indicated in the sub-sections below.

3.2 AIM OF PREPARING AND ADOPTING THE NGHG INVENTORIES GUIDEBOOK

The primary aim is to develop and deliver to National Stakeholders for adoption, the first version of the comprehensive draft NGHGI-MS guidebook that provides the framework for undertaking sustainable and transparent GHG inventories, systematic updates, building national capacities and undertaking other auxiliary activities that will ensure continuous improvements in the quality of GHG inventories in Nigeria.

3.3 SPECIFIC OBJECTIVES OF PREPARING AND ADOPTING THE NGHG INVENTORIES GUIDEBOOK

The following form the specific objectives of preparing and adopting the NGHGI-MS for use in inventories preparation and update in Nigeria:

i Propose the legal and policy framework to guide preparation and management of GHG inventories;
ii Propose the institutional and funding arrangements for compiling, archiving, updating, managing and reporting GHG inventories;
iii Develop for adoption, a sustainable procedural/operational arrangement process including the National Inventory Cycle (NIC);
iv Enhance the technical capacity for preparing national GHG inventories;
v Bring up systematic processes and programmes for improving methodologies, activities data and emission factors, among other issues; and
vi Propose periodic timelines for the review and update of the NGHGI-MS guidebook;

3.4 SCOPE OF ACTIVITIES DIRECTLY ASSOCIATED WITH PREPARING AND ADOPTING AN NGHGI-MS DOCUMENT FOR NIGERIA

The overall scope of this assignment covers the following sets of tasks or activities meant to support the design of the NGHGI-MS guidebook, capacity development and other auxiliary activities associated with the use of the guidebook.

3.4.1 TASK 1: Setting the legal and Policy Framework to Guide the Preparation and Management of GHG Inventories

The legal basis for the NGHGI-MS is expected to be an Act of the National Assembly (NASS) and/or individual State Houses of Assemblies (SHASS). It is the Act setting up the NGHGI-MS that would provide the framework for systematic procedures for undertaking GHG and other atmospheric emissions inventories, the institutional arrangements at each tier of government with the FMENV at the apex, and counterparts responsible for environmental matters at the other tiers of government with the NCCC at the apex at the national level and the State Climate Change Focal Institutions (SCCFI) at the apex at the state level. The Act is expected to create relevant institutions at each tier of government to undertake tasks incidental to the attainment of the objective of setting up the inventories management system to ensure smooth operations, as well as the procedural arrangements, based on professional practice and protocols. The Act is also expected to define the duration of the national inventories cycle, activities to be undertaken over the cycle, including the MRV procedures and protocols under the leadership of the focal point. The legal basis or the NGHGI-MS Act, shall provide for the creation, hosting and management of an NGHGI-MS for each tier of government, a web-based input and output database that would support results and information sharing and dissemination among other needs of the system.

In practice, the legal basis for emission inventories is not expected to be a stand-alone legislation, but could also be promoted under a wider national environmental legislation such as having a National Climate and Air Pollution Control (NCAPC) Act for Nigeria as part of the NCCC Act whenever it is reviewed. In view of the established overlaps between air quality issues and climate change, the NCAPC Act could in future be an integrated legislation to address all areas relevant to emissions implicated in air pollution and climate systems assessment and management. These include climate and air quality modifications; monitoring techniques; assay of the various dose-response relations; biogeochemical cycling and pathways for entry into the atmosphere, water resources, soil and food chain; the framework and criteria for translating emissions into stabilized atmospheric concentrations, atmospheric lifetimes and impact on global warming of these gases and particulates; the criteria for quantifying each class of impacts including impacts of atmospheric concentrations on air pollution and climate change; the criteria for assessing bio-physical impacts of air pollution and climate change on human health, ecosystems and biodiversity as well as modalities for enhancing human health, ecosystems and biodiversity protection, among others; development and implementation of the varying techniques and framework for abatement; among others. Such an integrated legislation is also expected to specify the respective roles to be played by the Council on the one hand, the Federal Ministry of Environment and its parastatals on the other, and the areas where both teams have to work collaboratively to address these issues. These are needed to enhance systematic migration to carbon neutral and/or green economy. The Legal Framework is also expected to encompass:

i Defining and providing comprehensive classification of all anthropogenic emissions which are detrimental to attain clean air quality, as well as implicated in climate system modifications;
ii Propose the framework under which GHG inventories and related activities could benefit from the National Climate Fund under the Climate Change Act;
iii Emissions and Ambient Air Quality Assessment and Management
iv Health and other impacts of air quality impairments
v Provision to address the science of climate change and understanding the framework to address vulnerabilities, impacts and adaptations;
vi Technological and other frameworks for managing climate change and air quality and their impact;
vii Design and deployment of relevant financial and policy instruments to enhance cost effective air quality management and climate change mitigation and adaptation;
viii Propose the respective institutional framework for addressing GHG inventories, emissions and ambient air monitoring, impacts assessment, and abatement of each class of emissions as they relate to air quality and climate system modification;
ix Propose the procedures for emissions monitoring and assessment for each of the atmospheric variables implicated in climate change and air quality deteriorations, as basis for establishing national emission factors

and national emission factors listing documents. The legislation shall in addition empower the respective institutions to evolve further methods for monitoring and assessment, including compliance monitoring as the science and technology evolves;

x Propose the roles and responsibilities of each tier of government to support the preparation of the respective State Implementation Plans (SIPs) for managing ambient air quality and climate change within their respective domains, as could be stipulated under such an expanded legislation; and

xi Propose any other provisions considered necessary and incidental to the attainment of the objective of the Act.

This Legal framework, when duly developed, shall have provisions for addressing the issues in bullets (i) to (xi) above.

Where the legal framework is not properly articulated or completely absent, policies shall be developed to fill in the gaps created by inadequate legal framework. This shall be with a view to streamlining the procedures for planning, preparation, compilation, reporting and archiving GHG inventory activities through a well-articulated policy.

3.4.2 TASK 2: Propose the Institutional Arrangements for Compiling, Archiving, Updating, Managing and Reporting GHG Inventories

The institutional arrangements under the NGHGI-MS are expected to bring together Ministries, Departments and Agencies (MDAs) at federal and state levels not associated with emissions, public and private research organizations, experts and consultants. The institutional arrangements should give in clarity the set of institutions that will oversee and manage every aspect of the inventory. Since the National Council on Climate Change or the Council remains the apex institution in Nigeria for all climate change matters, the institutional arrangements should then have NCCC at its apex.

3.4.3 TASK 3: Develop for Adoption, a Sustainable Procedural/Operational Arrangement Process Including the National Inventory Cycle

The Procedural framework for inventories is to provide the range of activities that are to be undertaken systematically to ensure a complete and sustainable inventories that meets the timelines and quality expected by the UNFCCC, the Paris Accord and NCCC. The procedural arrangement would comprise:

i The details of the national and sub-national GHG inventory schedule

ii The activities under the four main phases:
   a. Inventory Planning
   b. Inventory Preparation
   c. Inventory updating and management
   d. Inventory data archival and retrieval

iii Establish the Framework to Address known Inventory Challenges, namely Small Teams and Limited Funds.

3.4.4 TASK 4: Enhance the Technical Capacity for Preparing National GHG Inventories

i There will be systematic programme for regular training for younger and mid-level scientists to become involved in inventories activities.

ii Such courses shall be held either quarterly or bi-annually, as would be approved by NCCC.

iii Experts in software shall also be trained to develop emission inventory models and sub- activity models that could be used for individual processes such as:

a. factories,
b. urban road networks,
c. tanks,
d. urban areas, among others; for which the IPCC models and other larger models cannot be easily applied.

3.4.5 TASK 5: Bring up Systematic Processes and Programmes for Improving Methodologies, Activities Data and Emission Factors, among other issues

i The role of the national statistical institutions shall be clarified on how they would provide new data to fill the existing gaps for GHG inventories in all the plausible sectors, including Energy, IPPU. AFOLU and Waste.
ii The framework for liaising with national universities and research institutions to provide emission factors based on standardized procedures approved by NCCC for all GHGs and precursor gases.

3.4.6 TASK 6: Develop for Adoption the Components of GHG Inventories Data Archival and Retrieval System

The GHG Inventory System comprises a wide range of players, activities and data which are used in the course of undertaking an inventory. These also produce a wide range of data that result from the inventory process. There is a strong need for stakeholders, from the science community to policy makers in public and private sector to have access to such data for various uses. A database is therefore a necessary tool in the design and management of a systematic inventory process. The database must have both the front end and the backend which gives layers of access to different teams responsible for developing and managing it, as well as to the general public that require some range of unhindered access to such data. The National GHG Inventories Data Archival and Retrieval System is an important component of the NGHGIMS. This shall comprise at a minimum:

i I/O Module for each IPCC model,
ii data archival system,
iii data retrieval system.

3.4.7 TASK 7: Propose Periodic Timelines for the Review and Update of the NGHGI-MS Documents

These documents shall be given major review every three to four (3-4) years depending on need as approved by NCCC Secretariat. Major reviews could comprise any one or more of the following:

i. Alterations spreading across 60% or more of the sections of the guidebook in a single review period;
ii. Minor alterations spreading across 60% or more of the sections of the guidebook in two to three successive review periods;
iii. Addition or deletion of at least 75% of a whole section during a single review period and/or replacement with new texts.

The Head of NIMO, who shall serve as the National GHG Inventory Coordinator (NGIC), could propose to the DG, NCCC. and seek approval for major or minor reviews where such are considered exigent before the above timeframe for major reviews.

3.5 OTHER RELEVANT ACTIVITIES ASSOCIATED WITH DELIVERY OF THE NGHGI-MS

i The capacitation, that is building the capacity of NCCC Secretariat team with setting up of an operational NGHGI-MS. Training workshops were proposed by NCCC to be held to train its staff on:
   a. ETF requirements, available tools for reporting;
   b. use of the IPCC software, and UNFCCC reporting tools or any other tool useful in reporting including the use of national data that fits the IPCC requirements.

The reports of the training and other activities are expected to be published as a separate volume from these documents.

ii Conducting capacity building training workshops for NCCC Secretariat staff and key stakeholders. This will involve:

a. providing training to core NCCC staff on the NGHGI-MS including the needs, roles and responsibilities of each component of the institutional arrangements for the Inventory Management System and the operational proceedings among others;
b. presenting the NGHGI documents to relevant stakeholders for consideration and adoption.
c. Identifying the resources and other elements that would be needed to bring the NGHGI-MS to operation, and recommend the timeframe and modalities to NCCC.

The reports of the training and other activities are expected to be published as a separate volume from these documents.

3.6 WHAT CONSTITUTES THE TECHICAL ASPECTS OF A NATIONAL GHG INVENTORY MANAGEMENT SYSTEM AND WHY IT IS NEEDED

What constitutes a National GHG Inventory Management System (NGHGI-MS) has already been discussed in sub-section 3.1. This sub-section presents the technical issues directly associated with developing an NGHGI-MS. It is pertinent to note that undertaking atmospheric emission inventories which satisfy the UNFCCC reporting requirements for NAI Parties in respect of GHG inventories and similarly for other atmospheric emissions require a combination of technical issues. These include:

i Development of the legal and policy framework to support inventories management;
ii Developing and putting in place an institutional and funding arrangement that would provide administrative support for managing the inventory process;
iii Development of a well-defined inventory process which when put in place would provide the systematic array of activities that must be followed through in the course of inventory planning, preparation and reporting to achieve cost-effective inventory in line with TRACCC criteria;
iv Adoption of an inventory model and database to support the NGHGI-MS to ensure that TRACCC conditions are achievable;
v Bringing together a multidisciplinary team of experts and expert institutions whose knowledge and experience would be vital in the coordination of scientific support activities that would lead to knowledge enhancement and process improvement;
vi Designing the framework for a wide range of activities to support emission inventories including:
  a. Collection of accurate data and related information such as activities and emission factors data from the relevant economic sectors that contribute to each of the emission streams;
  b. Measurement of national emission factors and collection of emission factors data from elsewhere;
  c. Collection of other related source data from national and private sector institutions to ensure that such data are a good representation of national emissions;
vii. Planning and development of other activities that would enhance research and human capacity development, among others, to systematically improve the quality of inventories at national and state level.

The above form the key elements needed when developing a NGHGI-MS or any other atmospheric emission inventories management system. The sections below discuss these key elements and how they are used in defining the NGHGI-MS for Nigeria. If successfully followed through, they would assist the nation prepare GHG emission estimates that meet the transparency, reproducibility, accuracy, comparability, consistency and completeness (TRACCC) criteria. This is because any inventory system that is able to meet such criteria is considered adequate to

be used in reporting Nationally Determined Contributions (NDC) under international conventions and protocols on climate change.

4 THE LEGAL AND POLICY FRAMEWORK FOR NGHGI-MS

4.1 THE CONTEXTUAL FRAMEWORK

The National Council on Climate Change which was established by Act No. 11 of 2021 and subsequently referred to as the Climate Change Act ("The Act") is the apex body with the mandate to coordinate and manage climate change related activities in Nigeria. The objectives of the Act are to:

i ensure that Nigeria formulates programmes for achieving its long-term goals on climate change mitigation and adaptation;
ii mainstream climate change actions in line with national development priorities;
iii ensure that climate change policies and actions are integrated with other policies for promoting socio-economic development and environmental integrity;
iv set a target for year 2050-2070 for attainment of a net-zero GHG emission in line with Nigeria's international climate change obligations; among other related activities.

4.2 THE ROLE OF GHG INVENTORIES AS A CROSS-CUTTING ISSUE FOR SOME KEY FUNCTIONS OF THE COUNCIL

Emission Inventory is a cross-cutting issue that provides for the determination of GHG emissions by source and removal by sinks of all anthropogenic emissions not covered under the Montreal Protocol. It can be used for variety of applications including emissions, mitigation, climate modelling, vulnerability and impacts, and carbon trading, among others. Section 4 of The Act provides for the key functions of the Council. Some of these key functions are directly and indirectly related to emission inventories and emission modelling. The technical ones include:

i Coordinating the implementation of sectoral guidelines and targets for the regulation of GHG emissions and other anthropogenic causes of Climate Change;
ii Approving and overseeing the implementation of the Action Plan;
iii Ensuring the mainstreaming of climate change into the national development plans and programmes;
iv Recommending legislative, policy, appropriation, and other measures for climate change mitigation, adaptation and other related activities;
v Collaborating with the Nigeria Revenue Service to develop a mechanism for carbon tax in Nigeria;
vi Collaborating with the Federal Ministries responsible for (i) Environment and (ii) Trade, to develop and implement a mechanism for carbon emission trading;
vii Advising and recommending on technical, scientific, and legal matters relating to climate change, in accordance with the provisions of the Act;
viii Collaborating with the Nigeria Sovereign Green Bond in meeting Nigeria's Nationally Determined Contributions (NDCs); and
ix Performing such other functions necessary for the fulfilment of the objectives of the Act.

Although none of these functions clearly stipulate the legal basis for emission inventories, function (ix) enable the Council to set up any other necessary functions that will enable it achieve the objectives of the Act. Furthermore, Section 3 (1) of the Act provides that the Council shall be vested with powers to make policies and decisions on all matters concerning climate change in Nigeria. It is on the basis of Section 3 (1) that the Council has through this Guidebook developed the Policy Framework to support the management of emission inventories. These are presented in Section 4.3.

4.3 EMISSION INVENTORIES MANAGEMENT POLICY

Inventory activities are undertaken by following a systematic procedure that ensures:

i. identification of all sources and sinks, collection of all relevant data, identification and implementation of inventory planning and inventory preparation tasks, emissions compilation and reports preparation.
ii. application of relevant database to ensure that there is effective data archival and retrieval.
iii. undertaking any other relevant activities such as monitoring, modelling and associated research to bring good quality data into the inventory system.

In view of the dearth of a regulatory framework for managing GHG inventories in Nigeria, the Council hereby brings up a policy framework that shall be used for inventories management. These are presented in the subsections below. The ultimate objective of the Policy is to ensure that the national inventory process in Nigeria is moved from one that is completely ad-hoc to one that is highly regulated and standardized. One of the intermediate objectives of the Policy is to build human capacity at national and state levels, to the extent where nationally determined contributions shall be seamlessly established by national experts and institutions, without compromising on standards set in IPCC and UNFCCC Guidelines for such activities with the ultimate goal of working with other Parties to the Convention in meeting the ultimate objective of the UNFCCC. Another important objective is to have an inventory that provides information such as sectoral emissions, trends and other useful results that could be used for a variety of purposes. This includes providing information on the progress made by the country in meeting the targets of obligations to the UNFCCC and how emission reduction programmes could be used to optimise the performance of the national and states economies. The ultimate and other intermediate objectives shall form a strong component of the policy framework that would ensure that inventories meet the acceptable standards and quality that would be useful in planning.

4.3.1 Policy 1: General Issues

4.3.1.1 Anthropogenic Emissions Relevant to Inventories in General

These include:

i Criteria Air Pollutants (CAPs): These include Particulate Matter (PM), including the total suspended particulate (TSP), as well as respirable fractions: PM_{10}, $PM_{2.5}$, and PM_1; Carbon monoxide (CO); Volatile Organic Compounds (VOC); Nitrogen Dioxide (NO_2); Sulphur Dioxide (SO_2); Black Carbon; and Ozone (O_3).

ii Greenhouse Gases (GHGs): They include: Carbon dioxide (CO2); Methane (CH4); Nitrous Oxide (N2O); Ozone; Hydro-fluorocarbons (HFCs); Per-fluorocarbons (PFCs); and Sulphur Hexafluoride (SF6).

iii Greenhouse Gases (GHG) Precursors: They include: CO, SO_2, Oxides of Nitrogen (NO_x), VOC and PM.

4.3.1.2 Atmospheric Emissions Relevant to this Guidebook

The atmospheric emissions relevant to this Guidebook include GHGs and Precursor gases, namely CO2, CH4, N2O, O_3, HFCs, PFCs, SF6, CO, SO2, NOx, VOC and PM.

4.3.2 Policy 2: Achievement of Mass Balance

i For any cycle where inventories have been reported at national level, and for all 36 states of the Federation and the FCT, mass balance should be achieved for activities data and emissions data.

ii Where emissions are reported at the national level, but not for all the 36 states of the Federation and the FCT, summation of each activities data and associated emissions at state level should be less than the total of each activities data and associated emissions at the national level.

4.3.3 Policy 3: Prioritization of Local Activity Data over Off-shore Data Sources

i Priority shall be given to the use of activities data published nationally over activities data published by international sources.
ii Activity data should not be accepted from international sources to be used for national and state inventories in Nigeria without providing information on the assumptions used by the international source to generate the data so presented.
iii Where data are obtained from local/international sources without understanding the assumptions used in generating the data, such data sources should be ranked "low quality" and replaced as soon as higher quality data are obtained.

4.3.4 Policy 4: Template for National Data Collection

The Council shall provide a template specifying the kind of data that the statistical institutions and other national data sources will provide to improve the quality of national inventories, and sign agreements with these national data providers to ensure that data becomes available in the required format and quality.

4.3.5 Policy 5: Completeness

The inventory spreadsheets shall be complete with regards to sources identified in the IPCC guideline/model that exist in the country/state as well as for activities data and emission factors. It may also extend to other sources not included in the IPCC guidelines but exist in the Country/State.

4.3.6 Policy 6: National Vehicle Fleet

4.3.6.1 Definitions for National Vehicle Fleet

A National Vehicle Fleet comprises the total vehicles of a particular transportation system such as roads, air, etc. as well as their categorization including weight range, axle type, engine type and fuel injection technology, fuel type, emission control technology, among others, defined in such a way that no vehicle will come under more than one category in the fleet.

4.3.6.2 Competent Authorities to Define Each Fleet

The following shall be the competent authorities to define each fleet:
i Road vehicle fleet by Federal Ministry of Transport, or their successors in title.
ii Aircraft fleet for civil aviation by Federal Ministry of Aviation, or their successors in title.
iii Vehicle fleet for inland waterways navigation by Inland Waterways Authority, or their successors in title.
iv Fleet of Ships and Ocean Liners owned by public and private sectors in Nigeria, and ships berthing in Nigerian ports by Nigerian Port Authority, or their successors in title.
v Fleet of land combat vehicles in custody of the Nigerian military by Federal Ministry of Defence, or their successors in title.

vi Fleet of combat aircraft in custody of the Nigerian military by Federal Ministry of Defence, or their successors in title.

vii Fleet of combat watercraft and ships in custody of the Nigerian military by Federal Ministry of Defence, or their successors in title.

4.3.6.3 Responsible Officer for Liaising with Competent Authorities for Definition and Data Collection on each Vehicle Fleet

i While the National Inventory Management Office (NIMO) shall have the authority to contact the various competent authorities for definitions and data on each fleet categorization serving civil purposes, the Secretariat of the Council, shall be responsible for reaching out to the Federal Ministry of Defence for the respective fleets categorization and data serving combat purposes.

ii With respect to getting the cooperation to both define the fleets and release data on their fleets from the Ministry of Defence, the Secretariat shall have the responsibility to show the military authorities how this information shall be classified and used without compromising national security, and shall where so demanded enter relevant agreements to the effect that this information shall be used safely, and without compromising national security.

4.3.7 Policy 7: Institutional Arrangements for Inventories Management at the National Level

i The Council shall be the apex institution for emission inventories activities that shall be responsible for all emission inventories activities at both national and state level, and shall bring any relevant institution to work with it and achieve the mandate of GHG emission inventories activities.

ii Under the direction of the Secretariat of the Council, there shall be a National Inventories Management Office (NIMO) to be headed by the National GHG Inventory Coordinator (NGIC).

iii The responsibilities of NIMO shall be as provided for in Section 5.2.

iv There shall be a National Inventory Technical Support Institution (NITSI) which shall be a university-based institution or a non-profit R&D institution to be headed by the National Inventory Technical Team Leader (NITTL).

v The responsibilities of NITSI and NITTL shall be as provided for in Section 5.2.3 and any other responsibilities assigned by the National GHG Inventory Coordinator (NGIC).

vi There shall be National Sectoral Inventory Teams (NSITs) to be headed by National Sectoral Inventory Team Leaders (NSITLs) for each of Energy, IPPU, AFOLU and Waste sectors, who shall each report to the NITTL.

vii The responsibilities of the NSITs and the NSITLs shall be as provided for in Section 5.2.4 and any other responsibilities assigned by the NGIC.

viii There shall be a set of National Statistical Institutions (NSIs) whose responsibility shall be to provide activities data during each NIC for use in computing national GHG emissions based on emission factors available nationally and in literature.

ix The responsibilities of the NSIs shall be as provided for in Section 5.2.5.

x There shall be a National Inventory Review Group of Experts (NIRGE) accredited by NIMO to review inventory reports submitted by compiling entities namely the NITSI and NSITs.

xi The responsibilities of NIRGE shall be as provided in Section 5.2.6.

xii There shall be a set of Universities, Public and Non-Profit R&D Institutions recommended by the NITTL to NIMO for accreditation to engage in relevant research that would enhance the quality of national inventories.

xiii The responsibilities of these Universities, Public and Non-Profit R&D Institutions shall be as provided in Section 5.2.7.

4.3.8 Policy 8: Institutional Arrangements for Inventories Management at the State Level

i At the state level, there shall be a State Climate Change Focal Institution (SCCFI) which shall report directly to the Director General of the Council on matters not relevant to GHG inventories and to NIMO for matters relevant to GHG inventories. It shall be responsible for designing any climate change related activities inclusive of emission inventories activities within the state. It shall also have the authority to bring relevant institutions at the state level to work with it on climate change matters in general and emission inventories in particular.

ii Under the direction of SCCFI, there shall be a State Inventory Management Office (SIMO) to be headed by the State GHG Inventory Coordinator (SGIC).

iii The responsibilities of SIMO shall be as provided for in Section 5.3.2.

iv There shall be a State Inventory Technical Support Institution (SITSI) to be headed by the State Inventory Technical Team Leader (SITTL).

v The responsibilities of SITSI and SITTL shall be as provided for in Section 5.3.3.

vi There shall be State Sectoral Inventory Teams (SSIT) to be headed by State Sectoral Inventory Team Leaders (SSITLs) for each of Energy, IPPU, AFOLU and Waste sectors, who shall each report to the SITTL.

vii The responsibilities of the SSIT and the SSITLs shall be as provided for in Section 5.3.4.

viii Where there are State Statistical Institutions (SSIs), they shall complement the NSIs, in providing activities data for inventories at the state level.

ix The responsibilities of the SSIs shall be as provided for in Section 5.3.5.

x There shall be a State Inventory Review Group of Experts (SIRGE) accredited by SIMO to review inventory reports submitted by compiling entities namely the SITSI and SSIT.

xi The responsibilities of SIRGE shall be as provided in Section 5.3.6.

xii There shall be a set of Universities, Public and Non-Profit R&D Institutions within the States recommended by the SITTL to SIMO for accreditation to engage in relevant research that would enhance the quality of state inventories.

xiii The responsibilities of these Universities, Public and Non-Profit R&D Institutions shall be as provided in Section 5.3.7.

4.3.9 Policy 9: Qualification for States to Commence Inventory Activities

The following shall be the minimum qualification for any State to commence GHG inventory activities:

i There shall be a designated State Climate Change Focal Institution (SCCFI) approved by the state government;

ii The state shall have minimum of a State Inventory Management Office (SIMO) who shall be responsible for developing other institutional structures for GHG inventories subject to the approval of the SCCFI.

iii The state shall have a minimum of five (5) key personnel certified by the Council in GHG inventory activities with at least one each, in the Energy, IPPU, AFOLU and Waste sectors, or as applicable in the relevant IPCC model used.

4.3.10 Policy 10: Funding of GHG Inventory Activities

The Council shall set aside a fraction of the Climate Change Fund (CCF) for mitigation and adaptation activities, during a meeting of its Members, as the National Inventories Fund (NIF). The NIF with Federal and State components as provided in sub-sections 5.4.1 and 5.4.2 shall be used to support inventory activities at the Federal and State Government levels during each inventory cycle.

4.3.10.1 Funding of GHG Inventory Activities at National Level

Funding for national GHG inventories shall comprise the following elements:

i The percentage of the National Assembly annual appropriation for the Nigeria Climate Change Fund (CCF) for mitigation and adaptation activities as approved by the Council that shall be allocated to GHG inventory activities;

ii The percentage-share of donor funds and other funds of joint nature with the states based on the sharing formula between federal and state governments as approved by the Council that shall be allocated to GHG inventory activities.

4.3.10.2 Funding of GHG Inventory Activities at State Level

Funding for state GHG inventories shall comprise the following elements:

i The percentage of the State House of Assembly annual appropriation for the CCF for mitigation and adaptation activities as approved by the State House of Assembly (SHA) for GHG inventory activities.

ii The percentage-share of donor funds and other funds of joint nature with the states based on the sharing formula between federal and state governments as approved by the Council for GHG inventory activities.

4.3.11 Policy 11: Budget Arrangements for GHG Inventories

There shall be a 3-year composite budget cycle for GHG Inventories which if approved by the Council shall allow inventory activities to progress smoothly without disruptions except where force majeure comes to play. The Composite Budget shall be divided into 3 parts i.e., Part 1 for the first 12 months, Part 2 for the second 12 months and Part 3 for the third 12 months in alignment with the regular annual budgets.

4.3.12 Policy 12: Meetings

i. The Meeting of the National Inventory Team Leaders (MNITL) shall be chaired by the National GHG Inventory Coordinator (NGIC) with officers of National Inventory Management Office (NIMO) above a certain cut-off rank approved by the Council Secretariat, the NITTL and the NSITLs as members. The meeting shall be called at the instance of the NGIC who shall appoint a personnel member within NIMO to act as secretary. Meetings shall be called by the secretary in consultation with the NGIC and with an agenda. Quorum shall be formed when a simple majority of members are present.

ii. There a shall be a Meeting of the State Inventory Team Leaders (MSITL) which shall have similar responsibilities and scope of approval as that at the national level. However, NGIC, NIMO, NITTL and NSITLs shall respectively be replaced by the SGIC, SIMO, SITTL and SSITLs. The meeting shall consider and approve all items brought before it by the SGIC that is within its scope of approval and recommend those above its scope of approval to the State Climate Change Focal Institution (SCCFI) for necessary action.

iii. Sectoral Inventory Team Meetings (SITM) at the national and state levels shall respectively be chaired by NSITLs and SSITLs with NITTL and SITTL, and sectoral team members as members. The chairmen shall each appoint personnel among the sectoral team members as secretary. Meetings shall be called by each SITM's secretary in consultation with their chairman. Each call for meeting shall come with an agenda. Quorum for SITM shall be formed when a simple majority of members are present.

4.3.13 Policy 13: Scope of Approval for Meetings

i. Apart from issues brought for the consideration of Meetings associated with inventory planning, preparations and reporting which shall be within the limits of the MNITL and MSITL's approval, the Council Secretariat at the national level and the SCCFI at the state level shall prescribe other issues which are within the scope of

approval of the MNITL and MSITL respectively, as well as those outside that scope. For issues outside its scope, the MNITL and MSITL shall merely note and recommend them to the competent authority for necessary action.

ii. MNITL and MSITL shall consider and approve all items brought before it by the NGIC and SGIC respectively that is within its scope of approval and recommend those above its scope of approval to the competent authority for necessary action.

iii. SITM at national and state levels has no locus-standi to approve any item brought to it for implementation but shall forward items approved at the meeting to NITTL and SITTL respectively for necessary action.

iv. MNITL, MSITL and SITM at national and state levels shall consider and approve each item brought before it that has been approved by a simple majority of members present at the meeting to the NITTL and SITTL respectively for their necessary action.

v. Any item brought to the meeting that did not receive simple majority approval for forwarding to the NITTL/SITTL could be brought back to the next meeting for reconsideration and approval if necessary.

4.3.14 Policy 14: The National Inventory Cycle (NIC)

4.3.14.1 Modes of the Cycle

i The NIC shall at the beginning be operated in two modes vis the Normal National Inventories Cycle (N-NIC) and the Super National Inventories Cycle (S-NIC). This shall remain until a program to achieve the integration of the two modes into one is successful.

ii The N-NIC shall have a periodicity of 24 months and a period of one year before the commencement of the next cycle to plan the activities for the next inventory, source for funds and to build and fill the gaps in needed human capacity for inventories. The S-NIC shall have a periodicity of 30 months with a 6-month period for planning, sourcing of funds and filling the human capacity gaps.

iii The activities of the NIC shall be as defined in Section 6.5.

4.3.14.2 Commencement of the Cycle

Upon the adoption of this Guidebook, the cycle shall start with an S-NIC to bring the inventories up-to-date with the same IPCC model, and to ensure that all internal inconsistencies are removed.

4.3.14.3 Alternating between NIC Modes

After every 3 successive N-NICs, the inventory process shall automatically revert to an S-NIC, and shall thereafter automatically revert back to N-NIC after completion of the S-NIC.

4.3.14.4 Activities Falling on Weekends or Holidays

If and when any activity in the NIC calendar falls on a weekend or public holiday, it shall automatically be moved to the next working day.

4.3.15 Policy 15: Manual of Procedures

A manual of procedures (MoP) shall be prepared, updated and approved as specified in sections 6.2 and 6.3. Each MoP shall only be used to support inventories within the inventory cycle and shall be revised at the onset of a new inventory cycle.

4.3.16 Policy 16: Use of IPCC Tier Approaches

i. Consideration for migration from one Tier to the other shall be made only when the active phase of emission factors research has begun. During this active phase, measurements and modelling of new emission factors would have been published routinely, setting the stage for the development of an Emission Factors Listing Document and migration to an Emission Factors Listing Database later.
ii. The rule of thumb for the use of the IPCC tiers shall be to start with tier 1 and then to grow systematically to other tiers based on data on nationally estimated emission factors that has become available from research publications in past years.
iii. Where nationally estimated emission factors are yet to be published by research teams, they could be admitted temporarily into the National Emission Factors Listing (NEFL) document or database, whichever is available, while awaiting the publication of such works. If after two NICs such research works remain unpublished, the NGIC shall bring the matter to the MNITL for reconsideration and where necessary, to delist them from the NEFL document or database.
iv. Migration from one IPCC tier to the next shall be done after NGIC in collaboration with NITTL has provided sufficient data to show that about 25% of emission factors for the next tier are available nationally.

4.3.17 Policy 17: Selection of the Version of IPCC Model for an NIC

i. Since the IPCC model's accuracy increases from the earliest to the latest version, the first rule of thumb is that the latest version available should be considered.
ii. However, where national data, human and other resources are constrained to the extent where the latest IPCC model may not be easy to use, then resort to an earlier version may be considered.
iii. The MNITL shall, based on available data presented to it by NGIC, approve the version of the IPCC model that would be used during the next NIC.
iv. After this, it shall be good practice to develop an Excel-based tool of the Model for inter-comparison analysis purposes. Such inter-comparison analysis will enable the use of the Excel-based spreadsheet tool to calibrate the IPCC software as basis for providing more understanding in choices to be made for specific activity or process in the Model.

4.3.18 Policy 18: Funds Allocation to Research

i. The goal of the research programme shall among others include measurement and modelling of emission factors, research to improve the quality of activities data across all sectors of the inventory as well as other research programmes that directly and indirectly indicate that the quality of emission inventories and mitigation activities are improving.
ii. The inventories programme shall have a strategy to ensure advancement to the active phase in the shortest possible time to ensure that as much emission factors as possible are measured or modelled annually to the level that allows migration to higher IPCC tiers within two to four NICs.
iii. These emission factors will enable migration from one tier approach to the other, until the country is able to migrate all its emission estimates to Tier 3.
iv. Funding, being the stimulant for systematic research, shall be made available through a deliberate policy to allocate not less than 25% of the NIF to research with Federal and State components as provided in sub-sections 5.4.1 and 5.4.2 respectively.

v. Inventory research funds shall have both national appropriation and donor financing components, with financing through annual national and state budget. Research funding from Federal appropriation shall be divided into Small Federal Grant Programme (SFGP) and Medium Federal Grant Programme (MFGP) and similarly from State appropriations. Similarly, research funding from donor funds shall be divided into Small Donor Grant Programme (SDGP), Medium Donor Grant Programme (MDGP) and Large Donor Grant Programme (LDGP) each with Federal and State components as provided in sub-sections 5.4.1 and 5.4.2 respectively.

vi. The SFGP and MFGP shall share the annual appropriation for inventory research in the ratio of 35% to 65% respectively and similarly at the States level where the Small State Grant Programme (SSGP) and the Medium State Grant Programme (MSGP) shall share their appropriations in the same ratio. In the same vain, the SDGP, MDGP and LDGP shall share donor funds for inventory research in the ratio of 20%, 30% and 50% respectively. The Federal and State components of the donor funds for research shall be as stipulated in sub-sections 5.4.1 and 5.4.2 respectively.

vii. The terms of reference for implementing and managing these grants shall be as specified by the grantors.

4.4 TRANSITING FROM POLICY TO REGULATION

The policies in section 4.3 are not Acts and Laws of the National and State Assemblies respectively as expected of regulations supporting the management of MRV system (UNFCCC 2020). Furthermore, the Nigeria Climate Change Act does not currently contain provisions to support inventory management. The Council shall therefore adopt the policies in this Guidebook (along with any necessary amendments) into official Regulations as part of their functions under the Act. Additionally, the Council shall at every opportunity of proposing bills to amend its Act include as part of such bill provisions that support the management of GHG inventories and harmonize any Regulation created prior to such proposed bill into the provisions of the bill. Such bills would on the one hand convey the policies in section 4.3, while on the other hand add further regulations outside of these policies that will improve the management of national and state GHG inventories. The Council shall at the national level and the SCCFI shall at the state level consider bringing up draft bills which could be presented at the National Assembly (NASS) and State Houses of Assemblies (SHAs) either as private member(s) bills or as executive bills. Once passed by NASS and signed into law, it becomes the new Act that contains regulations or amended regulations for managing GHG inventories at the national level. Same shall be the case for bills proposed to the SHA which shall become laws at the state level.

5 INSTITUTIONAL AND FUNDING ARRANGEMENTS FOR NGHGI-MS

5.1 OVERVIEW OF THE NEED FOR AN INSTITUTIONAL ARRANGEMENT

Neither the activities associated with GHG inventories nor its institutional arrangements are specifically captured in the Acts establishing the NCCC. What is not under any contention is that the Council is the apex body responsible for managing climate change activities and that includes the compilation and reporting of national GHG inventories. In view of the multidisciplinary and sectoral nature of inventory activities in general, the institutional arrangements for managing NGHGI is expected to bring together:

i MDAs at federal responsible for science, technology, environmental matters and national statistics –
   a. National Council on Climate Change;
   b. Federal Ministry of Environment and its parastatals;
   c. Federal Ministry of Innovation, Science and Technology and its parastatals;
   d. National Bureau of Statistics;

ii Institutions overseeing others with emission relevant activities and who could provide emissions related data –
   a. Federal Ministry of Agriculture and Food Security;
   b. Federal Ministry of Livestock Development;
   c. Federal Ministry of Power;
   d. Federal Ministry of Transportation;
   e. Federal Ministry of Aviation;
   f. Federal Ministry of Industry, Trade and Investment;
   g. Nigerian National Petroleum Company Limited;
   h. Nigerian Coal Corporation;
   i. Electricity Generating Companies;
   j. Nigeria Ports Authority;
   k. Nigerian Maritime Administration and Safety Agency;

iii Public and private research organizations –
   a. Public Universities and Polytechnics;
   b. Public R&D Institutions;
   c. Private Universities and Polytechnics;
   d. Private Research Institutions;
   e. Non-profit and Non-governmental Organisations;

iv MDAs at state and municipal level –
   a. MDAs similar to the ones listed under (i) and (ii) above at the state and municipal level;
   b. State Wastes Management Agencies/Authorities.

These therefore justify the need for the development of an institutional framework for ensuring effective inventories planning, preparation, reporting and data archiving with NCCC at its apex. Based on (i) to (iii) above, these Institutions could be partitioned into the following classes:

i Institutions with responsibility for environmental control which could work as partner institutions under the NCCC;
ii Research and development institutions;
iii Data providing institutions; and
iv Institutions implicated in GHG and precursor gases emissions that could also provide emissions relevant data.

The institutional arrangement takes into consideration the above classes of institutions with different roles and responsibilities in inventories planning, preparation, compilation, reporting and archiving processes. It is divided into two segments: institutional arrangements at National and State levels. Where institutional arrangements below

the State level is required such as city municipalities or Local Governments, the State shall take responsibilities based on need.

5.2 REVIEW OF PAST INSTITUTIONAL ARRANGEMENTS FOR GHG INVENTORIES MANAGEMENT

As indicated in sub-section 2.3, UNDP in 2005 supported a project in West and Francophone Central Africa which developed among others a Manual of procedures (MoP) and institutional arrangement for national inventories management in the beneficiary countries. The national report for Nigeria was submitted by Obioh (2008) but which was never implemented.

In 2021 under the ICAT Phase I Project, an institutional framework for MRV was developed and presented in the final report of the Project by the Project team including the Centre Interprofessionnel Technique d'Etudes de la Pollution Atmosphérique (CITEPA) Paris, Greenhouse Gas Management Institute (GHGMI) Washington DC, National Consultants and DCC Project Steering Committee. The proposed institutional arrangement in the final Project report is presented in Figure 5.1.

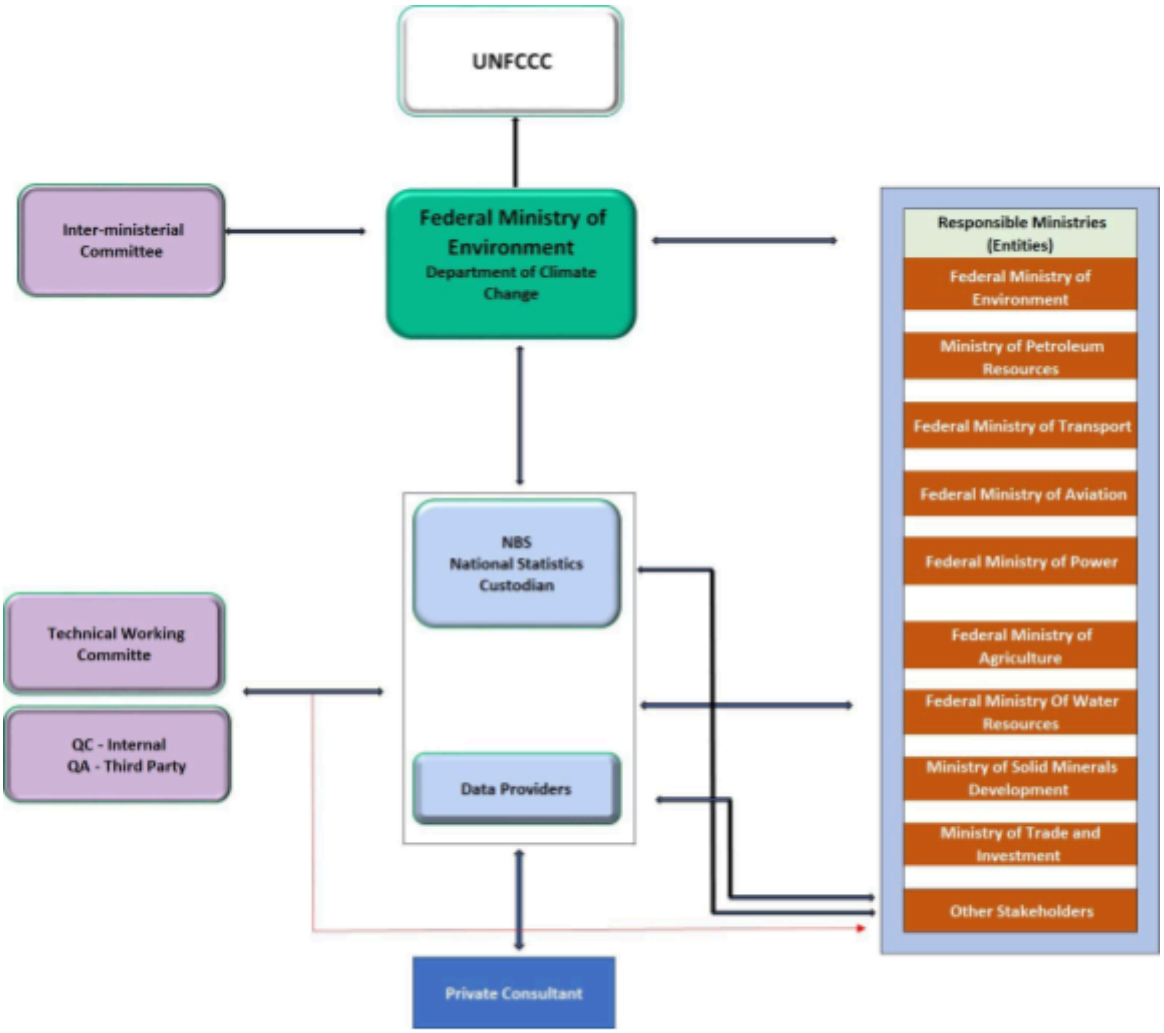

Figure 5.1: Abridged Overarching Institutional Arrangement for MRV in Nigeria Proposed in ICAT Phase I Report in 2021

The proposed institutional arrangement has the DCC at its apex within the Nigerian system and supported by a group of line ministries such as Ministry of Petroleum Resources, Federal Ministries of Transport, Aviation, Power, Agriculture, Water Resources, Solid Minerals Development, Trade and Investment, and other Stakeholders. Others are data providing institutions including National Bureau of Statistics (NBS), Technical Working Committee and private Consultants. The enumeration did not however include how these institutions would work together synergistically to deliver GHG inventories or mitigation activities reports that would be used to meet Nigeria's obligations on climate change.

In 2023, another MRV institutional arrangement was proposed under the National Climate Change Response Project (NCCRP) supported by the European community under the report titled "Analysis of the Legal Framework for the Institutional Measurement, Reporting & Verification System in the Energy Sector of Nigeria". This report which did not include specific authors was submitted under the EU Project titled "Implementation of National Climate Change Response Project (NCCRP), Project Contract No ENV/2019/409-995, proposed the institutional framework presented in Figure 5.2.

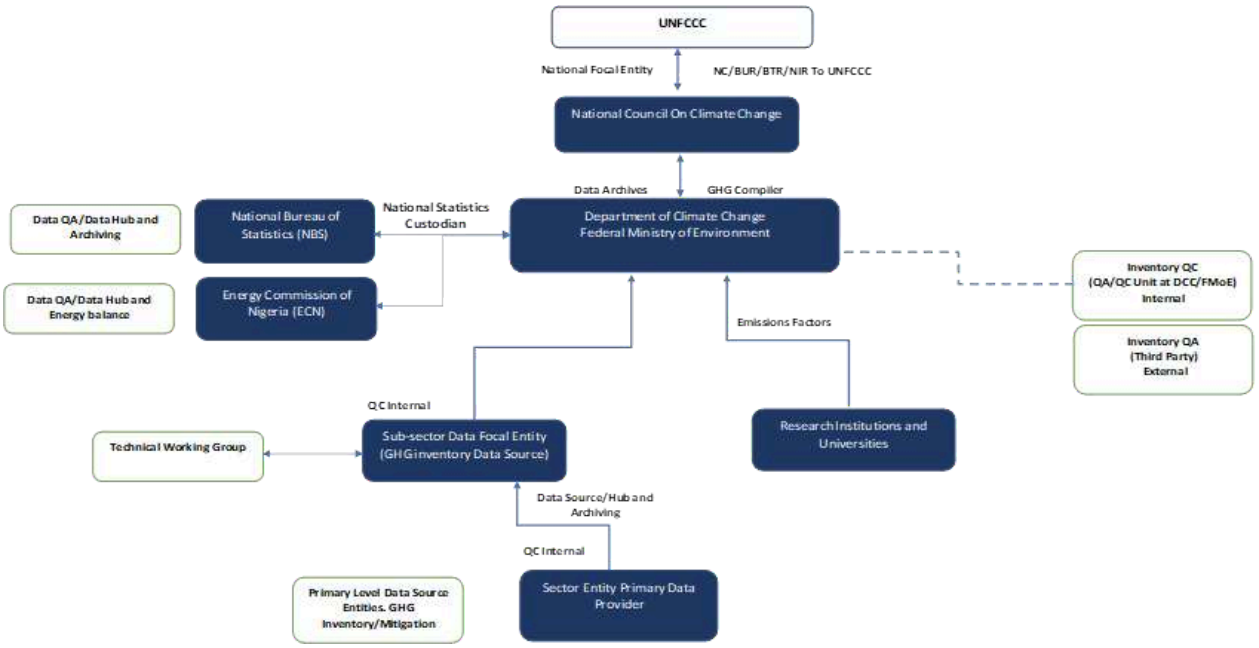

Figure 5.2: Proposed Institutional Arrangement for the Inventory and Emissions Reduction in the Energy Sector of Nigeria as a Result of Mitigation Measures Implementation MRV by the NCCRP Project

Figure 5.2 which has a structure similar to that of Figure 5.1 except that NCCC is now the apex institution for MRV following the Climate Change Act of 2021. In this institutional arrangement, DCC is proposed to work under NCCC to actualize the MRV. However, the modalities for DCC to work under the NCCC was not adequately elucidated. Other entities in the institutional arrangement include data providing institutions such as NBS, Energy Commission of Nigeria (ECN), Sub-sector Data Focal Entity, Technical Working Groups and Research Institutions in and outside the universities.

The institutional arrangements in Figures 5.1 and 5.2 did not elucidate on how the entities in the institutional arrangement are to work together seamlessly to deliver inventories and mitigation analysis to the Country. There is also a confusion in Figure 5.2 on how DCC would work as a department under NCCC which already has its own departments and staff. However, the most outstanding problem appears to be that there is no clear definition of roles and responsibilities in these tow institutional arrangements that specify which of these entities will take responsibility for inventory planning and preparation tasks which is explained in section 6 of this report. The

inventory or mitigation analysis may therefore not be able to meet the TRACCC criteria of the UNFCCC and the Paris Accord. Sequel to the above, a revised institutional arrangement considered adequate to address the above anomalies is proposed in sub-section 5.3.

5.3 INSTITUTIONAL ARRANGEMENT AT THE NATIONAL LEVEL

The proposed institutional arrangement at the national level for NGHGI-MS is presented in Figure 5.3. It has NCCC at its apex. The following form the key players in the national level institutional arrangement.

5.3.1 The National Council on Climate Change

The National Council on Climate Change (NCCC) having being empowered by the Act to take responsibilities for all climate change activities in Nigeria shall be the overall institution responsible for coordinating the activities of GHG inventories at both national and state levels. This implies that NCCC shall take responsibilities for developing draft regulations to NASS to amend subsisting regulations with a view to providing specific regulation for GHG inventories management, developing policies for inventory activities management, inter-agency agreements, hosting of web portal on matters of GHG inventories and any auxiliary activity required for the successful management of emission inventories programme in Nigeria. It shall also provide the basis for addressing quality control and quality assurance in inventories management to ensure that all inventories' data generated meet the standards of the IPCC and UNFCCC guidelines used in estimating emissions.

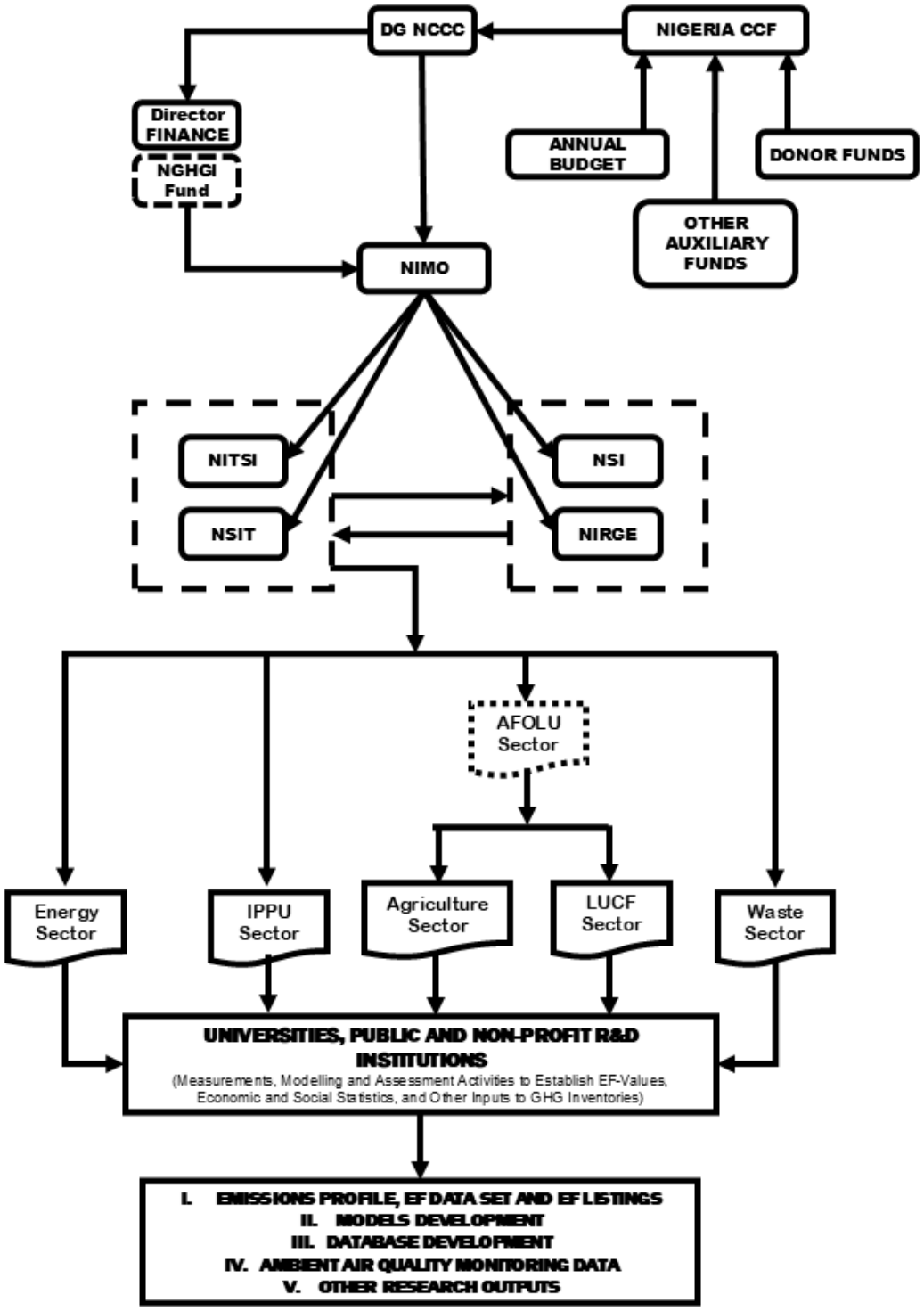

Figure 5.3: Institutional Arrangement at the National Level

5.3.2 National Inventory Management Office

The National Inventory Management Office (NIMO) is the national clearing house for inventories, emission factors and other associated GHG inventory activities. NIMO shall have the following specific responsibilities:

i Obtain and review the work plan for GHG inventory activities in the immediate past inventory cycle;

ii Initiate new plans for GHG inventory activities for the subsisting inventory cycle and for the immediate future;
iii Support research programmes brought up by the NITTL to enhance improved data quality;
iv Prepare draft agreement for NCCC to enter into with relevant National Statistical Institutions (see section 5.3.4) to explore opportunities for improved activities data collection for all plausible sectors of GHG inventories;
v Articulate and develop the process for accrediting experts capable of undertaking GHG inventories, inventory review experts (see section 5.3.6) as well as a web portal under the NCCC website for all accredited experts;
vi Shall, in consultation with the DG NCCC and the NITTL (see section 5.3.3) take decisions on all inventory planning issues and relay such decisions to the inventory team;
vii Responsible for overall QA/QC coordination, as well as overall database and documents management that come as products of GHG inventories activities;
viii Provide guidance and training for entry level, intermediate and advanced practitioners;
ix Communicate inventory reports to stakeholders;
x Provide short term training and other engagement through NITSI; and
xi Host event and activities related to GHG inventories.

Working under the direction of the DG NCCC, NIMO shall be headed by the National GHG Inventory Coordinator (NGIC). The NGIC shall have the overall authority and responsibility for planning and managing all activities over each inventory cycle. The individual shall be a scientist with vast experience in GHG inventories activities, appointed by NCCC Secretariat either within the NCCC or elsewhere, but with strong capacity to put in place and manage result oriented national GHG inventories activities.

5.3.3 National Inventory Technical Support Institution

The National Inventory Technical Support Institution (NITSI), shall working under the direction of NIMO provide technical support for inventory planning, preparation and reporting. NITSI shall be responsible for providing all technical activities that are needed for GHG inventories during the inventory cycle including the integration and review of sectoral reports submitted to it by each NSITL for submission to NIMO. NITSI does not have to be residual within NCCC but shall be a university-based institution or a non-profit R&D institution with technical capacity to support NCCC with all activities relevant for undertaking emission inventories, monitoring and modelling of emission factors, emission profiles and associated research activities. It shall also be the responsibility of NITSI to coordinate other research institutions within and outside the universities to bring into their research programme research activities that are relevant for GHG inventories, source testing and emission factors monitoring and compilation, systematic monitoring of atmospheric concentrations of GHGs in pristine atmospheres, relevant models' development, as well as other such related research activities. It shall also be responsible for the development of quality management tools for GHG inventories, as well as the development of websites and data visualization, among others.

In order to develop a wide range of capacity development, NITSI shall initiate and host training programmes on emission inventory related themes. This shall cover training workshops and short courses for entry level and relatively mature inventory personnel who shall be required to add value to relevant activities at national and state level. The capacity development programme shall be the basis for growing Specialized Communities of Practicing Experts (SCOPE) in each of the areas to enable them support future programmes. Each SCOPE shall be associated with the name of the specialized group, e.g. "SCOPE on Modalities, Procedures and Guidelines (MPGs)" and shall be managed by an administrator. It shall be a specialized group that will assist in evolving programmes within its members to build further capacity to improve the quality of their activities. Some of the specialized activities which could be the basis for these groups would include the inventory guidelines improvement, MPG Procedures, Inventory Planning and Preparation Tasks Related Activities (IPPTRA), IPCC and other inventory software, sectoral

inventories and data issues, emission factors measurement and/or modelling, models development for sections of the inventory guidelines, instrumentation associated with measurements, among others. Each SCOPE Administrator shall reach out to its Community through digital platforms to enable active interactions and interventions. It shall also undertake any other activity as may be assigned in Section 6 and by NIMO throughout the inventory cycle

NITSI shall be headed by the NITTL who shall provide technical support to NIMO to manage the inventory preparation procedure, supervise the NSIT to ensure that each NSIT is able to undertake its assignments in the most professionally sound manner and report its outputs to NITSI. NITSI shall finalize the preparation of national emissions based on inputs from NSITs through their leaders and provide all checks to ensure that the data meets TRACCC criteria.

NIMO shall make available adverts to pre-qualified institutions under a restricted tender to apply for consideration and approval to become the NITSI. In this case, the team leader of the institution bidding to become NITSI shall be required to obtain its institutional endorsement during application for the position. The institutional endorsement shall among others include the fact that the institution supports the NITTL to act in that capacity, and that time and other institutional resources shall be allowed to be used in supporting the work of NITSI.

5.3.4 National Sectoral Inventory Teams

National Sectoral Inventory Teams (NSITs) shall be responsible for the preparation and reporting of emissions from each sector. This shall include sectoral emissions compilation for the energy, IPPU, agriculture, LULUCF and waste sectors. However, for the IPCC 2006 and 2019 guidelines, the agriculture and LULUCF sectors shall if and when necessary be merged as AFOLU sector. It shall comprise expert teams for each sector and take responsibility for appraisal of data availability, quality, gaps analysis, collection and update in their respective sectors; methodology and data compilation; emission calculations and completion of text sections; quality control; uncertainty analysis; key source analysis; reporting; documentation and archiving; and development of inventory improvement strategies. NSITs shall be headed by Team Leaders who shall be responsible for delivering the sectoral inventories to NITSI. Members of NSIT need not reside in the same institution, but must be tied together by professional proficiency in the sector, and with demonstrated ability to undertake and deliver GHG inventories in the sector of interest.

The NSITs shall be headed by National Sectoral Inventory Team Leaders (NSITLs), who shall be required to have proficiency and demonstrated capacity to lead and manage the team for successful delivery of inventory results and report in each emissions relevant sector. Demonstration of previous work experience, research capacity and managerial leadership in inventories in the sector at national, regional or other administrative levels shall be an important added qualification of the NSITL.

Each NSIT shall be known and associated with the institutional address of the NSITL. In this case, the prospective NSITL shall be required to obtain its institutional endorsement during application for the position. The institutional endorsement shall among others include the fact that the institution supports the NSITL to act in that capacity, and that time and other institutional resources available within the institution shall be made available to the NSITL to play this role. NIMO shall make available adverts to pre-qualified institutions under a restricted tender to apply for consideration and approval to become the lead NSIT. NSITL shall reach out to the National Statistical Institutions (NSI) for relevant data either in the format required for GHG inventories or in a format that can be reduced to the format required for GHG inventories.

5.3.5 National Statistical Institutions

The National Statistical Institutions (NSIs) shall be institutions that would provide systematic data in all plausible or specific sectors of the GHG inventories based on their institutional mandate. The range of such input data shall include activities data and any other relevant data needed to compute/estimate GHG emissions. The range of institutions and modalities for ensuring systematic data gathering and provision of same for GHG inventories activities shall be as stipulated in technical documents.

The following shall be pursued within the context of an appropriate and practicable programme of continuous data delivery by the NSIs as well as data quality improvement over the years:

i Have cooperation with NIMO to deliver activities data and any other relevant data in appropriate format and in time to NITSI through NIMO, to support inventory compilation, allowing for all required QA/QC procedures within each inventory cycle;

ii Evolve its in-house assessment of current and future data acquisition, processing and reporting systems, taking into account GHG inventories data required for each of the Energy, IPPU, AFOLU and waste sectors, and the associated QA/QC requirements;

iii NIMO, under the advice of NITSI shall identify any required organisational coordination within Ministries, Departments/Agencies and legal memoranda that could be evolved with non-governmental and private sector organizations to make for smooth and safe delivery of data to NIMO through NITSI or each NSITs in the format required to meet the stringent NIMO data requirements, notably the security of data provision in the future.

5.3.6 National Inventory Review Group of Experts

The National Inventory Review Group of Experts (NIRGE) are the experts accredited by NIMO to review inventory reports submitted by compiling entities. They are to play a strong role in providing comments to improve the quality of inventory reports based on expert knowledge and the need to satisfy TRACCC criteria. Where national human capacity limitations persist, the review teams could be sourced from NITSI and NSITs, on the condition that no expert shall review his/her own inventory. The following shall be pursued within the context of evolving and managing the NIRGE for effective delivery of review services:

i NIMO shall pre-qualify the members of the NIRGE who shall be a reserve group with research and managerial expertise in at least one of the inventory sectors.

ii The NIRGE members would be selected based on modalities set by NIMO and shall be registered into the National Register of Inventory Expert Reviewers (NRIER). Such modalities shall be updated as expediency requires.

iii Each expert listed in the NRIER shall, when called upon by NIMO provide independent review of GHG inventory reports to assess current performance by both NITSI and NSIT and assist in the identification and prioritisation of required improvements.

iv When experts working within NITSI and NSIT are also listed in the NRIER, they could be called upon to review inventory reports other than those for which they personally participated in preparing.

v It shall be the responsibility of NIMO with guidance by the NITTL to develop and publish the TOR for the review at both sectoral and national inventory levels. Such TOR shall be subject for review, as NIMO finds it expedient.

5.3.7 Universities, Public and Non-Profit R&D Institutions

Under the coordination of NITSI, universities, public and non-profit R&D institutions shall undertake research activities that are relevant for GHG inventories, source testing and emission factors monitoring and compilation, systematic monitoring of atmospheric concentrations of GHGs in rural and pristine atmospheres, relevant models' development as well as other such related research activities for use by the Council in meeting its obligations to the nation. See Section 5.3.3.

5.4 INSTITUTIONAL ARRANGEMENT AT THE STATE LEVEL

Although GHG inventories are currently undertaken at national level only, States could as their capacities evolve, take decision to commence national inventory activities at the State and Municipal levels. The modalities for doing this are presented in the sections below for State-level inventories only. Modalities for Municipal-level inventories will be provided in future as each state gains experience in its GHG inventory activities.

5.4.1 The State Climate Change Focal Institution

Each State Government within the Federal Republic shall identify the State Climate Change Focal Institution (SCCFI) which shall be the apex institution at the State level. The SCCFI shall work collaboratively with the Council on all matters related to climate change, be the designated institution to host all climate change funds appropriated to the State at the national level and with NIMO for matters related to GHG inventories management. It shall have the authority to bring relevant institutions at the State level to work with it on climate change matters in general and emission inventories in particular. This implies that SCCFI shall through the appropriate organ take responsibilities for the policies, funding, planning, preparation, updates, management, database and any associated activity required for the successful management of emission inventories programme in the State. It shall also provide the basis for addressing quality control and quality assurance in inventories management to ensure that all inventories' data generated meet the standards of the IPCC and UNFCCC guidelines used in computing the inventory.

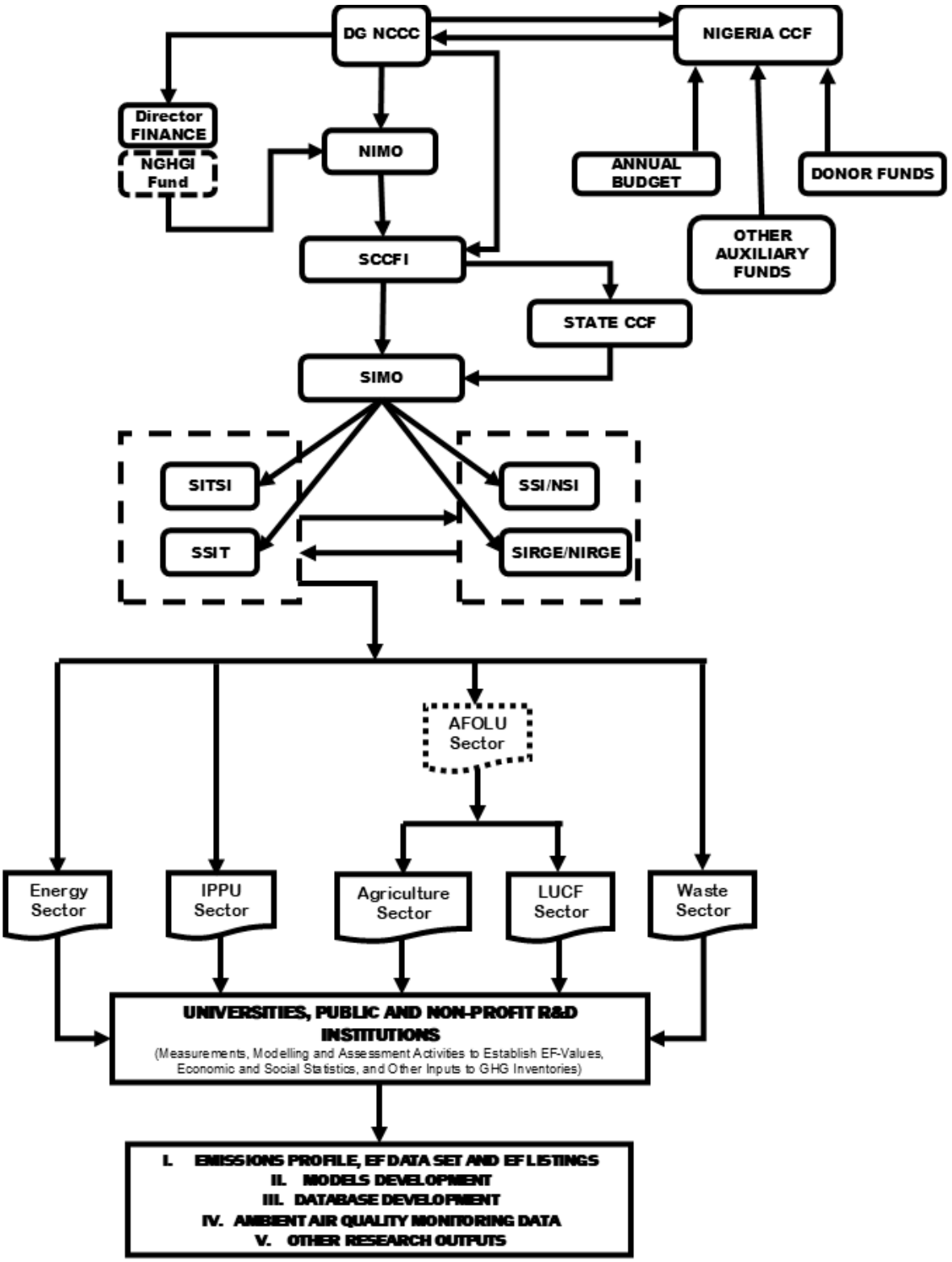

Figure 5.4: Institutional Arrangement at the State Level

5.4.2 State Inventory Management Office

The SCCFI shall establish the State Inventory Management Office (SIMO) as one of its structures. SIMO shall be responsible for designing GHG inventories management related activities. It shall act as the State Clearing House for Inventories and Emission Factors for Greenhouse Gases (SCHIEF-GHG). Working under the direction of the Head of SCCFI, SIMO shall be headed by the State GHG Inventory Coordinator (SGIC). The SGIC shall have the overall authority and responsibility for planning and managing all activities over each state inventory cycle. The individual shall be a scientist with vast experience in GHG inventories activities, appointed either within the SCCFI or elsewhere but with strong capacity to put in place and manage result-oriented state GHG inventories activities.

SIMO shall have the following specific responsibilities:

i Obtaining and reviewing the work plan for GHG inventory activities;
ii Initiating new plans for GHG inventory activities;
iii Supporting research programmes brought up by SITTL to enhance improved data quality;
iv Preparing draft agreement for SCCFI to enter into with relevant State Statistical Institutions (see section 5.4.4) to explore opportunities for improved activities data collection for all plausible sectors of GHG inventories;
v Articulate and develop the process for accrediting experts capable of undertaking GHG inventories, inventory review experts (see section 5.4.6) as well as a web portal under the SCCFI website for all accredited experts;
vi Take decisions in consultation with the Head of SCCFI and the SITTL (see section 5.4.3) on all inventory planning issues and relay such decisions to the inventory team; and
vii Undertake overall QA/QC coordination, as well as overall database and documents management that come as products of GHG inventories activities;
viii Communicate inventory reports to stakeholders;
ix Undertake short term training and other engagement through SGIC; and
x Host event and activities related to GHG inventories.

5.4.3 State Inventory Technical Support Institution

The State Inventory Technical Support Institution (SITSI), shall working under the direction of SIMO, provide technical support for inventory planning, preparation and reporting. It shall be headed by the SITTL and its technical support activities shall among others include auditing and reviewing of the inventory preparation procedures, supervising the SSITs to ensure that each SSIT is able to undertake its assignments in the most professionally sound manner and report its outputs to SITSI. SITSI shall also finalize the preparation of state emissions based on inputs from the SSITs and provide all checks to ensure that the data meets TRACCC requirements. SITSI shall be responsible for providing technical support needed for GHG inventories. In order to develop a wide range of capacity, SITSI shall also initiate and host similar capacity development programmes indicated in sub-section 5.4.3. However, being specialized groups on specific disciplines, it may not be urgent to have SCOPE groups at the state levels immediately until such a time where the SCOPE at national level is large enough to have state sub-groups without undue fragmentation of the populations at national level.

SITSI shall be an R&D institution with technical capacity to support SCCFI with all activities relevant for undertaking emission inventories, monitoring and modelling of emission factors, emission profiles and associated research activities. It shall also be the responsibility of SITSI to coordinate other research institutions within and outside the universities in the state to bring into their programmes activities that are relevant for GHG inventories, source testing and emission factors monitoring and compilation, systematic monitoring of atmospheric concentrations of GHGs in pristine atmospheres, relevant model development as well as other activities.

SIMO shall make available adverts to pre-qualified institutions under a restricted tender to apply for consideration and approval to become SITSI. In this case, the prospective SITTL shall be required to obtain its institutional endorsement during application for the position. The institutional endorsement shall among others include the fact that the prospective host institution supports the SITTL to act in that capacity, and that time and other institutional resources shall be allowed to be used in supporting the work of SITSI.

5.4.4 State Sectoral Inventory Teams

State Sectoral Inventory Teams (SSIT) shall be responsible for sectoral emissions compilation for the energy, IPPU, agriculture, LULUCF and waste sectors in the state. However, for the IPCC 2006 and 2019 model, the agriculture and LULUCF sectors shall if and when necessary be merged as AFOLU sector. SSIT shall be headed by Team Leaders who shall be responsible for delivering the sectoral inventories to SITSI. Members of SSITs need not reside in the same institution, but must be tied together by professional proficiency in the sector, and with demonstrated ability to undertake and deliver GHG inventories in the sector of interest.

SSITs shall be headed by State Sectoral Inventory Team Leaders (SSITLs), who shall be required to have proficiency and demonstrated capacity to lead and manage the teams for successful delivery of inventory results and report in each emissions relevant sector. Demonstration of previous work experience, research capacity and managerial leadership for undertaking inventories in the relevant sectors at state, municipal or other administrative levels shall be an important added qualification of the SSITLs.

Each SSIT shall be known and associated with the institutional address of the SSITL. In this case, the prospective SSITL shall be required to obtain its parent institutional endorsement during application for the position. The institutional endorsement shall among others include the fact that the parent institution supports the SSITL to act in that capacity, and that time and other institutional resources available within the institution shall be made available to the SSITL to play this role. SIMO shall make available adverts to pre-qualified institutions under a restricted tender to apply for consideration and approval to become the lead SSIT. The SSITL shall reach out to any existing State Statistical Institutions (SSIs) and National Statistical Institutions (NSIs) for relevant data either in the format required for GHG inventories or in a format that can be reduced to the format required for GHG inventories.

5.4.5 State Statistical Institutions

The State Statistical Institutions (SSIs) where they exist, shall be institutions that would complement NSIs in providing systematic data in all plausible or specific sectors of the GHG inventories based on their institutional mandate. The range of such input data shall include activities and any other relevant data needed to compute/estimate GHG emissions. The range of institutions and modalities for ensuring systematic data gathering and provision of same for GHG inventories activities in the state shall be as stipulated in the technical documents setting up the SSIs.

The following shall be pursued within the context of an appropriate and practicable programme of continuous data delivery by the SSIs as well as data quality improvement over the coming years:

i Have cooperation with SIMO to deliver activities data and any other relevant data in appropriate format and in time to SITSI, to support inventory compilation, allowing for all required QA/QC procedures within each State Inventory Cycle;

ii Evolve its in-house assessment of current and future data acquisition, processing and reporting systems, taking into account GHG inventories data required for each of the Energy, IPPU, AFOLU and Waste sectors within the state, and the associated QA/QC requirements;

iii SIMO, with technical support from SITSI, shall identify any required organisational coordination within government departments/agencies, and legal memoranda that could be evolved with non-governmental and

private sector organizations to make for smooth and safe delivery of data to SITSI in the format required to meet the stringent SIMO data requirements, notably the security of data provision in the future.

5.4.6 State Inventory Review Group of Experts

The State Inventory Review Group of Experts (SIRGE) are the experts accredited by SIMO to review inventory reports submitted by compiling entities within the state. They are to play a strong role in providing comments to improve the quality of inventory reports based on expert knowledge and the need to satisfy TRACCC requirements. Where state human capacity limitations persist, the review teams could be sourced from the NIRGE, SITSI and SSIT, on the condition that no expert shall review his/her own inventory. The following shall be pursued within the context of evolving and managing the SIRGE for effective delivery of review services:

i SIMO shall appoint the members of SIRGE who shall be a reserve group with research and managerial expertise in at least one of the inventory sectors.

ii SIRGE members would be nominated based on modalities set by SIMO and shall be registered into the State Register of Inventory Expert Reviewers (SRIER). Such modalities shall be updated as expediency requires.

iii Each expert listed in the SRIER shall, when called upon by SIMO, provide independent review of GHG inventory reports to assess current performance by both SITSI and the SSIT and assist in the identification and prioritisation of required improvements.

iv When experts working within SITSI and the SSIT are also listed in the SRIER, they could be called upon to review inventory reports other than those for which they personally participated in preparing.

v It shall be the responsibility of SIMO with technical support from the SITTL to develop and publish the TOR for the review at state, state-sectoral and municipal inventory levels. Such TOR shall be subject for review, as SIMO finds it expedient to do so.

5.4.7 Universities, Public and Non-Profit R&D Institutions

Under the coordination of SITSI, Universities, Public and Non-Profit R&D Institutions within the state shall undertake research activities that are relevant for GHG inventories, source testing and emission factors monitoring and compilation, systematic monitoring of atmospheric concentrations of GHGs in rural and pristine atmospheres, relevant model development, as well as other such related research activities for use by the SCCFI in meeting its obligations to the State. See Section 5.4.3.

5.5 FUNDING

5.5.1 Funds for Emission Inventories Activities at the Federal Level

The Climate Change Act has provided for a Climate Change Fund (CCF) to be maintained by the Council. The Fund is expected to have contributions from National Assembly appropriations, donor funds and other auxiliary funds as prescribed in the Act. Among the areas which the Fund is to support innovative climate change mitigation and adaptation projects. Since the National Assembly appropriation is derived from the Federal Government share of the Federation Account, that portion of the CCF may be shared with the States. However, donor funds and other funds that are provided to Nigeria as a nation, are of joint nature with States and can be shared with the States based on an approved sharing formula. National GHG inventory activities is one of the tasks under the mitigation activities. The National Inventories Fund (NIF) shall therefore comprise a percentage of the National Assembly appropriation for mitigation and adaptation activities as approved by the Council subject to due consideration of all activities associated with national inventories and the Federal Government's share of donor funds that are of joint nature with States, subject to approval by the Council. Once approved, the NIF will then be used to support all inventory activities at the Federal level.

5.5.2 Funds for Emission Inventories Activities at the State Level

In line with section 5.4.1, the inventories portion of donor funds and other funds that are of joint nature with States, shall be shared with states in line with the sharing formula between Federal and State Governments. In order to improve funding for inventories at the state level, the State Houses of Assembly (SHAs) wishing to undertake inventories, and having satisfied the minimum conditions for participation in GHG as stipulated in sub-section 4.3.8 shall provide appropriation for the State-CCF for mitigation and adaptation activities. SHAs shall also approve the percentage share of the CCF appropriated for mitigation and adaptation activities that will be used to support inventories. The State's share of the NIF together with its appropriated funds for inventories shall then make up the total State Inventory Fund (SIF). This shall then be used to support all inventory activities at the state level based on the proposed activities in Figure 5.4.

5.5.3 Budget

In view of the initial three-year NIC proposed in Section 6.5, it is best that the Council implements its budget for National Inventories as three-year composite budgets as an interim measure until the NIC is systematically reduced to one year. The Council Secretariat shall propose to the Council Chairman a special approval for such composite budget template which if approved shall allow each composite budget to commence in July of the first year of the NIC and end in June of the third year of the Cycle. The three-year composite budget could be divided into 3 parts namely, Part 1 for the first 12 months, Part 2 for the second 12 months and Part 3 for the third 12 months which represent budget for each year of the entire budget. Such a special approval is needed to allow the three-year NIC activities (see Figures 6.1 & 6.2) to progress smoothly without disruptions except where force majeure comes to play. This arrangement shall ensure that the inventory reports are submitted timely to the UNFCCC secretariat and National Stakeholders. The arrangement at the national level shall be replicated at the state level by States involved in national inventory activities.

5.5.3.1 Budget Preparation and Approval at the Federal Level

As soon as the budget preparation kick-off activities is announced at the federal level, the NGIC shall request the NITTL to request inputs from the respective NSITLs for the Energy, IPPU, AFOLU and Waste sectors, as well as the Research Teams under NITSI to submit their budget proposals for the next NIC. The NITTL shall then review the received budget proposals and forward same to the NGIC for further review and submission to the Secretariat for inclusion in the Council-wide budget. The Council shall then submit its final budget through appropriate channels for consideration and approval.

5.5.3.2 Budget Preparation and Approval at the State Level

The budget preparation and approval shall be a near replica of the Processes at the national level except for minor differences. At the State level, SIMO as the office managing inventories shall coordinate activities for budget preparation and submit same to the SCCFI to integrate into the SCCFI-wide budget. This shall then be submitted through appropriate State's budget channels for consideration and approval.

6 THE PROCEDURAL/OPERATIONAL ARRANGEMENTS FOR NGHGI-MS IN NIGERIA

6.1 SUMMARY OF KEY PROCEDURES REQUIRED FOR INVENTORIES MANAGEMENT

This sub-section provides in summary components of the activities that are to be undertaken in preparing, reporting, reviewing and submitting inventories during a specific inventory cycle. The procedures for planning all inventory tasks are provided in sub-section 6.2. Similarly, the procedures for preparing inventories which are to be used in conjunction with the procedures in sub-section 6.2 to prepare the manual of procedures (MoP) for distribution by NIMO to NITSI and the NSITs as part of the NIC kick-off meeting are provided in sub-section 6.3. The finalized MoP will help to ensure consistency across source categories and contribute to the inventory team's overall efficiency. These rules of procedure will constitute a significant part of the overall inventory preparation instructions. A country like Nigeria that has not previously documented its MoP, needs to do so as part of its inventory cycle. This is because doing so would ensure a far more sustainable inventory process and practice in the future. Similarly, sub-section 6.4 contains the procedures for GHG inventories update while sub-section 6.5 presents the NIC and the sequence of activities over the period covered by the NIC.

6.2 INVENTORIES PLANNING TASKS

The preparation of national inventories involves a wide range of tasks, personnel and institutions. For this, the role of competent team of personnel and institutions working together seamlessly cannot be overemphasized in executing and implementing any successful inventory whose results must meet the TRACCC criteria. For this to be possible, systematic planning is highly imperative. Inventory planning tasks is therefore sine qua none for the success of an inventory. There are two components to the planning process:

1. Planning the overall preparation of the inventory; and
2. Planning the preparation of individual sources.

The outputs of the first component are the inventory work plan and the overall inventory preparation instructions (sub-section 6.3.1). The output of the second component is the source preparation instructions (sub-section 6.3.2). The elements of planning the overall preparation of the inventory as well as the preparation of individual sources, presented in sub-sections 6.2.1 and 6.2.2 below, are derived mainly from the guidelines in section 3 of Braatz and Doorn (2005) and a few other literatures. They are prepared to ensure that there is clarity on who is responsible for the planning as well as how each element of the planning shall be accomplished.

6.2.1 Overall Inventories Planning Tasks

The inventories planning tasks are those that must be completed and approved by NIMO before the inventory preparation instructions in sub-section 6.3.2 are undertaken to provide inputs to the MoP for circulation at the kick-off meeting in the NIC in sub-section 6.5.3.1. The overall inventories planning rests squarely on NIMO headed by NGIC and would when appointed given technical guidance and support by the NITTL. The inventories planning tasks under this guidebook are presented in the sub-sections below.

6.2.1.1 Planning Task 1: Appointment of National Inventory Team Leaders

The NCCC Secretariat shall at least six months to the Kick-Off Meeting where the vacancy exists, appoint the NGIC who shall be the overall national inventories coordinator and head of NIMO. He/she shall be responsible for the overall inventories planning and could be appointed from within NIMO or elsewhere. The qualifications and experience shall be as stipulated in sub-section 5.2.3. Within the same timeframe where the vacancy exists, the NCCC Secretariat shall appoint the NITSI who shall be a university-based or a non-profit R&D institution. NITSI shall be headed by the NITTL and provide technical support to NIMO to manage the inventory planning activities as well

as oversee the NSITs to ensure that each NSIT is able to undertake its assignments in the most professionally sound manner and report its outputs to NITSI. Similar appointments shall be made by the competent authority at the state level. The qualifications for the institution that shall serve as the NITSI shall be as provided in section 5.2.4.

6.2.1.2 Planning Task 2: Defining of Inventory Products and Planning of Results/Reports Dissemination

As part of the overall inventory planning, the NITTL shall prepare for the approval of the NGIC, the following overall inventory planning activities:

i Plan for products that would be produced by the inventory: the template of products that shall be covered during the subsisting inventory cycle and the format for their preparation. This shall include the data sources, data collection procedures, methodologies and assumptions, gases to be reported, data improvement needs, uncertainty analysis and data archival procedures. Others include: key source analysis and MPGs. If an inventory improvement strategy (Preparation Task 10) was prepared as part of a previous inventory, then NITTL shall review the strategy during this planning task pursuant to Section III.B. of the annex to COP Decision 17/CP.8 which contains the UNFCCC guidelines for reporting of national GHG inventories by NAI Parties. The NGIC, in consultation with NITTL shall present these issues to the MNITL for approval. When approved, the NGIC shall communicate the decisions to the NSITLs for further communication with their team members. A similar approval pathway shall be taken by competent authorities at the state level.

ii Plan for results/reports dissemination: the NITTL shall also provide the template for results dissemination with public and private decision-makers at national and state level. This dissemination might include:
   a. same detailed NIR/BTR with focus on sectoral details with graphics, per capita emissions, among other socio-economic details;
   b. Policy Makers' Summaries; and
   c. Synthesis report (a synthesised form of template (a) above).

The NITTL can also consider additional products and results dissemination plans which shall overtime be built into an inventory improvement strategy as indicated in Preparation Task 10. These could be done incrementally, as basis for improving the quality of future inventories and dissemination plans. This information shall be useful to NIMO during the public dissemination of its key outputs to stakeholders.

6.2.1.3 Planning Task 3: Assigning of Other Inventory Personnel

Apart from the appointment of NITTL to work in close collaboration with NGIC, there are a number of team members that support:

i NIMO headed by NGIC
ii NITSI headed by NITTL; and
iii NSITs headed by the four sectoral inventory leaders for Energy, IPPU, AFOLU and Waste.

These arrangements are shown at the national level in Figure 5.3 and at the state level in Figure 5.4.

The NGIC shall assign tasks to officers within NIMO, the NITTL shall assign tasks to team members under the NITSI, while the NSITLs shall assign tasks to their respective team members for the Energy, IPPU, AFOLU and Waste sectors. There shall be similar tasks assignment by competent authorities at the state level.

On conclusion of the planning activities, the NSITLs shall be responsible for overseeing the preparation of sources within their respective sectors. The team members shall undertake activities such as research, data collection,

calculations, writing, quality control, and archiving and documentation. The NITTL shall take responsibility for overall quality assurance/quality control co-ordination, overall data management and the management of report preparation including the templates and content, among others. The sectoral inventory team leaders i.e. the NSITLs shall be the inventory compilers for their respective sectors, and shall prepare and forward their reports to the NITTL for integration and subsequent submission to the NGIC for consideration and circulation to the team of national and international reviewers. Similar responsibilities shall be borne by similar competent authorities and team members at the state level.

It is important that NGIC, NITTL and NSITLs assign their staff appropriately, given the expertise and costs of specific individuals, and the expertise and schedule required by the various tasks. Once NSITLs are assigned, the NITTL shall review the previous inventory organisational structure and results, and provide the NGIC a template of activities for the next NIC. Similar task assignments shall be made by competent authorities at the state level with SITTL reviewing the previous inventory organisational structure and results, and providing the SGIC a template of activities for the next NIC. In reviewing the previous inventories, the NITTL at the national level and SITTL at the state level shall include in their respective plan for inventory activities and key category analysis (see Preparation Task 6 in sub-section 6.3.2.6).

6.2.1.4 Planning Task 4: Establishment of Rules of Procedure for Overall Inventory Preparation

The rules of procedure are meant to contain the requirements and guidelines on:

i **Documentation:** Accurate and detailed documentation is needed across inventories to ensure that records of documentation used is passed from one NIC to the other. The rules of procedure for documentation include requirements for:
   a. Referencing data sources in spreadsheets;
   b. Dating files; and
   c. Maintaining hard copies of references for archiving.

ii **Choice of IPCC Model and Related Issues:** The rules of procedure for this shall include:
   a. Directions on which IPCC software is to be used during the NIC;
   b. Providing the template for naming all files from one NIC to the other;
   c. Guidelines to ensure that all values are referenced and how to document the references; and
   d. Guidelines on agreed global warming potentials that is to be used during the NIC.

iii **Template and Format for Inventory Report:** The report being prepared during the NIC whether detailed report or its summaries shall have consistent template and format across NICs (see sub-section 6.2.1.2). The rules of procedure in this sub-section shall include designing the template, content and format for each of the report which includes:
   a. The comprehensive National Inventory Report for submission to the UNFCCC secretariat;
   b. Another comprehensive National Inventory Report with strong highlights on sectoral contribution to national emissions, which would be of interest to national stakeholders;
   c. Inventory Summary for policy and decision makers in public and private sector institutions;
   d. Preparing booklet for distribution to the general public.

iv **Quality Assurance/Quality Control (QA/QC):** A QA/QC plan whose scale depends on available resources is needed in order to achieve results that are not only accurate but reliable and defensible. The rules of procedure for preparing such a plan shall at a minimum include how to cross check and confirm data entry into IPCC models, internal and external reviews, among others.

v **Uncertainty Analysis:** There is need to provide information on uncertainties associated with data used for inventories during each NIC. To assess uncertainties, the rule of procedure needed shall include:
   a. The minimum approaches to be used for uncertainty analysis;
   b. Recommendation of more rigorous assessment and the assessment procedure;
   c. Instructions for documenting and reporting the results of uncertainty assessment.

vi **Key Source Analysis:** The rules of procedure in this segment is expected to describe the key source analysis that will be undertaken so that the rules are complete and the entire team is aware of how this component of the inventory will be handled.

vii **Additional MPG Adherence:** The MPG manuals contain new information regarding QA/QC, uncertainty assessment and key source analysis. They also contain new information about emission factors, activity data and method. The MPG manuals contain an entirely new accounting structure for the Land-Use Change and Forestry inventory sector. There is need to take a decision on which components of MPG, if any, the inventory team should adhere to and how source-specific issues will be handled.

viii **Archiving:** Preparation of a national GHG inventory requires the collection, generation, manipulation and storage of large amounts of information. The information is generated by a team of people that is likely to change between inventories. Therefore, a rigorous system for storing this information is necessary for ensuring sustainability of the inventory process. The rules of procedure should contain requirements on what needs to be archived (both electronic and hard copy records), due dates for delivery and specific formatting or notational instructions. For example, if an activity data source is a very large electronic database that is impractical to archive, then a memo to the inventory archive that contains the title of the database, the website, a description of how the database was used and a hard copy of relevant sections of the database may be sufficient for archiving.

The NITTL and SITTL shall be responsible for preparing and refining the rules of engagement for each of the elements in (i) to (viii) above at national and state levels respectively, submitting same to NGIC and SGIC respectively for submission to the MNITL and Meeting of State Inventory Team Leaders (MSITL) at national and state levels who shall respectively consider and approve at a time sufficient for the rules of engagement to be implemented by responsible teams. The approved rules of engagement shall then be distributed by NGIC and SGIC to all inventory teams at national and state levels respectively for preparing the elements in (i) to (viii).

6.2.1.5 Planning Task 5: Planning of the Overall Inventory Preparation Schedule

The activities under the inventory preparation schedule (sub-section 6.3) must be planned for if the final date of all activities in the NIC must be met. The key date for the entire schedule is the date that the final version of the inventory is due to the NITTL and SITTL for incorporation into the national and state inventory reports respectively (see sub-section 6.5 for schedule for commencement of report preparation in the NIC). The NITTL shall prepare a schedule of intermediate deadlines based on the final due date. He/she shall then provide all the inventory preparation steps and the respective deadlines for their completion taking into account realistic time for their completion and making sure no intermediate activity exceeds the final due date. Similar activities shall be undertaken by the SITTL to ensure that final deadline for inventory preparation schedule is not exceeded at the state level.

To make the planning of the inventory preparation schedule to align with the inventory planning task, the first date shall be made to coincide with the date that Planning Task 14 in sub-section 6.2.2.4 is implemented since this is the

date by which all inventory supporting materials will have been distributed to the inventory team. The inventory preparation steps that are to be completed before the final draft of the inventory report is due for submission to the Council include:

i. Preparation of draft and final versions of each source section of the inventory;
ii. Possibly, additional internal reviews (QC) and external reviews (QA);
iii. Incorporation of revisions based upon QA/QC;
iv. Compilation of individual source sections into one cohesive document; and
v. Key category analysis.

The timeframe for these activities should be made a little elastic to incorporate issues such as data collection, challenges associated with QA/QC issues and deadlines, delay in release of funds, training for new inventory personnel and personnel welfare issues including leave and possible health challenges that could arise during the NIC, among others. All these are risks for which the NITTL shall bring up to the NGIC for submission to MNITL for approval of concrete alternatives for their mitigation. Regular meetings of the MNITL shall be called by the NGIC with the NITTL and NSITLs to discuss progress and problems that could disrupt the schedule. These same activities shall be undertaken by the respective competent authorities at the state level.

Activities that are likely to be undertaken after the final draft inventory report is due to the National Entity include:

i. Finalisation of any other inventory products, such as a brochure for public education;
ii. Completion of all documentation and archiving of electronic and paper inventory materials;
iii. Implementation of public education and outreach activities; and
iv. Completion of the inventory improvement strategy (for future inventories).

While the overall inventory implementation schedule is presented in sub-section 6.5, the specific intermediate steps are lacking in that sub-section. NITTL and SITTL shall prepare a more detailed inventory implementation step in tabular form with short timelines between the schedules of each major task completion and the other for intermediate steps to be completed at national and state levels respectively. Such a table shall have in its columns date for task completion, the task to be completed, responsible officer(s), and any other information the NITTL and SITTL consider important while the rows shall contain the specific task and associated relevant information demanded by the columns. Such timelines once approved by MNITL and MSITL respectively shall be distributed to the inventory teams at national and state levels before the commencement of such activities.

6.2.1.6 Planning Task 6: Establishment of Major Legal and/or Collaboration Arrangements

There is a need to establish from among the existing state, national and international institutions that have as part of their mandate the provision of data that could be used for inventory preparation activities and how to access such data. Where formal data is currently weak, the NITTL at national level and SITTL at state level shall respectively explore opportunities establishing formal collaborations with such institutions in form of Memorandum of Understanding (MOU), Memorandum of Agreements (MOA) or any other kind of legal arrangements in order that:

i Data provided by them are in a format that is adequate for GHG inventory activities;
ii Where data gaps exist, NCCC at national level and similarly SCCFI at state level shall respectively suggest new data collection forms that bring in data in a format that would improve the quality of their respective inventories;
iii Whether such statistical institutions could provide data in electronic format to NCCC and SCCFI rather than in hardcopies; and
iv Whether such statistical data providing institutions will allow the NCCC at the national level and similarly SCCFI at the state level have an arrangement that would allow past data that have been collected but published in

formats that are difficult to use for inventories to have access to the original data, to enable them reappraise such data in formats that are useful for their respective inventories.

The NITTL and SITTL shall also respectively identify other institutions that have data that would be useful for preparing their inventories but whose mandate does not include provision of data to public institutions. In the case of such institutions whose data are not publicly available, the NITTL and SITTL shall in collaboration with the legal department of NCCC and SCCFI respectively bring up a template for MOU, MOA or any other kind of legal arrangements that would ensure that data flows from such institutions to the requesting competent authorities at national and state levels.

The template or format for collaboration between NCCC and a). statistical institutions with mandate for provision of data to the public and b). other institutions that have data but whose mission do not include provision of data to the public shall be submitted by the NITTL to the NGIC for consideration and approval for use as basis for collaboration between NCCC and data providing institutions.

It is also important to have some form of agreement that would bring the NIRGE/SIRGE into the inventory process. These shall be in the form of agreement forms which the experts shall sign to indicate that they are willing and committed to provide review services to NCCC and SCCFI respectively during each NIC. Such a form shall also show among others the role and responsibility of NCCC and SCCFI respectively to the review experts including timelines for review which would not be very elastic and remunerations, among other item considered important by the NITTL and SITTL and their respective legal department. The draft agreement form for NIRGE/SIRGE shall then be submitted to the NGIC and SGIC respectively for consideration and approval.

6.2.1.7 Planning Task 7: Preparation of Budget

Sub-section 5.4.3 proposes a 3-year composite budget for GHG inventories. Such a composite budget shall be divided into 3 segments, part 1, part 2 and part 3, each representing the regular annual budget but coupled to run smoothly without the interruptions that are usually associated with annual budget. As soon as budget preparation announcement is passed down from NGIC to NITTL, the NITTL shall forward the budget preparation announcement to each NSITLs and the research teams under NITSI. Similar sequence shall be followed at the state level. Such a budget shall exclude salaries but shall include labour for personnel not under the payroll of NCCC or SCCFI respectively. It shall also include all non-labour tasks such as training, data collection, research, QA/QC, uncertainty assessment, reporting, archiving, computer hardware and software, office rental where needed, paper, and telephone calls, among other logistical needs. It shall also be necessary to propose a budget for the preparation and printing of all reports that are included as part of the activities of the NIC. The NITTL shall on receipt of inputs to the budget by all sectoral heads integrate them into a single draft budget which shall be forwarded to the NGIC for inclusion into the NCCC-wide budget. Similar sequence of processes shall be followed at the state level for inclusion of inventory budgets to the SCCFI-wide budgets.

6.2.1.8 Planning Task 8: Completion of Work plan for Distribution

As soon as the preparation of all work plans are completed, they shall be circulated among individual source team leaders, appropriate managers within NIMO and other relevant stakeholders for review and comment before the work plan reaches its draft final stage. The draft final work plan shall then be adopted by MNITL chaired by the NGIC. The finalized report shall then be distributed to all NSITLs and the research teams under NITSI. Similar procedures shall be followed through at the state level to get draft workplans approved for implementation.

6.2.1.9 Planning Task 9: Completion of Overall Inventory Planning Instructions

The overall inventory planning instructions should include the following information:

i A matrix of personnel and responsibilities (output of Planning Tasks 1 and 3);
ii An outline and description of each inventory product to be prepared (output of Planning Task 2);
iii The inventory preparation rules of procedure (output of Task 4);
iv The overall inventory schedule (output of Planning Task 5);
v Information about legal and/or collaboration arrangements for data collection and/or staff sharing (output of Planning Task 6);
vi A draft budget (output of Planning Task 7); and
vii Completion and distribution of workplan (output of Planning Task 8).

6.2.1.10 Planning Task 10: Planning for the Preparation of Manual of Procedures

This and other information in sub-sections 6.2.2 and 6.3.2 shall be compiled by the NITTL as a fresh document known as Manual of Procedures (MoP) for the subsisting NIC. The MoP shall have four main sections as follows: Section1: Introduction; Section 2: Overall Inventory Planning Instructions; Section 3: Source-specific Inventory Planning Instructions; and Section 4: Source Preparation Instructions. Section 1 would contain elements that introduce users to the components of the MoP and how it would be used. Section 2 would contain the output of the overall inventory planning instructions that would be followed by Sectoral Inventory Teams to complete the inventory planning. It would have nine sub-sections viz, 6.2.1.1 to 6.2.1.9 provided for under sub-sections 6.2.1. Section 3 on the other hand, would contain outputs of the source-specific inventory planning instructions. It would have five main sub-sections comprising the source-specific planning instructions. Each of the source specific planning instructions shall be devoted to the key GHG Inventory sectors as their sub-sections, Energy, IPPU, Agriculture, LULUCF and Waste sectors. Finally, Section 4 would have ten main sub-sections comprising the source preparation instructions. Each of these sub-sections would be further divided into the key GHG inventory sectors as their sub-sections.

6.2.2 Source-specific Inventories Planning Tasks

The Planning Tasks 10 through 13 described will be undertaken for each source team. These shall include planning for assessment of sources and determination of priorities, establishment of rules of procedure for source preparation and source preparation schedule as well as development of complete source preparation instructions. The source-specific planning tasks will be undertaken by the NSITLs and SSITLs responsible for the energy, IPPU, AFOLU and waste sectors at national and state levels respectively. These are presented in sub-sections 6.2.2.1 to 6.2.2.4.

6.2.2.1 Planning Task 11: Assessment of Sources, Determination of Priorities and Assignment of Roles and Responsibilities

The NSITLs and SSITLs shall be responsible for preparing the instructions for the source covered under their respective inventory teams at national and state levels. The preparatory instructions for each source which the NSITLs and SSITLs are to undertake are expected to include:

i Reviewing the relevant sections of the IPCC guidance materials and the UNFCCC reporting guidance so that default methods, data sources, basic QA/QC, uncertainty assessment and reporting procedures are understood;
ii Reviewing the overall inventory preparation instructions;

iii Undertaking a preliminary assessment of data sources (local, national and regional) that might be available.
iv Reviewing the relevant section(s) of previous inventories that contain the source(s) of interest;
v Reviewing any source inventory improvements contained in past inventories; and
vi Determining what new data and/or methods have become available since the previous inventory was completed.

The NSITLs and SSITLs shall respectively also determine linkages with other sources. For instance, in the energy sector the data used to estimate non-CO_2 emissions from woody biofuel combustion must be seen to be consistent with the wood fuel harvest data compiled in the AFOLU sector.
This information shall be used by the NSITLs and SSITLs to determine what needs to be done, how long tasks will take, what the research priorities should be, and what coordination is needed with other source teams. Once the NSITLs and SSITLs have made these determinations, they can respectively make specific staff assignments for the team.

Where a source is relatively complex, the NSITLs and SSITLs shall respectively be required to prepare a graphical illustration of data flows and data manipulations for the team and submit same with due concurrence of the SITM at national and state levels respectively to NITTL and SITTL for further submission to MNITL and MSITL respectively for approval.

6.2.2.2 Planning Task 12: Establishment of Rules of Procedure for Source Preparation

There are source-specific rules of procedure that will not be included in the overall inventory preparation instructions but which, if defined and distributed before work begins, will ensure that work on preparing each source proceeds smoothly and efficiently. Such source-specific rules of procedure might include:
i Procedures for data collection and sharing both within, and among, sources;
ii File management procedures, especially naming conventions and version control;
iii Adherence to MPGs;
iv Editorial directions; and
v Additional information on personnel and responsibilities as needed.
The NSITLs and SSITLs shall respectively be required to prepare the draft rules of procedure for source preparation and submit same with due concurrence of the SITM at national and state levels respectively to NITTL and SITTL for further submission to MNITL and MSITL respectively for approval.

6.2.2.3 Planning Task 13: Establishment of Source Preparation Schedule

Based on the critical dates given the overall inventory schedule (Planning Task 5) and the results of Planning Task 11, each NSITL and SSITL shall respectively establish a schedule for his/her source in tabular form. Such a table shall have in its columns date for task completion, the task to be completed, responsible officer and any other information the NSITL and SSITL considers important while the rows shall contain the specific task and associated relevant information demanded by the columns.

Where the NSITLs and SSITLs find there is inadequate time in the schedule for contingencies because of the overall inventory deadlines they shall try to redesign their respective schedules so that necessary tasks will be completed on time, and all optional additional tasks are prioritised, defined by time constraints and with fall-back plans.

For example, the NSITLs and SSITLs might plan to improve on a previous inventory by revising the method from Tier 1 to Tier 2 and include time in the schedule for the expected research. However, a time limit must be placed on this research so that, if the research is unsuccessful, there is still sufficient time to complete the inventory using the Tier

1 method. The NSITLs and SSITLs should also take into account the personnel available for undertaking the tasks, their level of expertise and experience, and the level of training that will be needed.

The NSITLs and SSITLs shall respectively work in close collaboration with NITTL and SITTL at national and state levels to ensure that in addition to a source-category kick-off meeting (see Planning Task 14), periodic team meetings be scheduled throughout the inventory preparation process so that data collection issues and questions, and other problems are addressed in a timely manner.

6.2.2.4 Planning Task 14: Completion of Source Planning Instructions

The source category planning instructions would include:

i. A matrix of personnel responsibilities, guidance on research priorities, guidance regarding coordination with other source teams and estimated level of effort for inventory preparation tasks (output of Planning Task 11);
ii. The source rules of procedure (output of Planning Task 12); and
iii. The source preparation schedule (output of Planning Task 13).

Under Planning Task 14, each NSITL and SSITL shall respectively compile the planning instructions for their Sector and submit same with due concurrence of SITM to the NITTL and SITTL for necessary action. The NITTL and SITTL shall on receipt of the submission from each NSITL and SSITL integrate them into a single document as sub-sections 1-4 of the main GHG sectors, namely, Energy, IPPU, Agriculture, LULUCF and Waste sectors.

6.3 INVENTORIES PREPARATION TASKS

One of the primary goals of any reliable GHG inventory programme is to work continually to improve the quality of emission estimates using approved inventory preparation procedures for each task. Among these shall include the documentation of the procedures for data availability and quality, identifying the most appropriate methodology and compile data, emission calculations and completion of text sections, quality assurance and quality control, uncertainty analysis, key source analysis, reporting, documentation and archiving, public dissemination of results, and inventory improvement strategies by each NSITL under the supervision of the NITTL. Once these are completed, the NSITLs shall submit these as their respective source preparation instructions for each task to the NITTL who shall integrate each submission into a single document titled “Source Preparation Instructions (SPI) for the NIC” and on concurrence recommend same to the NGIC for approval. On approval, the NGIC shall recirculate the document to all entities involved in inventories preparation. Thereafter, the NSITs shall use this document to support inventories preparation in their respective sectors under the guidance of each NSITL. The same approach shall be followed at the state level by the SSITL and other competent authorities to prepare and approve source preparation instructions for use by inventory teams.

6.3.1 Outputs of the Preparation Phase

The outputs of the preparation phase will be the products that were defined under Planning Task 2 (in Section 6.2.1.2). As discussed in Planning Task 2, many decisions regarding the scope, detail and format of the GHG inventory will be undertaken by the NSITLs while the NITTL provides oversight.

The NITTL shall prepare the schedule of MNITLs, SITMs and agenda for each meeting to be held during the inventory preparation process.

Besides the meetings, the key outputs expected from the inventory preparation phase shall be

i. The approved detailed SPI; and
ii. The inventory outputs based on the approved SPI.

The SPI shall be distributed to the source teams to undertake their respective inventories after which it shall be supervised by both NSITLs and the NITTL to ensure that the inventory preparation are aligned with the preparation instructions. Equivalent competent authorities at the state level will also be responsible for undertaking each of the tasks above.

6.3.2 Source Preparation Instructions

There are a number of tasks involved in the source preparation instructions. These are the tasks reported in sub-sections 6.3.2.1 to 6.3.2.10 which are derived mainly from the guidelines in section 4 of Braatz and Doorn (2005) and a few other literatures. They are prepared to ensure that there is clarity on the content of the inventory preparation instructions for each source and who shall be responsible for the preparation as well as how each element of the preparation shall be accomplished. The SPI shall be divided into five sections in accordance with the sources in the inventory manual. The sections shall include:

Source Section	Titled Source/sector
1	Energy
2	IPPU
3	Agriculture
4	LULUCF
5	Waste

6.3.2.1 SPI for Preparation Task 1: Data Availability, Quality and Gaps Analysis Procedures Instructions

Assessing data availability and quality is necessary before an appropriate method can be chosen and all the data required by that method compiled. The Revised IPCC manuals provide default emission factors for all sources and fairly comprehensive default conversion factors for the most important sources. It however has very limited guidance on activity data sources. Therefore, activities data collection is considered one of the most time-consuming tasks in inventory preparation if data transparency is to be assured. It is for this reason that legal and/or collaborative arrangements are provided for in sub-section 6.2.1.6. Such arrangements, when implemented, will improve the accessibility and quality of activities data. Besides identifying the sources for activities data, sources for conversion factors and activities data gaps shall also be identified. The approaches for filling data gaps, including extrapolation, interpolation, derivation from proxy data or scientific studies shall also be identified.

Sources of information on emission factors shall be explored within and outside the country, especially from IPCC reference manuals, MPG manuals. Where information are available, local emission factors shall also be identified. Where major gaps exist, the IPCC emission factors database (www.ipcc-nggip.iges.or.jp/EFDB/main.php) shall be used to bridge such gaps, where possible.

The aim of this Task is to prepare instructions manual that would enable the determination of data availability and quality for emission computation. The NSITLs shall be responsible for identifying sources of activities data, conversion factors, emission factors, gap analysis and how data gaps can be breached. The NSITLs shall as part of the instruction's manual for "Data Availability and Quality":

i. Prepare the template for assessing activities data, conversion factors and emission factors and rank such data on a scale of 1 to 5, where 1 is the most reliable and 5 is the weakest, with reasons for such ranking.

ii. Review the MPG manuals documents and provide other details that can be used for improving the quality of activities data, conversion factors and emission factors.
iii. Use the above information to prepare a comprehensive template for compiling activities data, conversion factors and emission factors, that presents adequate information about data quality, subsisting gaps and the framework for breaching such gaps. This shall be submitted with due concurrence of SITM to NITTL for integration into the SPI. This integration shall form the first sub-section of each of the five main sections titled "Energy", "IPPU", "Agriculture", "LULUCF", "Waste" and shall respectively be titled "Data Availability and Quality Procedures Instructions".

The competent authorities above at the state level shall similarly follow the same approach to prepare the "Data Availability and Quality Procedures Instructions" for use during the NIC.

6.3.2.2 SPI for Preparation Task 2: Methodology and Data Compilation Procedures Instructions

On the conclusion of the SPI for Preparation Task 1 (Section 6.3.2.1), appropriate inventory methodology can be determined iteratively. In that process, after the initial data is assessed, an initial method is chosen, more data collection ensues where needed. From these, more data or less data, or data of better or worse quality, are uncovered, the initial method or a different method is finally chosen.

As in Preparation Task 1, the NSITLs shall establish a list of additional work that could have be done in past inventories, but was not done due to either time or financial constraints. This list shall be submitted to NITTL for consideration and concurrence, who shall thereafter submit it to the NGIC for final consideration and approval. Once approved, this shall be distributed to each NSITs for incorporation into the Inventory Improvement Strategy in Preparation Task 10 (Section 6.3.2.10).

The MPG manuals contain decision trees to help Parties choose the methodology most suited to national circumstances. The NSITLs shall study these decision trees and develop templates containing the inventory methodologies for their respective sectors. Besides the templates for inventory methodologies, the NSITLs shall also based on the MPG manuals develop templates for the following:

i. List of additional work that could have be done in past inventories but which were not included in those inventories;
ii. The appropriate formats for compiling the activities data, conversion factors, emission factors and all the related information;
iii. Decision tree for the conditions that must be met for the sector to buttress recalculations;
iv. The recalculation options that are recommended in order of decreasing suitability to the available data;
v. Including new sources that were not included in previous inventories; and
vi. The format for new time series assessment for all inventory years.

They shall with due concurrence of SITM submit these as the template for source preparation instructions to the second sub-section of each of the five main sections of the SPI titled "Methodology and Data Compilation Procedures Instructions" to the NITTL for necessary action.

The competent authorities at the state level shall similarly follow the same approach to prepare the "Methodology and Data Compilation Procedures Instructions" for use during the NIC.

6.3.2.3 SPI for Preparation Task 3: Emission Calculations and Completion of Text Sections Procedures Instructions

The NSITLs shall provide instructions for entering data into the IPCC model (software or spreadsheet tool) selected for use during the NIC. The instructions shall be adequate to guide team members to use the software or spreadsheet tool especially where different options are presented to the team members for choice. The NSITLs shall organise sectoral meetings where different options in the software or spreadsheet tool are presented to the team. Where different options are presented in the software or spreadsheet tool for team members regarding a particular source, the NSITLs shall convoke the SITM and document the decision taken on what option presented by the software or spreadsheet tool should be adopted for use and justification for the choice. The NSITLs shall then present a template for choice of options adopted by the sectoral team and forward same to the NITTL for consideration and necessary action.

In addition to inputting data into the different modules of the software or spreadsheet tool, the NSITLs shall also develop the template for documenting information and data entered into the software or spreadsheet tool as there is no provision in the software or spreadsheet tool for entering text data. Such information could include source of data (activity, EF and conversion factors), ranking of data, assumptions used wherever necessary, or any other information the NSITLs sees as vital to enhance transparency during reporting.

The NSITLs shall then convert these into a template for the text sections and submit same to the NITTL for review and necessary action. The template for decisions taken during data input into the software or spreadsheet tool and the template for accompanying text to the data presented into the software or spreadsheet tool shall be submitted with due concurrence of SITM to the NITTL who shall after review integrate both templates into the third sub-section of each main sections of the SPI titled “Emission Calculations and Completion of Text Sections Procedures Instructions”.

The competent authorities at the state level shall similarly follow the same approach to prepare the “Emission Calculations and Completion of Text Sections Procedures Instructions” for use during the NIC.

6.3.2.4 SPI for Preparation Task 4: Quality Assurance/Quality Control Procedures Instructions

According to MPG manuals, the QC process is a system of routine, planned technical activities to measure and control the quality of the inventory as it is being prepared. The typical procedures include:

i. Routine and consistent checks to ensure data integrity, correctness and completeness;
ii. Routine and consistent checks to identify errors and omissions;
iii. Accuracy checks on data acquisition and calculations and the use of approved standardised procedures for emissions calculations, emissions measurements, estimating uncertainties, documentation, archiving and reporting; and
iv. Technical reviews of data, methods and results.

On the other hand, the MPG manuals also defines QA process as a planned system of review, and sometimes audit procedures conducted by personnel not involved in the inventory development process. Reviews, preferably by independent third Parties, are performed on a finalised inventory following implementation of the QC procedures. These reviews:

i. Verify that data quality objectives were met;
ii. Ensure that the inventory represents the best possible estimates of emissions and sinks given current scientific understanding and data availability; and
iii. Support the QC programme.

A good QA/QC plan is important for the preparation of a reliable, defensible emissions inventory. This task describes the procedures for implementing QC and QA on GHG inventories as provided for in MPG manuals.

The NSITLs shall undertake detailed technical review of MPG manuals as well as any other source of information on how to conduct QA and QC processes and from this bring up the comprehensive template for:

i. Conducting QC procedures; and
ii. Conducting QA procedures.

These templates shall be submitted with due concurrence of SITM to the NITTL for necessary action. The NITTL shall on receipt review the templates and make them the fourth sub-section of each main section of the SPI called "Quality Assurance/Quality Control Procedures Instructions".

The competent authorities at the state level shall similarly follow the same approach to prepare the "Quality Assurance/Quality Control Procedures Instructions" for use during the NIC.

6.3.2.5 SPI for Preparation Task 5: Uncertainties Analyses Procedures Instructions

Uncertainty analyses of GHG emissions quantifies the variability and potential errors in the estimated amount of greenhouse gases being emitted. IPCC (2019) Refinements to the IPCC 2006 model posits that uncertainty analyses are crucial for assessing the reliability of GHG inventories and involves identifying sources of uncertainties, such as inaccuracies in activities data and emission factors, then using methods like the Monte Carlo simulation to model how these uncertainties propagate through the calculations. The goal is to provide a more accurate range or probability distribution for the total emissions.

There are uncertainties associated with every estimation of GHG emissions (ghgprotocols.org, 2005). These could be broadly categorized as scientific and estimation uncertainties. Scientific uncertainty arises when the science of the actual emission and/or removal process is not sufficiently understood. For example, many of the direct and indirect emissions factors associated with global warming potential (GWP) values that are used to combine emission estimates of different GHGs to estimate CO_2e emissions involve significant scientific uncertainty. Analysing and quantifying such scientific uncertainty is extremely problematic. Estimation uncertainty arises any time GHG emissions are quantified. Therefore, all emission or removal estimates are associated with estimation uncertainty. Estimation uncertainty can be further classified into two types: model uncertainty and parameter uncertainty.

Model uncertainty refers to the uncertainty associated with the mathematical equations used to characterize the relationships between various parameters and emission processes. For example, model uncertainty may arise either due to the use of an incorrect mathematical model or inappropriate parameters in the model. Like scientific uncertainty, estimating model uncertainty is also likely to be beyond the scope of most institutions inventory efforts; however, some institutions may wish to utilize their unique scientific and engineering expertise to evaluate the uncertainty in their emission estimation models.

Parameter uncertainty refers to the uncertainty associated with quantifying the parameters used as inputs to estimation models. Parameter uncertainties can be evaluated through statistical analysis, measurement equipment precision determinations, and expert judgment. Quantifying parameter uncertainties and then estimating source category uncertainties based on these parameter uncertainties will be the primary focus for those institutions that wish to estimate uncertainties in their emission inventories.

Braatz and Doorn (2005) indicates that uncertainties in national GHG inventories arise from three different processes (IPCC 2000):

i Uncertainties in definitions of sources or sinks or other;
ii Uncertainties from natural variability of the process that produces an emission or uptake; and
iii Uncertainties resulting from the assessment of the process or quantity, including:
    a. Uncertainties from measuring;

b. Uncertainties from sampling;
c. Uncertainties from reference data that may be incompletely described; and
d. Uncertainties from expert judgement.

While the qualitative assessment of uncertainties indicates whether confidence in the emission estimation is "high", "medium" or "low", the quantitative uncertainty assessment indicates that uncertainties in emission factors and activity data are expressed as the 95% confidence intervals. There are also processes for combining emission factor and activity data uncertainties to derive uncertainties for source emission estimates and for total emission estimates for each GHG or precursor gas. If quantitative uncertainty ranges are estimated using these methods, they should be reported in a second set of Sectoral and Summary Report Tables.

NSITLs shall review recent IPCC guideline documents as well as the MPG manuals to identify all methods for estimating qualitative and quantitative uncertainties. These methods should be used to develop the different templates that would be used to estimate uncertainties during the. The different methods for uncertainty estimates shall be submitted with due concurrence of SITM to the NITTL for necessary action. The NITTL shall on receipt integrate them into a single document as the fifth sub-section of each main section of the SPI called "Uncertainties Analyses Procedures Instructions".

The competent authorities at the state level shall similarly follow the same approach to prepare the "Uncertainty Analyses Procedures Instructions" for use during the NIC.

6.3.2.6 SPI for Preparation Task 6: Key Source Analyses Procedures Instructions

A key source is one that is prioritised within the national inventory system because its estimate has a significant influence on a country's total inventory of direct GHGs in terms of the absolute level of emissions, the trend in emissions, or both (IPCC 2000, 2003). In terms of the absolute level of emissions, key sources are defined as those which, when summed together in descending order of magnitude, add up to over 95% of total emissions. This cumulative emissions threshold is based on research that indicates that for most inventories, a 95% threshold will capture 90% of the inventory uncertainty. When emission trends have been prepared, key sources are those that are not just the largest sources but also the sources that are growing more rapidly or more slowly than total national GHG emissions. Such trend analysis will indicate which sources are likely to become more, or less, important in the future. MPG manuals identify both the steps to be taken and the depth required for key source analysis (KSA).

The NSITLs shall:
i. follow the guidelines provided in MPG manuals and establish the appropriate level of KSA;
ii. determine for each key source if certain sub-sources represent a significant share of emissions;
iii. provide the steps for preparing KSAs based on the approaches for i) qualitative KSA, ii) tier 1 quantitative KSA and iii) tier 2 quantitative KSA; and
iv. following the procedures in the MPG manuals and available national data determine which of the KSA methods, qualitative, tier 1 quantitative and tier 2 quantitative approaches is recommended for use during the NIC.

Each NSITL shall on completion of the above submit the template and logical steps for KSA in their sectors with due concurrence of SITM to the NITTL for necessary action. The NITTL shall on receipt integrate them into a single document as the sixth sub-section of each main section of the SPI called "Key Source Analyses Procedures Instructions".

The competent authorities at the state level shall similarly follow the same approach to prepare the "Key Source Analyses Procedures Instructions" for use during the NIC.

6.3.2.7 SPI for Preparation Task 7: Reporting Procedures Instructions

The primary objective of any National Inventory Report (NIR) is to communicate how the inventory was undertaken, the outputs and the outcome. It in summary describes how data were entered, the methods and tools used, and the results presented with the level of details depending on factors such as time and resources. It may where possible summarise uncertainties, QA/QC procedures, key category analyses, present and review trends as well as suggestions to improve future inventories.

The specific objectives may include to:

i. Provide a good documentation of the activities and outputs of the inventory for presentation to the government, the UNFCCC secretariat and other interested Parties;
ii. Document the knowledge gathered during each inventory for the benefit of future inventories;
iii. Stimulate awareness of national and sub-national governments, the private sector and other stakeholders in the state of emissions and trends, the implications for the economy and the climate system, and the potential mitigation needs, among others; and
iv. Enable the inventory team propose detailed recommendations for improving the inventory processes and inventory quality in the future.

The Conference of Parties (COP) Decision 17/CP.8 and other emerging COP decisions as may be included in the different IPCC inventories manual and other documents contain the guidelines for preparing NIRs and other reporting tools such as Biennial Transparent Reports (BTRs). These guidelines encourage NAI Parties to:

i. Report on all gases;
ii. Include additional information on data collection and archiving procedures, institutional arrangements, data sources and inputs, methodologies, assumptions, data improvement needs and uncertainties; and
iii. Undertake key source analyses, among others.

Each of the IPCC Guidelines from 1996 to 2019 contain step-by-step instructions for assembling, documenting and transmitting completed national inventory data and results consistently, regardless of the methods used to produce the estimates. These instructions are to enable users of the inventory manuals provide the primary means of ensuring that all reports meet the TRACCC requirements.

The NSITLs shall review all the UNFCCC guidelines as reported in IPCC 1996 to 2019 guidelines as well as in MPG manuals, among others and identify and bring out elements that should be included in the reporting instructions for Nigeria. These elements shall then be used to develop the first template for reporting titled; "Template A: Reporting Instructions for Meeting National Reporting Obligations to the UNFCCC". The NSITLs shall also develop the second set of templates entitled "Templates B: Templates for Reporting Emissions for Stimulating Awareness to National Stakeholders". Templates B shall have the following sub-versions:

i. Template B1: same detailed NIR with focus on sectoral details with graphics, per capita emissions among other socio-economic details;
ii. Template B2: Policy Makers' Summaries; and
iii. Template B3: Synthesis Report (a synthesised form of template B1).

Each NSITL shall submit each of the reporting templates with due concurrence of SITM to the NITTL for necessary action. The NITTL shall on receipt integrate them into a single document as the seventh sub-section of each main section of the SPI called "Reporting Procedures Instructions".

The competent authorities at the state level shall similarly follow the same approach to prepare the "Reporting Procedures Instructions" for use during the NIC.

6.3.2.8 SPI for Preparation Task 8: Documentation and Archiving Procedures Instructions

According to Wartmann (2022), an archive is a collection of records and where these records are kept. In this regard, GHG inventory archives include all materials created and used to develop an inventory. It helps with planning, preparing and managing the inventory compilation processes. Archiving, with methods and data documentation, is a key step to ensure that an inventory is sustainable, consistent and reproducible. The following form the criteria for a good archive:

i. Safeguarding against loss of information records and institutional knowledge;
ii. Providing documentation that is accessible to the right people; and
iii. Improving efficiency and sustainability of inventories compilation and quality of inventories.

A good archive makes sure that the following are avoided:

i. Starting from scratch;
ii. Losing information when inventory team changes;
iii. Difficulty referencing previous work; and
iv. Difficulties in finding previous work.

A standardized inventory is one that is based on the TRACCC principles. It is good practice to complete, archive and provide full documentation for every inventory produced so that each inventory is transparent, all inventories are consistent and the next version of the inventory can be produced efficiently even if the inventory team changes. The full documentation should also include the components of the archive, how and where each component of the archive is stored and how to retrieve the archived information. A new inventory team should not have to redo work that has already been done to prepare a previous inventory. In addition, full documentation and archiving may be necessary to justify the inventory work to political office holders or the public.

It is also good practice to use a standardised documentation and archiving system for both numerical and qualitative information and to undertake documentation throughout the inventory preparation process. Documentation and archiving procedures shall include standardised procedures for documenting spreadsheets and text sections as well as procedures for dating files and for keeping paper and electronic copies of files, reference materials and other sources of data.

The issues to be documented by source teams include:

i. complete descriptions of the data assessment and manipulation processes, including the source and ranking of the data that were evaluated;
ii. why a particular data source was chosen for use in the inventory and why others were not chosen;
iii. what assumptions were made in manipulating or choosing data for final use;
iv. complete references for the data;
v. why recalculations were made and what those recalculations were; and
vi. responses to internal and external review comments.

This information shall be archived in a memo or other format such as use of digital logbooks (DLB) with a content and format that has been reviewed and approved. Each material should be archived with all the other inventory materials.

Table 6.1 provides a sample tool for compiling such documentation for each source. Each inventory team member would complete the top row and all columns of this table for each source the team member is responsible for. The advantage of a table such as this is that it provides a check-list to help ensure that documentation procedures are followed.

Archiving shall comprise both soft and hard copy versions organised in a logical sequence and with back-ups of electronic files. Voluminous hard copy versions (exceeding 150 pages) should be replicated. It is good practice that the archiving system is transparent, well designed and well managed with the following archived in soft and hard copies:

i. The work plan;
ii. The overall inventory preparation instructions;
iii. The source preparation instructions;
iv. The NIR and any other inventory report considered valuable for archiving;
v. Final inventory spreadsheets and text files for each source; and
vi. All other documentation materials, internal and external reviews, inventory improvement strategy.

Each NSITL shall appoint for its team an Archiving and Documentation Officer (ADO) who shall be responsible for reviewing the MPG manuals and other sources of information on archiving and documentation to be able to develop a template for:

i. Digital Archiving and Documentation System (DADS);
ii. Hardcopy Documents Archiving and Documentation System (HDADS);
iii. User manual for DADS; and
iv. User manual for HDADS.

The ADO shall submit each of (i) to (iv) above to the NSITLs for consideration and concurrence. Each NSITL shall on receipt of the submission by the ADO consider, concur and submit same with due concurrence of SITM to the NITTL for necessary action. He/she shall integrate them into a single document as the eight sub-section of each main section of the SPI called “Documentation and Archiving Procedures Instructions”.

The competent authorities at the state level shall similarly follow the same approach to prepare the “Documentation and Archiving Procedures Instructions” for use during the NIC.

Table 6.1: Sample Documentation Tool for Source-Specific Tasks Adapted from Braatz and Doorn (2005)

Source			
Person Responsible:			
Task	Information Sources, Assumptions, Data Manipulations, Items for Inventory Improvement Strategy and Other Notes	Data Quality Ranking (1 – 5)[2]	Remark on Ranking Quality
Assess Data Availability and Quality			
Determine Method			
Collect Activity Data and Conversion Factors			
Choose Emission Factor			
Conduct Calculations			

[2] 1 = for highest quality; 5 = lowest quality.

Conduct Uncertainty Analysis			
Conduct QC Procedures on Spreadsheets			
Complete Text Sections			
Conduct QC Procedures on Text Sections			
Incorporate Revisions Based on Internal Review			
Incorporate Revisions Based on External Review			
Complete Documentation and Archiving			
Compile Inventory Improvement List			

6.3.2.9 SPI for Preparation Task 9: Public Dissemination of Results Procedures Instructions

Once the inventory reporting is completed, the processes by which inventory information as reported in Templates B in section 6.3.2.7 shall be made ready for dissemination by NIMO. This shall include the preparation of a plan for reports distribution as well as information dissemination. The information dissemination segment could among others include national and regional workshops, preparation and distribution of short pamphlets, videos and jingles.

The NSITLs shall design the plan for reports distribution and information dissemination with costing for each sector and forward same with due concurrence of SITM to the NITTL for necessary action. The NITTL shall on receipt integrate them into a single document as the ninth sub-section of each main section of the SPI called “Public Dissemination of Results Procedures Instructions”.

The competent authorities at the state level shall similarly follow the same approach to prepare the “Public Dissemination of Results Procedures Instructions” for use during the NIC.

6.3.2.10 SPI for Preparation Task 10: Inventory Improvement Strategy Procedures Instructions

The inventory improvement strategy will consist of a prioritised list of tasks for improving and refining the inventory over the medium-to-long-term. It is important to remember that this strategy is also part of the sequence of activities in the inventory cycle and should be reviewed for each new cycle. The inventory improvement strategy should include:

i. The general objectives and scope of the work;
ii. Source-specific improvements that are to be undertaken by each source team during inventories preparation; and
iii. How and when the objectives will be met with priorities clearly delineated.

The key source and uncertainties analyses, if undertaken, will inform the priority setting processes.

Items that are needed in an inventory improvement strategy include:

i. a more rigorous QA/QC plan;
ii. source-specific ideas for further research;
iii. corrections and/or peer review comments that were not included in the previous inventory cycle;

iv. reporting and documentation improvements;
v. possible new data sources and methodologies; and
vi. archiving improvements.

Other strategies for improving the quality of inventories include:
i. awareness raising with government, academia and the public on current constraints and seeking feedback on strategies for improvements; and
ii. training of inventory personnel on existing constraints and emerging strategies for quality improvements.

The NSITLs shall design the plan for inventory quality improvements as well as capacity development to enhance quality of inventories, among other strategies and submit same with due concurrence of SITM to the NITTL for necessary action. The NITTL shall on receipt integrate them into a single document as the tenth sub-section of each main section of the SPI called "Inventory Improvements Strategy Procedures Instructions".

The competent authorities at the state level shall similarly follow the same approach to prepare the "Inventory Improvements Strategy Procedures Instructions" for use during the NIC.

6.3.2.11 SPI for Preparation Task 11: Submission of Draft MoP for Review and Approval

The NITTL shall review the single document of the SPI as section 4 of the MoP and submit same to the NGIC for necessary action. The whole MoP comprising Sections 1 to 4 when approved shall be one of the documents to be distributed during the kick-off meeting for use by inventory teams as source preparation instructions for inventories.

6.3.3 Source Preparations and Inventory Reporting

On receipt of the MoP, each inventory team shall use the sections of the manual derived from sections 6.3.2.1 to 6.3.2.10 as SPIs to support preparation of inventories in their different sectors under the supervision of each NSITL. In order to do this, NSITLs shall identify key Officers under each NSIT to be the lead Officer for each SPI under sections 6.3.2.1 to 6.3.2.10. These Officers shall be responsible for each activity under the source preparations. However, depending on training and experience, one Officer is permitted to be a lead Officer for more than one source preparation activity. The sections below provide elements that will be the focal areas of source preparations and inventory reporting.

6.3.3.1 Source Preparations

Each key Officer shall lead others in preparing key activities and sub-activities as defined by the SPI. For instance, the Officer responsible for section 6.3.2.1 shall use the SPI to prepare the full report on data availability, quality and gaps analysis. The data availability, quality and gaps analysis shall be given as a standalone report that would be used in providing information on data gaps during inventory report writing. Similarly, the key Officers responsible for methodology and data compilation and emission calculations and completion of text sections, shall respectively undertake emission calculations based on approved instructions in the SPI. As soon as data availability, quality and gaps analysis have been undertaken, the key Officers responsible for sections 6.3.2.2 and 6.3.2.3 shall undertake emission calculations and completion of text sections based on the methodology in section 6.3.2.2.

Also, the key Officers responsible for sections 6.3.2.4, 6.3.2.5, 6.3.2.6, 6.4.2.8 and 6.3.2.10 shall use the results of emission calculations, other associated data and the MoP for their respective activities to provide reports on outputs of:

i. QA/QC;
ii. Uncertainty Analysis;
iii. Key Source Analysis;
iv. Documentation and Archiving; and
v. Inventory Improvement Strategies.

in preparation for full reporting in section 6.3.3.3.

6.3.3.2 Preparation of Digital Logbook

The Officer responsible for emission calculations and completion of text sections in section 6.3.2.3 shall apart from inputting data into the different spreadsheets of the model, also use the template for documenting information and data entered into the model as there is no provision in the model for entering text data and other information. Such information and data include source of data, ranking of data, model option used out of the options available, assumptions used wherever necessary or any other information. This information should be saved as a special report titled "Digital Logbook" as provided for in section 6.3.2.8. The Digital Logbook will be one of the sources of information for preparing the comprehensive NIR. The key Officers responsible for source preparation activities in section 6.3.3.1 and 6.3.3.2 shall prepare their respective reports and submit to their respective NSITLs for integration into a single report for the sector. On receipt of the key Officer's report, each NSITL shall prepare three standalone reports for the sector as provided for in section 6.3.2 including:

i. Data Availability, Quality and Gaps Analysis (6.3.2.1);
ii. Draft Template A of the Full National Inventory Report (6.3.2.7); and
iii. Versions of the Digital Logbook (6.3.2.8).

6.3.3.3 Inventory Reporting

The NSITLs shall forward their respective sectoral reports to the NITTL who shall thereafter integrate each report from the sector to produce the respective full report for the nation with all the elements required by the inventory report as provided in section 6.3.2.7. The scope and content of each report shall be as provided for in the inventory cycles.

On completion of the full draft of the Template A and Templates B of the inventory report for the NIC, the NITTL shall submit the report to the NGIC for review and concurrence before circulation to the NIRGE experts for review in accordance with the provisions of section 6.3.2.8. On receipt by NIRGE experts, they shall review and revert their comments to the NGIC for circulation to the NITTL and NSITLs. The NSITLs shall thereafter review and integrate NIRGE experts' comments and prepare an updated draft Template A and Templates B reports. The NSITLs shall submit the updated draft Reports to the NITTL who shall further integrate and re-submit to the NGIC for further action. The NGIC shall then circulate the updated draft Reports to international experts for review. The international experts shall review and revert their comments to the NGIC who shall then use it to prepare to host the National Stakeholders Workshop (NSW) to consider and adopt the report.

The NGIC shall thereafter re-circulate the draft final Reports to the designated Authorities. While Template A report is to be submitted UNFCCC Secretariat, Templates B reports are meant for national stakeholder and not to satisfy Nigeria's obligations under the UNFCCC. They are to be used for public awareness with focus on how the inventory reports align with various economic development and policy issues.

6.4 GHG INVENTORIES UPDATE

A GHG inventories update refers to the processes associated with revising and improving a past inventory using more standardized methods. It is important in enhancing inventory accuracy, reflecting changes in activities, technologies emission factors with time as basis for ensuring the removal of internal inconsistencies in emission estimates through all the years the inventory. This process ensures that the inventory remains a reliable tool for understanding and managing national GHG emissions.

6.4.1 What an Update Entails

An update typically involves:

i. Revising emission factors;
ii. Adding new emission sources;
iii. Adjusting existing emission sources;
iv. Improving data collection and analysis;
v. Providing new inventories improvement strategies based on research; and
vi. Undertaking recalculations where needed and providing updated trends based on the above processes

6.4.2 Why Updates Are Needed

National Emissions continue to change based on systematic changes in emission factors and activities data which necessitate regular updates to bring the emissions to be in line with actual emission factors and activities data. Emissions update are also needed when emission factors and activities data used were not reflective of the actual emission factors and activities data due to poor data quality and gaps necessitating developing strategies for inventory improvement.

6.4.3 Procedure for Undertaking Inventories Update

In order to undertake inventories update, the NSITLs shall review the relevant sections of the inventory report notably:

i. Report on data availability, quality and gaps analysis;
ii. Report on inventory quality improvements undertaken based on SPIs developed in sub-section 6.3.2.10;
iii. Report on strategies and steps for recalculations based on SPI activities from sub-section 6.3.2; and
iv. Approved strategy for the best recalculations option based on the list provided in descending order of suitability to the available data.

Each NSITL shall submit the sectoral report on options for the emission updates to the NITTL for integration into a national strategy for inventories update across sectors. The NITTL shall then review and submit the integrated strategy to the NGIC for approval. The approved integrated strategy shall then be circulated and used for emissions update during each NIC period for which emission recalculations shall be undertaken from the first to the last year of national inventories to ensure that all inventories are internally consistent. The procedure for inventories reporting shall then be undertaken in accordance with sub-sections 6.2 and 6.3.

The competent authorities at the state level shall similarly follow the same approach to prepare the “Inventories Update” whenever needed.

6.5 NATIONAL INVENTORY CYCLE AND SEQUENCE OF ACTIVITIES

A National Inventory Cycle (NIC) refers to the periodic cycle in terms of activities and time in years during which a complete national inventory is prepared and submitted to competent authorities. It involves planning, data collection, processing, emission estimation, quality assurance and improvement; all aimed at producing an accurate and transparent national inventory. During this period, the inventory preparation activities are undertaken with a robust plan for data collection, processing, emission computations, reporting of emissions and removal by sinks within an entity, QA/QC and other associated activities. The inventory reports also contain the methodologies and data used to produce these estimates. The timeframe for an NIC could be flexible depending on certain issues. These include institutional arrangements developed for data collection from NSIs and other institutions, national capacity for planning and implementation of inventory activities, availability of adequate human and institutional capacity as well as budgets to support inventory preparation and reporting activities among others.

6.5.1 Evolving the National Inventory Cycle for Nigeria

The gold standard proposed under the UNFCCC and the Paris Accord is for countries to have a one-year NIC during which all activities are undertaken and completed and a new cycle is expected to begin immediately. In some countries however, there may be significant constraints to being able to maintain a one-year NIC. These include availability of adequate human capacity, funding, national activities and emission factors data availability and logistical system for data collection from NSIs and other institutions. Some of these constraints have already been mentioned in sub-section 2.2.2. This sub-section shows that substantial gaps exist in the activities database of the emission inventories spreadsheet over the years which do not appear to be narrowing over time. This is because there has been little success in past efforts to include new data collection details or new data collection strategies into what the NSIs have been gathering over the years. There has also been perennial poor logistical support system for data collection and inventory management. Resulting from these, no past inventory has been completed within twelve months. Sub-sections 6.2 and 6.3 are now adding new templates for inventory planning and inventory preparation tasks which could take some time to master by NIMO, NITSI and the NSITs and similarly the state level. It is for this reason that this Guidebook proposes that NIC would initially comprise inventories taken every three years during which all activities for inventory planning, compilation, reporting and review are completed and the inventory report submitted. It is proposed to operate under two modules.

The first module should be the “Normal National Inventory Cycle (N-NIC)” which would be undertaken over a twenty-four-month period. During that period, all inventory activities would be undertaken and inventory reports submitted. After each N-NIC, a period of one year would be used to plan the activities for the next inventory, source for funds and bridge the gaps needed in human capacity for the next inventory. Figure 6.1 provides the proposed cycle of activities for N-NIC. After every 3 successive N-NICs, the inventory process shall automatically revert to a Super National Inventory Cycle (S-NIC), which shall last for only one cycle before reverting to the N-NIC.

The S-NIC would have a periodicity of two and half years during which inventory activities would not only include the computation of emissions for the years after the last inventory but also recalculations of emissions for all years where inventories have been undertaken in the past and archived in the database. The recalculations under each S-NIC would allow updates to ensure that all inventory data are internally consistent. After each S-NIC, a period of six months would be left to plan the activities for the next inventory, source for funds and bridge the gaps needed in human capacity for the next inventory. Figure 6.2 provides the cycle of activities for the proposed S-NIC.

Despite these constraints, the two NIC modes should be short-lived and the inventory cycle systematically reduced to a one-year cycle within approximately six years if funding and other constraints are removed.

6.5.2 Towards Having a Harmonized One-Year Single NIC

Braatz and Doorn (2005) indicates that whenever an NGHGI-MS Guidebook such as this is being prepared for the first time, the inventory will possibly need to go through several short-term iterations that involve activity data improvements, emission factors update, methodology re-assessments and/or recalculation. When the inventory is compiled in subsequent cycles, these iterations are likely to be less extensive for the simpler, straightforward source categories. Any freed resources including time could then be used to reduce the length of the NIC. Each new inventory builds on the information gathered during the previous inventory effort as well as on the planning, management, coordination and execution systems that were established to carry out the inventory assessment. It is for this reason that experts advise that rigorous systems are established and maintained for reporting, documenting, data sourcing and archiving, computation of results and reporting. Without such systems, inventory teams and the national inventory itself would not be able to optimally benefit from precious works. Each new inventory is an opportunity to not only improve the accuracy and comprehensiveness of emission estimates but also to improve the management systems designed to carry out all phases of the inventory. The purpose of this kind of Guidebook is to provide overall guidance on inventory planning and preparation so that each successive round builds on the previous one and free time and other resources for greater efficiency.

The following forms the proposal for converging the two inventory modes into one, having a one-year inventory cycle and an improvement plan for inventory activities within the cycle. Under this proposal, the Council shall:

i. Evolve and approve a GHG inventory funding mechanism in line with sub-section 4.3.10.1 that seeks adequate NIF to support inventories back-to-back from one NIC to the other without the need to pause to seek finance for the next inventory which has added one year to the current N-NIC;
ii. Propose and develop strategic activities for improving the quality of activities data and a template for improved data collection logistics;
iii. Work with NSIs and other stakeholders responsible for activities data to design the template for data collection as in sub-section 4.3.4;
iv. Design research programmes to improve nationally estimated emission factors and the quality of activities data collection in line with recommendations in sub-sections 8.2 and 8.3 respectively;
v. Ensure that the MoP is prepared and contains comprehensive procedures for inventory planning tasks as well as inventory preparation tasks that would be followed by sectoral inventory teams for inventory preparation and reporting. In this case, the review of MoPs for each new NIC will take much shorter time;
vi. Endorse the use of alternative inventory models that are based on the most recent IPCC guidelines (sub-section 7.2) such as the Excel-based Resource for Inventory Safety and Quality (RISQ) tool that allows multi-year calculations in one spreadsheet. If such an inventory platform could allow Nigeria to put all its inventory years from 1988 to the subsisting NIC in one spreadsheet, then it will minimize the need for a separate time for recalculations which is what the S-NIC is all about; and
vii. Undertake other activities incidental to minimizing time used to support inventory activities in general and the MoP task in particular. This would build capacity to develop tools that would automate many of the activities listed in the source-specific planning instructions and source preparation instructions of the MoP.

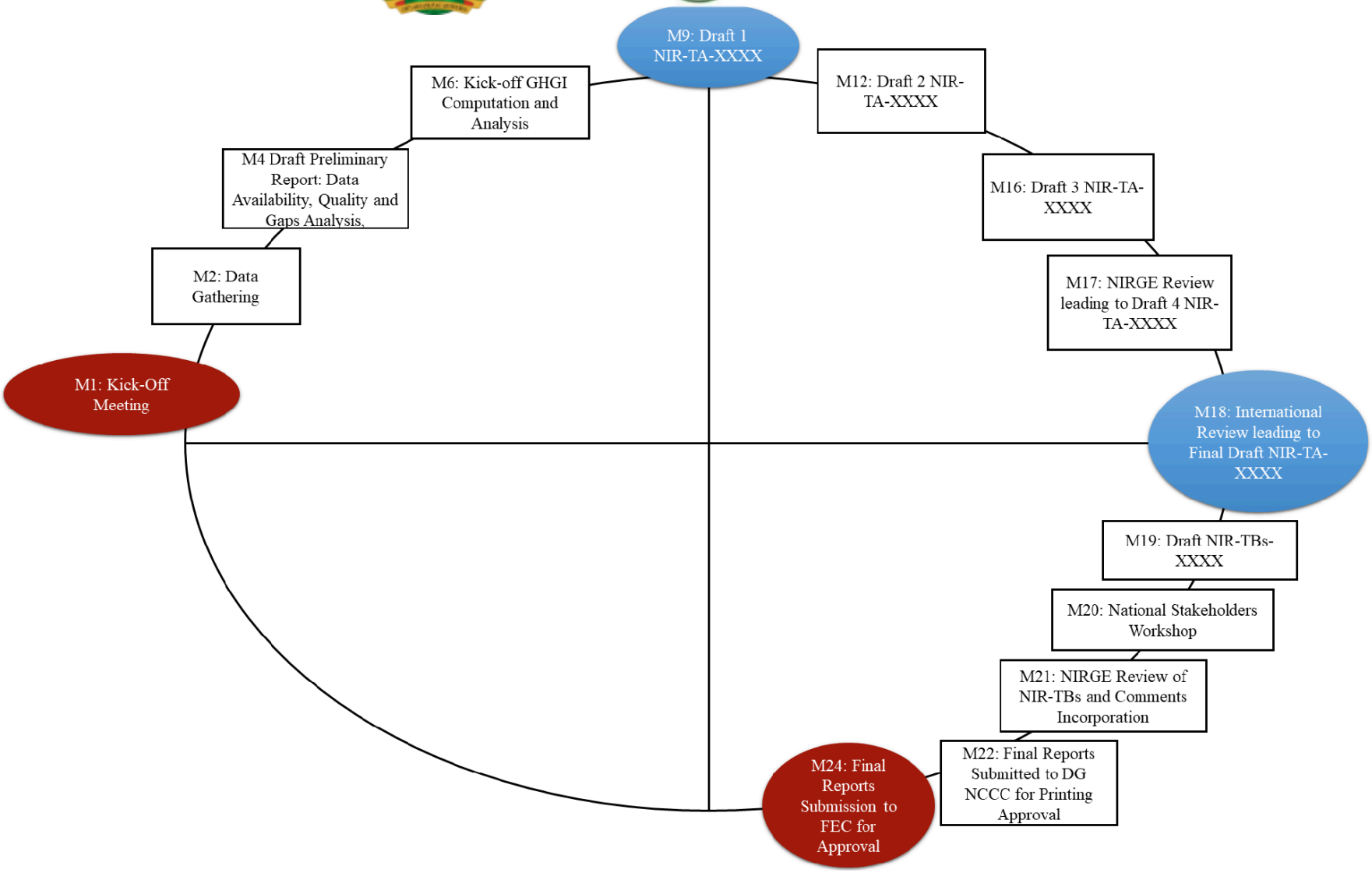

Figure 6.1: Normal National Inventory Cycle

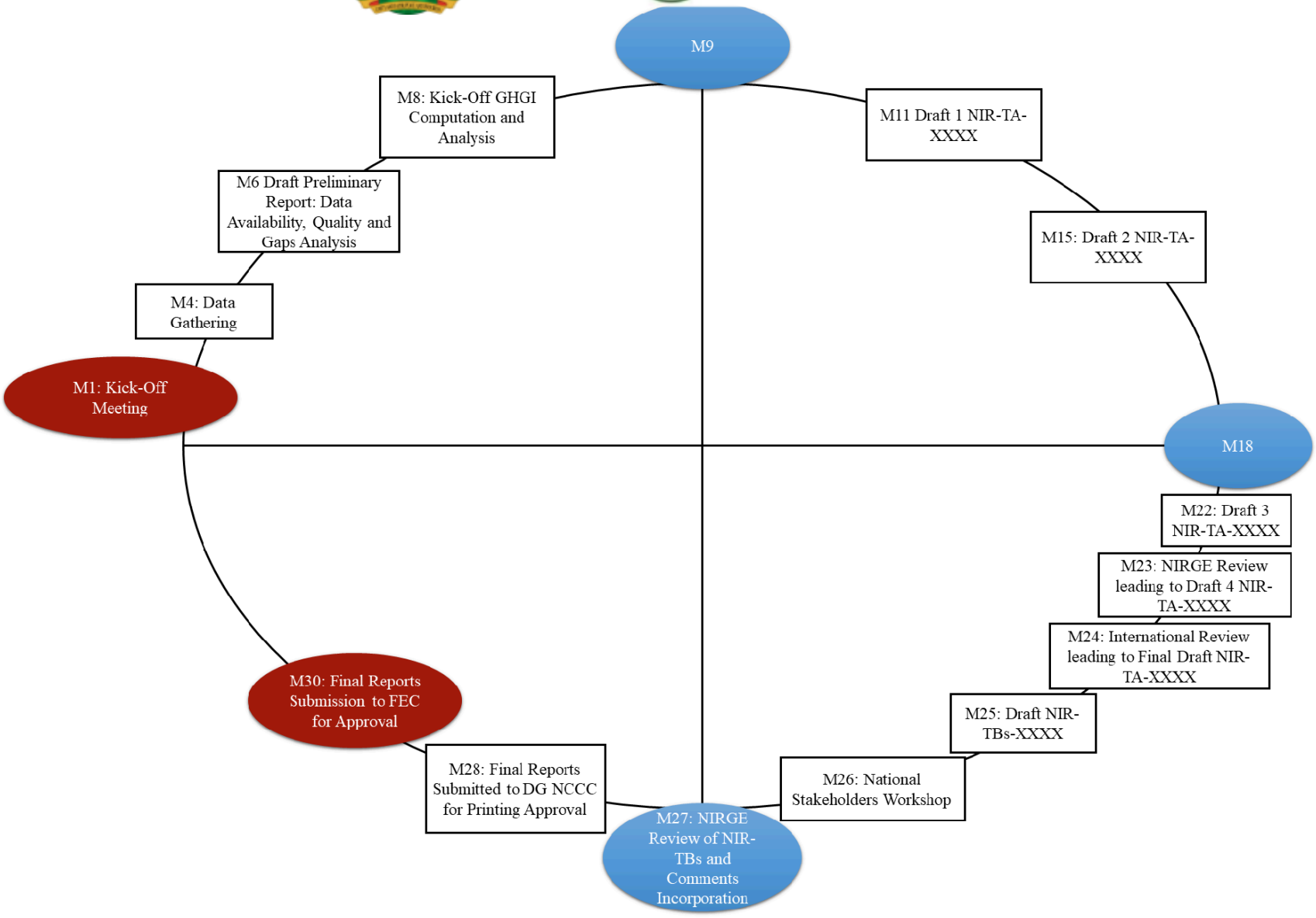

Figure 6.2: Super National Inventory Cycle

6.5.3 Sequence of Activities for the NIC

During each N-NIC and S-NIC, the following would form the sequence of activities. It will commence with the kick-off meeting which signals the beginning of the activities for the NIC and end with the submission of the final reports to the Federal Executive Council (FEC).

6.5.3.1 Kick-Off Meeting

The inventory shall begin on the first of July of the first year of the inventory cycle, which shall be the first month (M1) of the inventory. The first weeks shall be used to finalize plans for the kick-off meeting. The kick-off meeting shall be fixed for the third Tuesday of July of the first year of any NIC. The Meeting shall be hosted by NIMO with NITSI as co-host. It shall present abridged review of the immediate past inventory, identify gaps and present the approved plan for the subsisting NIC. It shall introduce all team leaders for the subsisting NIC including the NGIC, key Officers working under him/her and their role in the inventory; the NITTL, his/her key team members and the role they will play; as well as the NSITLs, their respective key team members and the role they are to play in the inventory. The NGIC shall then provide any other information that would assist the teams to undertake their respective tasks successfully, and NIMO's plan for monitoring and evaluation throughout the cycle. He/she shall then declare the activities of the inventory cycle started and circulate the MoP and other documents that are needed for the activities.

6.5.3.2 Data Gathering

As soon as the kick-off meeting is concluded, each NSIT shall commence activities (A) data gathering from the respective NSIs that cover their sector. They shall also commence EF data collection from IPCC and national EF databases. Where the national EF database is not yet in place, the sectoral teams shall undertake literature review for new national EF data. They could also visit universities and research institutions with expertise in EF monitoring to update their records. The data gathering phase shall continue throughout the period of inventory computation.

6.5.3.3 Draft Preliminary Report: Data Availability, Quality and Gaps Analysis

The Draft Preliminary Report on A and EF data gaps by source and by GHG/Precursor gases shall be prepared and submitted by the end of M4 for N-NIC mode and M6 for the S-NIC mode based on data availability and quality procedures instructions in the MoP. The File shall be named according to the file naming format approved by the MNITL. The template for the Draft Preliminary Report shall be as contained in relevant section of the MoP. The Draft Preliminary Report shall give an appraisal of new data sources needed to fill subsisting gaps in the inventories data. The NITTL shall oversee the work of each NSIT to ensure that there is agreement with each team on which should be the best source of A data; EF data; the rankings of such A and EF data on a scale of 1 to 5 where 1 is the best and 5 is the least quality data; and assumptions used to finalize the computation of the inventory. The NITTL shall also ensure that this information is comprehensively documented in the Digital Logbook (DLB) created by each NSIT as part of information that would be used for report writing. The template for the DLB shall be as contained in the relevant section of the MoP.

6.5.3.4 Kick-Off GHG Inventories Computation and Analysis

As soon as substantial data is available during this period, each NSIT shall commence emissions computations using the IPCC model chosen by NIMO for the inventory during the cycle (see section 7). The inventory computation shall commence on the first Tuesday of M6 for N-NIC mode and M8 for S-NIC mode based on the data obtained. The computation phase shall continue until all data have been input into the model.

6.5.3.5 First Draft of Template-A Full National Inventory Report

The First Draft of Template-A Full National Inventory Report shall be prepared and submitted by the end of the M9 for N-NIC mode and M11 for S-NIC mode. It shall be named according to the approved File naming format for inventory reports as provided for in sub-section 6.3.2.7, based on the template in the MoP. It shall contain the introductory sections of the NIR or BTR and data on emissions compilation so far. The first updated Draft Preliminary Report shall also be prepared by each NSITL to indicate the current status of A and EF data, existing gaps and the current status of the DLB. The NSITLs shall submit their respective Draft Reports by the second Tuesday of M9 for N-NIC mode and M11 for S-NIC mode to the NITTL for integration into the respective single Draft Reports to be submitted to the NGIC for necessary action by the last Tuesday of M9 and M11 for N-NIC and S-NIC respectively.

6.5.3.6 Second Draft of Template-A Full National Inventory Report

The Second Draft of Template-A Full National Inventory Report shall be prepared and submitted by the last Tuesday of M12 for N-NIC mode and M15 for S-NIC mode. It shall be named according to the approved File naming format for inventory reports as provided for in sub-section 6.3.2.7, based on the template in the MoP. It shall show the subsisting status of inventories compilation and what more remains to be done for the Final Report. Besides the inventories compilation, it shall also contain elements of QC, uncertainty analysis, key source analysis, documentation and archiving, inventory improvement strategies and others as available at this stage of the Report. The second updated Draft Preliminary Report shall also be prepared based on Draft Preliminary Report template to indicate the current status of A and EF data, existing gaps and the current status of the DLB. The NSITLs shall submit their respective Reports by the second Tuesday of M12 for N-NIC mode and M15 for S-NIC mode to the NITTL for integration into the respective single Draft Reports to be submitted to the NGIC for necessary action by the last Tuesday of M12 for N-NIC mode and M15 for S-NIC.

6.5.3.7 Third Draft of Template-A Full National Inventory Report

The Third Draft of Template-A Full National Inventory Report shall be prepared and submitted by the end of the M16 for N-NIC mode and M22 for S-NIC mode. It shall be the second updated report of Template A full National Inventory Report. It shall show the final status of inventories compilation and trends among other elements as provided for in the MoP. The final updated Draft Preliminary Report shall also be prepared based on Draft Preliminary Report template to indicate the final status of A and EF data, existing gaps and the final status of the DLB. The NSITLs shall submit their respective Reports by the second Tuesday of M16 for N-NIC and M22 for S-NIC to the NITTL for integration into the respective single Reports be submitted to the NGIC for necessary action by the last Tuesday of M16 for N-NIC mode and M22 for S-NIC mode. After every inventory cycle, the NITTL shall convert the DLB to PDF files and submit to the NGIC for filing for future reference.

6.5.3.8 NIRGE Review Leading to Fourth Draft of Template-A Full National Inventory Report

Upon receipt of the Draft 3 Template-A full National Inventory Report, the NGIC shall select six reviewers from NCCC's NIRGE portal who were not part of the inventory preparation teams. He/she shall forward the report to the selected reviewers by the first Tuesday of M17 for N-NIC mode and M23 for S-NIC mode. Four of these reviewers shall be assigned the key sectors to review in their areas of competence. The fifth and sixth shall be assigned the entire document for general editorial and technical reviews. The two Reviewers shall ensure that not only are editorial issues highlighted and corrected but that the Document is consistent with the approved format. The NIRGE reviewers shall return their edited Reports to NGIC by the last Tuesday of M17 for N-NIC mode and M23 for S-NIC

mode. The NGIC shall thereafter forward the edited document to NITTL for integration of Reviewer's comments with all NSITLs. The NITTL shall revert with the Fourth Draft of Template-A Full National Inventory Report to the NGIC for necessary action by the first Tuesday of M18 for N-NIC mode and M24 for S-NIC mode.

6.5.3.9 International Review Leading to Final Draft of Template-A Full National Inventory Report

The NGIC shall circulate the Draft 4 Template-A Full National Inventory Report, to the Appropriate Authority under the UNFCCC Secretariat for review in line with the laid down procedures by the Modalities, Procedures and Guidelines (MPGs) for international review by the second Tuesday of M18 for N-NIC mode and M24 for S-NIC mode. He/she shall thereafter forward the international Reviewers' comments when received to NITTL who shall complete the integration of their comments into the Final Draft of Template-A Full National Inventory Report. The NITTL shall re-submit the Final Draft Template-A Full National Inventory Report to the NGIC by the first Tuesday of M19 for N-NIC mode and M25 for S-NIC mode. If by this date, the international Reviewers' comments are not received and there is no assurance of when they would be received, the NGIC shall proceed to use Draft 4 Full National Inventory Report to prepare the Templates B Reports.

6.5.3.10 Draft Templates B National Inventory Reports

The Final Draft or Draft 4 Full National Inventory Report shall be used to prepare the various Templates B reports based on the formats provided in sub-section 6.3.2.7 and the MoP. These Reports are meant for national consumption and not to satisfy Nigeria's obligations under the UNFCCC. They are to be used for public awareness with focus on how the inventory reports align with various economic development and policy issues. It shall be concluded by the second Tuesday of M20 for N-NIC mode and M26 for S-NIC mode.

6.5.3.11 National Stakeholders Workshop

A four-day National Stakeholders Workshop (NSW) shall be held within the second week of M21 for N-NIC mode and M26 for S-NIC mode. The NSW shall be an opportunity for NIMO and NITSI to present the report and trends of inventories in the cycle to national stakeholders as well as give them an opportunity for inputs into the Template A and Templates B reports.

6.5.3.12 Final Reports Submission to the Secretariat for Printing Approval

The final Reports shall be submitted by NGIC to the NCCC Secretariat for printing approval by the second Tuesday of M22 for N-NIC mode and M28 for S-NIC mode. On receiving the printing approval, the NGIC shall proceed to send the report for printing.

6.5.3.13 Final Reports Submission to FEC for Approval

The final Reports shall be submitted to the Federal Executive Council (FEC) by M23 for N-NIC mode and M29 for S-NIC mode. The FEC approval shall provide the authority to transmit the Template-A final report to the UNFCCC secretariat through diplomatic channels and to NIMO to circulate the Templates B final reports for use in conducting public awareness activities nationally.

The competent authorities at the state level shall similarly follow the same approach to prepare, review and approve inventory reports for submission to their respective competent authorities.

7 GREENHOUSE AND PRECURSOR GASES INVENTORY MODELS AND SELECTION CRITERIA

7.1 INTRODUCTION TO GHG INVENTORY MODELS

The emission (E) of GHG and precursor gases is represented mathematically by the relation shown in equation 1.1.

In this regard, the total GHG or precursor gas emissions may be obtained by summing each GHG or precursor gas across sectors and processes. An inventory represents the process where emissions as represented in Equation 1.1 are estimated for all processes across all sectors and then summed for the entire geographical zone which the inventory is meant to cover. Such a process will be repeated for all other GHGs under investigation by the inventory including CO_2, CH_4, N_2O, CO, SO_2, NO_X and NMVOC among others. This implies that computation of the Equation will be undertaken many times before all GHGs, all relevant processes and sectors are covered. In order to obtain solution to the Equation, leading to the preparation of an inventory, all processes leading to the emission of GHG or its precursor gas must be identified and quantified. For each identified process, the activity data (A) and emission factors (EF) data must be established.

There are different models for undertaking national level inventories. The model used for national level GHG inventories is however developed by IPCC to support estimation of emissions by sources and removals by sinks for parties to the UNFCCC.

The purpose and uses of the model include:

i. Assisting in estimating gross and sectoral emissions and identify key sources and sinks;
ii. Providing data for developing and implementing mitigation strategies and policies to reduce emissions;
iii. Evaluating the effectiveness of mitigation measures and tracking progress towards emission reduction goals;
iv. Acting as inputs for atmospheric transport and photochemical transformations to understand the impact of GHG emissions on the climate system; and
v. Generating outputs that assist regulatory agencies and businesses to assess compliance with emission targets as set by their institutions or by Government.

Models that use Equation 1.1. successively to prepare emissions for each greenhouse gas, summed over all the processes and all the sectors and presenting emissions and other relevant data for all greenhouse gases, either over a specific year or over a range of years are called Greenhouse Gas (GHG) Inventory Models. These models quantify and estimate gross annual emissions and emission trends over the geographical entity of interest. Some of the Models go further to assist in prognostic and scenario analyses of how much mitigation would be needed and the associated policies that would be required to achieve low-carbon or carbon–neutral economy over a foreseeable future. There are different categories of inventory models. These include models that provide industrial/facility level, municipal area, sub-national and national level inventories among others. This document is centred on developing the Guidebook that provides the regulatory and institutional arrangement, funding arrangement, define inventory planning and preparation tasks and other associated activities for conducting national and state level inventories based on the IPCC model to meet the TRACCC criteria.

The IPCC has updated and refined its model over the years for parties to the UNFCCC to use in preparing their national GHG inventories. Currently, there are three versions of the IPCC model in existence following various refinements and expanded methodologies and guidelines over the years. They include the IPCC 1996, 2006 and 2019 versions of the Models. The IPCC has also developed guidelines that provide step by step approach on how to estimate emissions for each sector and sub-sector of each version of the model. In addition, IPCC has also developed standalone software based on each version of the model and associated guidelines. These are now standard platforms with input/output (I/O) data interface. The I/O data interface allows users to undertake data entry into the software, quantify and generate emissions and other data that are used to prepare inventory reports.

An overview of each of these versions of the model and the associated software are presented in the sub-section below.

7.2 VERSIONS OF THE IPCC INVENTORY MODEL AND STANDALONE SOFTWARE

As stated in section 7.1 above, IPCC has developed three versions of its national inventories model. Each of these has associated standalone software based on their respective guidelines and methodologies. The software are applications that implement the methodologies and guidelines outlined in each version. They are used for both individual inventory sectors and the entire sectors for national emissions estimate and offer a tiered approach to emission estimation, ranging from simple default emission factors (Tier 1) to more complex, site-specific measurements (Tiers 2 and 3). The sub-section below presents a brief description of the components of the versions of the model, associated sectors and how to download the associated software.

7.2.1 IPCC 1996 Model and Software

7.2.1.1 Model Overview

The IPCC 1996 model and its Guidelines are based on the "Revision of earlier IPCC Guidelines for National Greenhouse Gas Inventories" for NA1 Parties. It was developed in 1996 and has since been used together with the “Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories” (GPG 2000) and the “Good Practice Guidance for Land Use, Land-Use Change and Forestry” (GPG-LULUCF2003). Taken together, they provide internationally agreed methodologies that NA1 Parties use to estimate greenhouse gas inventories to report to the UNFCCC. The three-volume 1996 IPCC Guidelines define the coverage of the national inventories in terms of gases and categories of emissions by sources and removals by sinks, and the GPG 2000 and GPG-LULUCF2003 provide additional guidance on choice of estimation methodology, improvements of the methods as well as advice on cross-cutting issues including estimation of uncertainties, time series consistency and quality assurance and quality control.

7.2.1.2 Sectors Covered

The following are the sectors covered under the IPCC 1996 Model:

i. Energy;
ii. Industrial Processes;
iii. Agriculture;
iv. Land Use, Land Use Change and Forestry (LULUCF); and
v. Waste.

7.2.1.3 Software and Associated Documents Download

The Software and Guidelines could be downloaded from the site below.
https://www.ipcc-nggip.iges.or.jp/public/gl/invs1.html

7.2.2 IPCC 2006 Model and Software

7.2.2.1 Model Overview

At its seventeenth session held in New Delhi in 2002, the Subsidiary Body for Scientific and Technological Advice (SBSTA) under the UNFCCC invited the IPCC to revise the 1996 IPCC Guidelines, taking into consideration the

relevant work under the Convention and the Kyoto Protocol, with the aim of completing the work by early 2006. The IPCC 2006 Model and its Guidelines for National Greenhouse Gas Inventories provide an updated framework for NA1 Parties to estimate their GHG emissions by sources and removals by sinks. The Guidelines are organized into five volumes, offering guidance for inventory development across various sectors of the economy. Volume 1 provides general guidance on inventory development while Volumes 2-5 offer sector-specific methodologies.

7.2.2.2 Sectors Covered

The following are the sectors covered under the IPCC 2006 Model:

i. Energy;
ii. Industrial Processes and Products Use (IPPU);
iii. Agriculture, Forestry and Other Land Use (AFOLU); and
iv. Waste.

7.2.2.3 Software and Associated Documents Download

The Software and Guidelines could be downloaded from the site below.
https://www.ipcc-nggip.iges.or.jp/software/index.html

7.2.3 IPCC 2019 Model and Software

7.2.3.1 Model Overview

The IPCC 2019 Model and its Guideline refer to the 2019 Refinement to the 2006 Model and Guidelines for National Greenhouse Gas Inventories. This refinement was not a complete revision of the 2006 Guidelines but rather an update and improved elaboration, addressing gaps and bringing up improved scientific knowledge for the methods where available. It provides more detailed methodologies for estimating emissions from various sources, including those related to agriculture, land-use change and forestry. It also provides improved methods for estimating emissions from various sources, including halogenated GHG, non-CO_2 emissions from biochar production and emissions from flooded lands. The refinements offer new guidance on how to use the model to report inventories that meet the TRACCC criteria. It does not replace the 2006 IPCC Guidelines but should be used in conjunction with the 2006 IPCC Guidelines and where indicated, with the 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Wetlands (Wetlands Supplement).

7.2.3.2 Sectors Covered

The following are the sectors covered under the IPCC 2019 Refinements similar to the 2006 Model:

i. Energy;
ii. Industrial Processes and products Use (IPPU);
iii. Agriculture, Forestry and Other Land Use (AFOLU); and
iv. Waste.

7.2.3.3 Software and Associated Documents Download

The Software and Guidelines could be downloaded from the site below.
https://www.ipccnggip.iges.or.jp/public/2019rf/index.html.

7.3 SPREADSHEET-BASED INVENTORY TOOLS

Spreadsheet-based tools like macro-enabled Excel and Google Sheets can be used to support programming-like tasks by utilizing built-in formulas and functions to automate inventory calculations, data manipulation and data analysis. These macros act as mini-programmes, allowing users to perform complex operations without writing traditional codes. Macro-enabled spreadsheets have been used to develop the IPCC software based on the respective Guidelines thus enabling them to be used as GHG inventory tools. These tools are used for various purposes, including national GHG inventories, emissions preparation and reporting, scenario analysis and/or sectoral calculations.

The key features include:

i. Data Input Interface: These tools require users to input data on various factors like energy consumption, industrial processes, agricultural activities and waste;
ii. Calculations: The tools perform calculations based on each IPCC Guidelines and methodologies to estimate emissions;
iii. Default Data: They may provide default emission factors and other data from the IPCC Guidelines, allowing users to estimate emissions if country-specific data is not available;
iv. Flexibility: These tools allow users to use their own country-specific information and adjust calculations as needed; and
v. Data Output Interface: The tools generate outputs in formats consistent with the IPCC reporting tables, BUR and BTR.

7.3.1 Early Spreadsheet-Based Inventory Tools

Early development of IPCC-based inventory spreadsheet tools focused on creating macros-enabled spreadsheets that would help countries accurately and efficiently estimate GHG emissions, particularly following the 1996 IPCC Guidelines. These tools, often using spreadsheets were designed to be user-friendly and implement the simpler Tier 1 methods outlined in the IPCC Guidelines. The goal was to provide a standardized approach for national inventories and facilitate reporting by NA1 Parties to the UNFCCC without waiting for sophisticated software. The tools aimed at simplifying the process of data collection, processing and estimating emissions and removals by sinks from various sources.

The challenges and limitations include:

i. Simplicity of Tier 1 Methods: While Tier 1 methods are simpler, they lack the detail and precision of higher tier methods, particularly for more complex or specific sources; and
ii. Data Availability: The accuracy of the inventories depends strongly on the quality and availability of data related to activity and emission factors.

Over time, more tools were developed with more sophisticated features. In summary, the development of early IPCC-based inventory spreadsheets tools was a crucial step in opening the access of many NAI Parties to undertake GHG inventories using simple and reliable tools.

7.3.2 Recent Spreadsheet-Based Tools for Sectoral Inventories

There are several spreadsheet-based tools for sectoral inventories in line with the IPCC Guidelines that are available and many more are still being developed. Although most of them cover sectoral emission calculations, there are few that cover all sectors in one model. Some recently developed sectoral inventory tools include:

i. CGIAR SECTOR: A tool developed by CGIAR for estimating GHG emissions from cropland, based on the IPCC Tier 2 approach;

ii. Spreadsheet Templates for Livestock Emission Sources: Templates developed by FAO (2020) for calculating emissions from livestock, including enteric fermentation, manure management, and direct/indirect N_2O emissions from soils. Find the link to the templates as follows: FAO and Global Research Alliance on Agricultural Greenhouse Gases. 2020. Livestock Activity Data Guidance (L-ADG): Methods and guidance on compilation of activity data for Tier 2 livestock GHG inventories. https://doi. org/10.4060/ca7510en, Available at: https://openknowledge.fao.org/server/api/core/bitstreams/8fcb2863-d094-4698-a5b1-fa505877c8ec/content
iii. GHG Protocol Calculation Tools: GHG Protocol has published series of excel tools for sectoral emissions calculations. The full list of tools can be found and downloaded at: https://ghgprotocol.org/calculation-tools-and-guidance?ap3c=IGXmCH6WDeDPomoEAGXmCH6mIt-Db9NCNH00dmje0ZqebCmgPw

7.3.3 Benefits of Spreadsheet-Based Sectoral Tools

i. User-Friendliness: Spreadsheets are generally easy to use and understand;
ii. Data Flexibility: Users can easily customize and adjust the models to fit their specific needs and data availability;
iii. Data Completeness: When some sources in the country are not listed in the IPCC models, such sources can be captured in the spreadsheet tools, thus satisfying the completeness criteria; and
iv. Opportunity for Multi-Year Inventories: These tools can be designed with flexibility for adding Activity and Emissions data for many years in one spreadsheet which is not possible with the existing IPCC software.

7.4 SPREADSHEET-BASED COMPLETE IPCC INVENTORY TOOLS FOR ALL SECTORS

7.4.1 Introduction to RISQ: An MRV Tool for Inventories

Drawing on its national experience, **the Centre Interprofessionnel Technique d'Etudes de la Pollution Atmosphérique (**CITEPA. https://www.citepa.org**)** supports national GHG inventory focal points in developing countries in implementing their national inventory systems that comply with MRV rules. The Resource for Inventory Safety and Quality (RISQ) tool, inspired by the French model, was developed to enable signatory countries of the Paris Agreement to meet the obligations of the ETF and facilitate the monitoring, reporting and verification of pollutant and greenhouse gas emissions (https://www.citepa.org/expertise-et-solutions/accompagnement-et-renforcement-des-capacites-a-linternational/risq/). As part of its work to strengthen the capacities of developing countries, CITEPA has designed and developed an inventory data management tool available in three versions depending on the progress of the countries, their expectations and their organisation:

i. Excel;
ii. Access; and
iii. The web.

This is to allow wider sharing of consultations and development by stakeholders.

The purpose of this tailor-made RISQ tool is to help countries meet their obligations in terms of estimation, reporting and verification, which is for example compatible with the Climate Convention and the Paris Agreement. Nigeria is one of such countries where the RISQ MRV tool, inspired by the French inventory tool could be deployed. It also allows comparisons between inventory editions, facilitation of tracing of non-conformities and various types of data visualization, adjusted to national information and inventory systems. Equipped with QA/QC modules, possible spatialization, RISQ operates in inventory mode and projection mode. If adopted, this would be brought as one of the tools for inventory preparation in Nigeria.

7.4.2 How to Install and Use the Input/output Interface Module for IPCC Inventory Models

The RISQ tool if adopted shall be distributed during the kick-off meeting with training later on installation and setup.

7.5 CRITERIA FOR SELECTING IPCC MODELS

The selection of the national GHG inventory models and tools to be used for a specific NIC is guided by several criteria including the need to satisfy the TRACCC criteria. Satisfying these criteria is mandatory in ensuring robust and reliable emissions data for reporting. Selecting the most appropriate version of GHG inventory model and tool for use in preparing inventories at national and state levels therefore involve balancing the need to achieve the TRACCC criteria with the availability of data, resources and the specific needs of the country or state. Specifically, since each IPCC model's accuracy increases from the earliest to the latest version, it means that accuracy and satisfaction of TRACCC criteria are best achieved with the latest version available. However, where national data, human and other resources are constrained to the extent where the latest IPCC model may not be easy to use, resort to an earlier IPCC model may be considered. Based on available data provided in immediate past inventories, the NITTL shall bring a report on the data availability, quality and gaps analysis based on the MoP used for each of the NICs. This report shall be presented to the NGIC for consideration and presentation at the MNITL. Based on available data, the MNITL shall take a decision and approve which version of the IPCC model shall be used during the next NIC. After this, another decision on whether to directly use the IPCC software or a comparable spreadsheet-based tool shall also be taken by the MNITL. Running both IPCC software and spreadsheet-based tools concurrently would in special circumstances, provide an opportunity for intercomparison of their outputs.

The first rule of thumb is that once a particular IPCC model has been used, future inventories shall be based on that model or new models. The inventory management system shall be such that new versions shall be better than the immediate past version used without recourse to going back to use an earlier version of the model. The second rule of thumb is that the NGIC and NITTL shall continue to assess the data gaps and data quality in future inventories. As soon as the data quality is improved to use newer IPCC models or higher tier of the subsisting model or newer version, a recommendation shall be made for approval by MNITL to shift to higher tier inventory or newer IPCC model or both.

The competent authorities at the state level shall similarly follow the same approach for selection of IPCC models and spreadsheet-based tools for their respective inventory reporting for each NIC.

8 BACKUP RESEARCH TO ENHANCE THE QUALITY OF GHG INVENTORIES

8.1 INTRODUCTION

National GHG inventories provide a valuable snapshot of GHG emissions by sources and removals by sinks at global, regional national or sub-national levels for a given year and emission trends over time. Inventories quality is built on the premise that in all aspects of preparing and undertaking the inventories, the TRACCC criteria are met. Inventory reports are expected to highlight countries' key sources of GHGs, quantify the uncertainty of these estimates, present information to verify whether climate policies are adequate to provide the intended outcome and highlight the strategies for improving their quality. Parties to the UNFCCC are now mandated to begin submitting a Biennial Transparency Report, with varying responsibilities for AI and NAI Parties (Hanle and Alcobé, 2023). The BTR is expected to include GHG inventories and related information to demonstrate the contribution of countries in planning and implementing activities aimed at establishing their NDCs on the one hand, and the year when they are expected to reach their peak and net zero emissions respectively on the other.

The need for accurate GHG inventories has been highlighted by Lim et al (1999) and others. These include:

i. Implications for monitoring and verification of commitments under the Kyoto or succeeding Protocols such as the Paris Accord; and
ii. Impact on the design and participation of Parties in any emission trading system and other emission reduction mechanisms.

The quality of GHG inventory outputs by Parties whether AI or NAI are used internationally by institutions undertaking climate modelling as one of the inputs to their climate models. The global climate models will therefore get closer to reality if the GHG inventory quality is enhanced across all Parties to the UNFCCC and similarly further away from reality if the GHG inventory quality is poor. As the global community awaits future climate change projections, the quality of inventories is strongly tied to such climate projections which is the driver for a wide range of potential future vulnerabilities, impacts and adaptations. It is also pertinent to note that economic efficiency is now tied to the production and consumption activities that are associated with increasingly low-carbon to carbon-neutral emissions. This is one of the measures of the efficiency at which production and consumption activities evolve with time in relation to GHG emissions in any economy.

In Nigeria, the quality of national GHG inventories is affected by a combination of factors. These include use of IPCC default EF values across board with very limited nationally determined EF values available. Such challenges cut across all sectors including energy, IPPU, agriculture, LULUCF and waste, and conversely for point sources, line sources and area sources within each of the sectors. Similarly, the quality of activity data is also considered low following the fact that published data of NSIs show varying data gaps from year to year. This is because such data were primarily not collected with GHG inventory issues in mind. The data also do not have adequate segregation needed in some sectors and sub-sectors including livestock sub-sector of agriculture where ruminants do not have segregation for male, female, lactating adults and other sub-categories which have different EF values from adults; and for LULUCF sector where ground truthing data are not available for soil carbon, annual litter loads, above and below ground biomass stocks, annual growth rates for standing and underground biomass, C and N contents of living and dead biomass, biomass harvests with time across the different forests and savanna zones of Nigeria. In the energy sector, the only record for petroleum products consumption is the total consumption of each petroleum product without segregation to what is consumed by road transport, inland navigation, private generators and electricity generation among others. This leaves tremendous burden on how to segregate such data to fit into the data structure required by IPCC models. It is for this reason that Nigeria has only been able to use the tier 1 approach to report its inventories and is stuck with inability to migrate to higher tier approaches due to inadequate data. This means that new approaches for establishing national level EFs across sectors and sub-sectors must be undertaken. These are to be carried out through systematic research. The sub-sections below identify in summary some backup research areas which Nigeria would need to undertake subject to availability of

funds to improve the quality of its inventories. Beyond the EF values, the current poor EF and activities data call for the need to develop data archival and retrieval system to support GHG inventories management. There is also a sub-section that is not directly an inventory improvement strategy but a programme to commence the monitoring of atmospheric concentrations of GHGs beyond urban areas atmospheres. Such measurements are expected to build capacity to undertake atmospheric concentration measurement in pristine atmosphere (i.e. well mixed atmosphere far removed from urban centres).

8.2 RESEARCH TO EXPAND THE SCOPE AND INCREASE THE QUALITY OF EMISSION FACTORS

8.2.1 Source Testing

There are very few source testing activities that have established national EF values in Nigeria over the last four decades despite the expanding economic activities in all sectors. Despite the death of EF data, the number of sources continue to increase as the economy expands. Source testing will therefore require measurement of EF values in the following categories.

8.2.1.1 Point Sources

Emission factors for point sources have to be measured using a combination of emission monitoring systems for stationary sources. These would include determination of source profile, excess air and flue-gas flowrate among others; and used in establishing EF values for all GHGs. Standardized mobile emission monitoring stations among others for point sources would be required for this activity. The key sectors of interest here would be energy, IPPU and where incinerators exist, the waste sector.

8.2.1.2 Line Sources

Emission factors for line sources have to be measured using a combination of stationary and on-board emission monitoring systems for line sources. These would include determination of source profile, excess air and flue-gas flowrate among others; and used in establishing EF values for all GHGs. Standardized mobile emission monitoring stations for road vehicle fleet, inland waterways craft fleet and civil aviation fleet by each fleet class would be measured. Fleet of military vehicles including those on land, air, inland waterways and sea, deployed for combat purposes would similarly be measured where possible. The vehicles in each fleet defined by weight, fuel and associated technology adopted shall be required for this activity. The key sectors of interest here shall be the different transportation sub-sectors of the economy.

8.2.1.3 Area Sources

Emission factors for area sources have to be measured using standard procedures that is in mobile source testing stations for stacks of facilities that are below the category of point sources, generator exhaust pipes, home appliances among others. Standardized mobile emission monitoring stations for area sources shall be required for this activity. The key sectors of interest here shall be energy, IPPU and where incinerators exist, for the waste sector. Besides these, specialized arrangements for monitoring EF values in the agriculture, LULUCF and waste sectors excluding incineration would also be undertaken.

8.2.1.4 Fugitive Sources

Specialized arrangements would be made to measure CH_4, NMVOCs and total VOC emissions associated with leak-modules in the energy, IPPU and any other relevant sector. This shall require specialized equipment for VOC

monitoring and leak measurements from flanges, valves, among other leak modules on facilities like crude oil and natural gas well-heads, pipelines, storage facilities, gas treatment facilities, natural gas processing plants among others in the oil and gas sector. Others include filling stations, vehicle fuel tanks and similar modules in the road transport, inland water waste transport, civil aviation among others.

8.2.2 Emission Factors Modelling

Emission factors modelling shall be undertaken through detailed understanding of process flows in energy, IPPU sectors as well as incinerators among others. To a limited extent, such models could be extended to emissions from livestock, crop production, LULUCF and waste.

8.2.3 Research on Emission Factors in Agriculture, LULUCF and Waste

8.2.3.1 Emission Factors from Agriculture

Research on EF values in agriculture focuses on estimating the GHG emissions associated with various agricultural activities. These include crop production, livestock and land use and land cover changes. The assessment of these values is crucial in improving the accuracy of the estimates in the sector.

The following are the key areas of EF values research in this sector:

i. Crop Production: Researches under this heading are to explore the estimation of EF values associated with fertilizer use, tillage practices, pesticide application and crop residue management among others;
ii. Livestock: Research under this heading would include the estimation of CH_4, emissions from enteric fermentation and manure management in each livestock type and sub-types including adults, juvenile, lactating adults among others;
iii. Land Use and land cover Change: Research would investigate EF values associated with deforestation, land clearing and conversion of land to agricultural use, focusing on changes in carbon stocks and soil organic matter;
iv. Emission Factor Development and Refinement: Researchers are expected to develop and refine EF values for different agricultural practices and localities across Nigeria's agro-ecological zones, considering factors like climate, soil type and farming systems; and
v. Uncertainty Analysis: Research would also address uncertainties associated with emission factor estimates, including variability in agricultural practices, regional differences and measurement techniques.

Challenges in estimating EF values include:

i. Data Scarcity: Obtaining accurate data on agricultural inputs, outputs and emissions remains challenging in Nigeria and research to provide new data and reduce data scarcity is imperative;
ii. Variability in Farming Practices: Emission factors can vary significantly from one agricultural practice to the other, making it difficult to develop generalizable estimates. The development of EF values associated with each agricultural practice therefore becomes imperative;
iii. Differences across Agro-Ecological Zones: It is known that EF values could vary significantly going from one agro-ecological zone to the other due to differences in local climate, soil type and agricultural practices. The need to investigate changes in EF values across the zones therefore become imperative; and
iv. Model Complexity: Some complex emission models while providing more accurate estimates, can be computationally demanding because there are no studies that have been carried out locally to investigate some of the indices such models require. The development of this index is therefore necessary for those complex models to be used to estimate improved EF values according to the model requirement.

8.2.3.2 Emission Factors from LULUCF

There is a dearth of data on emission factors in the LULUCF sector generally in Nigeria. New research is therefore needed to bridge this gap in knowledge. Research on EF values in LULUCF shall focus on quantifying the GHG emissions by source and removals by sinks associated with land management practices and land cover changes which are crucial for accurate carbon accounting and the pathway for optimal mitigation strategies. There is need to measure EF values that could then be used to estimate the amount of GHG released or absorbed from a specific activity, such as deforestation, forest growth or changes in agricultural land use.

The following are the key areas of EF values research in this sector:

i. Quantifying carbon stocks in different land use and land cover types: This involves determining the amount of carbon stored in above and below ground biomass, soil, and peatlands. This shall involve measurements of biomass stock in turns of biomass per hectare and the carbon content of this biomass by land use types in different agro-ecological zones;
ii. Developing EF values for various land cover changes: There is need to develop EF values associated with conversion of land from one land cover type to another in each agro-ecological zone. This shall include determining the EF values for deforestation, conversion of forest to cropland, establishment of tree crop plantations among others;
iii. Analysing the impact of land management practices on carbon EF values: Investigating the effects of forestry practices like thinning, harvesting and afforestation on EF values associated with carbon emissions and removals;
iv. Carbon accounting associated with disturbances: Assessing the impact of fires, pests and diseases on carbon storage and emissions shall be undertaken using specialised research methods; and
v. Developing methods for estimating EF values associate with specific land use/land cover types and activities: This includes developing models and tools for estimating EF values from agricultural lands, wetlands and urban areas.

8.2.3.3 Emission Factors from Waste

Research on EF values in the waste sector focuses on quantifying GHG emissions, particularly CH_4 and CO_2 from various waste management practices. These include landfilling, incineration and wastewater treatment. The studies would use EF values which are quantitative estimates of GHG emissions per unit of activity (e.g., tons of waste, volume of wastewater). The goal is to improve the accuracy of GHG inventories, understand the impact of different waste management techniques and establish policies and strategies for reducing waste-related emissions.

The following are the key areas of EF values research in this sector:

i. Landfills: Landfills are a major source of CH_4 emissions. The research shall focus on estimating CH_4 EF values in landfills, accounting for factors like waste composition, landfill age and gas collection efficiency;
ii. Incineration: Incineration of waste can contribute to non-CO_2 emissions such as CO, CH_4, NO_x and NMVOCs among others. Estimates of EF values from CO_2 emissions can also be considered when the waste used for incineration contain a known percentage of plastics and other waste streams that originate from the petroleum sector. Research examines the efficiency of different incineration technologies and the impact of different waste streams on these emissions;
iii. Wastewater Treatment: Wastewater treatment, particularly anaerobic digestion, releases CH_4 into the atmosphere. Researchers would investigate CH_4 EF values from wastewater treatment processes and the potential for reducing these emissions through improved treatment technologies;
iv. Emission Factor Development: Some of the EF value estimates for different waste streams and management practices would take into account factors like waste composition and geographical location;

v. Life Cycle Analysis: In some studies, researches would employ life cycle analysis (LCA) methods to assess the overall environmental impact of waste management. This would start from waste collection, transportation and processing;
vi. Regional and National Studies: Researchers would conduct studies at state, geopolitical zones and national levels to assess GHG emissions from the waste sector and identify the right policies to be used to enhance mitigations; and
vii. Data Collection: There would be specific studies that would focus on developing EF values based on specific data collection methods for waste-related GHG emissions. This would include using supplier-specific data, waste-type-specific data and average data.

8.2.4 Other Emission Factor Estimates

Besides the approaches used for EF value measurements in sub-section 8.2.1 and EF value modelling in sub-section 8.2.2, there may be other specific EF value measurements and modelling. These would be investigated and where the conceptual framework is found to be adequate, the additional EF values would be measured or modelled.

8.3 RESEARCH TO IMPROVE QUALITY OF ACTIVITIES DATA

The impact of the quality of activities data on emission estimates appears to be higher than those of EF values. This is because even when all EF values used are default IPCC values, national EF values when measured may not differ from these default values by more than 10 – 20 %. However, activities data values from different source could sometimes reach 100% or more especially for sources were the assumptions made are not provide. Research to improve the quality and fill gaps in activities data are required across all sectors. Some key areas of potential focus are presented below.

8.3.1 Research on Modelling Indicators to Estimate Missing Activities Data

Some activities data could be estimated using specific modelling indicators. Such modelling indicators rely on known parameters like population where known information on per capita waste generation can be used to estimate the total waste generated by volume or by mass. Known estimates of per capita fuel wood extraction for different ecological zones of the country could also be used in conjunction with the population of these zones to estimate annual gross fuel wood extraction nationally. Similarly, diesel or gasoline consumption per vehicle kilometre travelled (VKT) could be used to estimate the total diesel or gasoline consumption when the total kilometres travelled by all vehicles is known. Therefore, per capita waste generation, per capita fuel wood extraction and gasoline and diesel consumption per VKT are examples of modelling indicators that could be establish by research and used to estimate gross waste generation, gross fuel wood extraction and total gasoline consumption among other activities data.

There is a wide range of modelling indicators that could be related with certain activities data and when such modelling indicators are established, they form the basis for estimating activities data with a certain range of accuracy. Research on a wide range of modelling indicators are therefore needed for individual processes across all sectors which could be used to estimate activities data for such processes. When a modelling indicator has been established for a small region (state, municipal authority etc.), such an indicator could then be used to establish the activities data at the national level. A wide range of such studies would need to be undertaken in different parts of the country and used to bridge the gap in the national activities data.

8.3.2 Appraisal of Land Cover, Land Use and Land Use Change through Mapping and Ground Truthing

The Forestry Management, Evaluation and Coordinating Unit (FORMECU) in 1994 had a joint project with the consortium of Geomatics International Inc. of Canada, Beak Consultants Limited of Canada and Unilag Consult of Nigeria. The Project undertook an 'assessment of vegetation and land use changes in Nigeria between 1978 and 1993'. The project duration was between 1993 and 1995. For ease of coordination, Geomatics International was assigned the lead role for the contractors. The objectives of this project were to: 1) assess and evaluate the available data on land use and vegetation changes and their interrelationships; 2) identify data gaps; 3) develop programs for the production of reliable and up-to-date information on vegetation changes and degradation over time; and 4) develop and implement a GIS database for Nigeria. This database contained polygon and point information in raster and vector formats that were used in the analysis of trends in the extent and intensity of changes in vegetation and land use and to evaluate the socio-economic effects of these changes over time. Although the project was relatively successful, a major demerit was that ground-truthing of biomass stocks was not included as part of the scope of the project. Therefore, the project could not establish biomass loads per unit area in turns of standing biomass per hectare as well as other above ground and below ground biomass, among other indices that are needed to estimate carbon loads in the LULUCF sector. Furthermore, there is no information whether studies of similar scope and magnitude have been done since 1995. That is approximately 30 years after the FORMECU study. Where such new data is not available, it is important that new mapping and research be done in this area to establish land cover and land use changes as well as ground-truthing for biomass loading across the geo-spatial space over Nigeria. This would enable new data for activities in the sector to be established.

8.3.3 Other Potential Research Areas

There are other potential researches that needs to be done to improve the quality of activities data. This kind of research needs to be appraised and resources to finance them need to be sought for to ensure that more gaps in the activities data are filled in all sectors nationally.

8.4 NATIONAL DATABASE DEVELOPMENT TO SUPPORT INVENTORIES

In order to be able to provide efficient compilation, management and analysis of GHG emissions data which are essential for assaying future climate scenarios, understanding atmospheric GHG concentrations, developing mitigation strategies and ensuring compliance with regulations among others, the development of GHG associated database is an important step in any organized management of inventories. This is because databases play crucial roles in emission inventories management. They provide organized systems for data storage, retrieval and analysis of emissions-relevant data from various sources.

The role of databases in emission inventories among others include:

i. Data Storage and Retrieval: Databases serve as the central repository for all emission inventory data, including information on greenhouse and precursor gases, emission sources, activity levels and emission factors. Such organized storage allows for easy access and retrieval of data as needed;
ii. Data Compilation and Aggregation: Databases facilitate the collection and aggregation of data from various sources, such as industry reports, statistical data and monitoring data. This allows for a comprehensive overview of emissions from different sectors and locations;
iii. Data Analysis and Modeling: Databases enable the analysis of emission data to identify trends, patterns and key sources. This information is among what is needed for developing effective atmospheric concentrations models and predicting the impact of various mitigation measures;
iv. Reporting and Compliance: Databases are used to generate reports and provide data for regulatory compliance, ensuring that organizations can meet reporting requirements and track their progress towards emission reduction goals; and

v. Collaboration and Data Sharing: Databases are useful in facilitating collaboration and data sharing among different stakeholders, including businesses, regulatory agencies and research organizations. This can improve the quality and consistency of emission data.

Research on database development is therefore sine qua none for any systematic GHG inventories management. The research programmes would among others include the following categories of databases:

i. Emission Factors Information System (EFIS); and
ii. Sectoral Activities Data and Modelling Indicators System (SAMIS)
iii. Socio-Economic Data System (SEDS).

For each of the above, data systems would have an associated Query, Import and Export function. If and when these are developed, they shall become a valuable asset to the inventory management programme in the future.

8.5 ATMOSPHERIC CONCENTRATIONS OF GHG AND PRECURSOR GASES MONITORING RESEARCH

The atmospheric concentrations of GHGs, precursor gases and other atmospheric pollutants are continually evolving. The current general understanding is that the concentrations of these gases are systematically increasing in the atmosphere. Increasing concentrations of GHGs and precursor gases in particular affect the atmospheric energy balance meaning that the total radiant energy from the sun received by the earth will no longer be balanced by the total radiant energy transmitted by the earth system into the outer space. The deficit in the atmospheric energy balance occurs because GHGs absorb some of the outgoing long wave radiant energy from the earth to outer space creating what is now generally known as global warming. Global warming then exacerbates global and regional climate change, now one of the world's biggest developmental challenges since substantial part of the GHG emissions in the atmosphere are from anthropogenic activities.

Long-term monitoring of atmospheric concentrations of GHGs and precursor gases is the key step in understanding the evolution of these concentrations in recent times, in comparison with historical values. It also provides the basis for estimating the rate of increase in concentrations and how these could affect future climate. As atmospheric concentrations are currently increasing, the expectation is that if mitigation activities globally are yielding effective results, the rate of increment of atmospheric concentrations should gradually decrease until it reaches a turning point (peak value) when the concentrations would start decreasing. That turning point will be a time of monumental success for the current inventories and mitigation management programmes. Once this turning point is surpassed, the concentrations would gradually decrease until the world attains the ultimate objective of the UNFCCC which inter-alia is to stabilize GHG concentrations in the atmosphere at a level that will prevent dangerous anthropogenic interference with the climate system, in a time frame which allows ecosystems to adapt naturally and enables sustainable development to occur.

Atmospheric concentrations monitoring is a very long-term research programme which Nigeria is encouraged to participate in order to be able to remain at par with other countries regarding the level of success of mitigation activities as reflected by atmospheric concentrations dynamics with time. Such a programme is expected to build national capacity (human and infrastructure) to participate in such measurements, possibly under the World Metrological Organisations (WMO) Background Pollution Monitoring (BAPMON) programme. The BAPMON programme is generally undertaken in pristine atmospheres far removed from urban centres and other locations where human activities are active. They are meant to measure concentrations in well mixed atmospheres in what may be regarded as global average concentrations. There would be a need to select a site that fits the demand of the site for BAPMON programme monitoring centre, undertake training and acquire needed monitoring facilities as well as undertake analysis of data associated with the programme to establish trends.

8.6 OTHER RELATED AREAS OF RESEARCH

There are a wide range of other research areas that are not related to issues included in sub-sections 8.2 to 8.5. These include development of models to support emission inventories at facility, street and municipal areas, among others. It would also involve the development of inventory estimation procedures based on new improvements provided by science. These and many more would be required to ensure that Nigeria participates in broader range of research activities rather than remain a consumer of research products from other countries. Such research would on the one hand, add value and depth to other researches already described in the sub-sections above while on the other, it would enable Nigeria reduce dependence on imported products as a means of narrowing its trade balance with other countries.

8.7 IMPLEMENTATION STRATEGIES

The success of the research programmes discussed in summary in sub-sections 8.1 to 8.6 depends on a number of issues. The key ones include the strategies for scoping and funding each programme with clear objectives and what the expected outputs would be. The second major issue is the strategy for managing each of the research programmes to ensure that the objectives and expected outputs are achieved. The following sub-section provides in summary the proposed implementation strategies that would ensure success.

8.7.1 Funding Arrangements

The objectives and arrangements for funding inventory research are provided in sub-section 4.3.18. It has also indicated that funding will come through national and donor grants with Federal and State components as stipulated in sub-sections 5.4.1 and 5.4.2 respectively. The sub-sections below identify the grants and how they would be utilised.

8.7.1.1 National Funding

Annual appropriations for research shall be derived from the NIF as stipulated in sub-section 4.3.18 (iv) with the Federal component as provided for in the ratio between national and state appropriations in sub-sections 5.4.1. and 5.4.2. The Federal component would then be used to support two categories of research grants namely; the Small and Medium Federal grant programmes as stated below. Share of Funds between the two Grants shall be as stipulated 4.3.18 (vi).

i. Small Federal Grant Programme (SFGP): This shall be used to issue the Request for Proposal (RFP) for a number of projects which can be applied for by individual researchers or teams up to a maximum of five. The Team shall have a Leader who shall be the responsible Officer for the Project. The focus for the SFGP shall cover any of the issues in sub-sections 8.2 to 8.6 above with maximum budget per project as in the RFP. SFGP shall have minimum need for facilities and models purchase. Priority shall be given to individuals or teams that already have some of the basic facilities for the proposed research. The grants shall be used for purposes for which the RFP was made and for the approved activities in the proposal. Teams are expected to be Nigerian nationals working in universities and other research institutions. The Terms of Reference (TOR) for SFGPs shall be provided in the RFP.

ii. Medium Federal Grant Programme (MFGP): This shall be used to issue the RFP for a number of projects which can be applied for by research Units[3] of universities and other research institutions in Nigeria. The research Unit shall be identified with a Leader who shall be the responsible Officer for the Project. The research focus for the MFGP shall cover any of the issues in sub-sections 8.2 to 8.6 above with maximum budget per project as in the RFP and shall have higher need for facilities and models purchase. Research Units that already have some research facilities to support the grants or who show that they have access to such facilities outside

[3] Research Units of universities and other research institutions shall include Units of a Department, Departments, research centres/institutes and shall exclude Consultancy Services Units.

their Units shall be given higher priority. Research Units in different institutions can also associate to apply. The grants shall be used for purposes for which the RFP was made and for the approved activities in the proposal. The TOR shall also be provided in the RFP.

Similarly, the States component would also be used to support two categories of research grants namely; the Small State Grant Programme (SSGP) and Medium State Grant programme (MSGP). Both Programmes shall operate in same manner as the Federal Grants Programmes above.

8.7.1.2 Funding from Donor Institutions

Funding from donor institutions shall comprise funds from international donors and or public and private sector entities in Nigeria outside the national appropriation to the CCF as national donor institutions. Annual appropriations for research shall then be derived from the NIF as stipulated in sub-section 4.3.18 (iv) with the donor component as provided for in sub-sections 5.4.1 and 5.4.2. It shall consist of small, medium and large grant programmes. Share of Funds among the three Grants shall be as stipulated 4.3.18 (vi).

i. Small Donor Grant Programme (SDGP): This shall be used to issue the RFP for a number of projects which can be applied for by individual researchers or teams up to a maximum of five. The Team shall have a Leader who shall be the responsible Officer for the Project. The research focus for the SDGP shall cover any of the issues in sub-sections 8.2 to 8.6 with maximum budget per project as in the RFP. SDGP shall have minimum need for facilities and models purchase. Priority shall be given to individuals or teams that already have some of the basic facilities for the proposed research. The grants shall be used for purposes for which the RFP was issued and for the approved activities in the proposal. Teams are expected to be Nigerian nationals working in universities and other research institutions. The TOR shall also be provided in the RFP by the donor in consultation with NIMO.

ii. Medium Donor Grant Programme (MDGP): This shall be used to issue the RFP for a number of projects which can be applied for by research Units of universities and other research institutions in Nigeria. The research Unit shall be identified with a Leader who shall be the responsible Officer for the Project. The focus for the MDGP shall cover any of the issues in sub-sections 8.2 to 8.6 with maximum budget per project as in the RFP and shall have higher need for facilities and models purchase. Research Units that already have some research facilities to support the grants or who show that they have access to such facilities outside their Units shall be given higher priority. Research Units in different institutions can also associate to apply. The grants shall be used for purposes for which the RFP was issued and for the approved activities in the proposal. The TOR shall also be provided in the RFP by the donor in consultation with NIMO.

iii. Large Donor Grant Programme (LDGP): This shall be used to issue the RFP for a number of projects which can be applied for by research Units of universities and other research institutions in Nigeria. The research Unit shall be identified with a team Leader who shall be the responsible Officer for the Project. The focus for the LDGP shall cover any of the issues in sub-sections 8.2 to 8.6 with potential for high national impacts across geopolitical zones or the entire country with maximum budget per project as in the RFP. The projects shall have the highest need for facilities and models purchase. Research Units that already have some research facilities to support the grants or who show that they have access to such facilities outside their Units shall be given higher priority. Research Units in different institutions can also associate to apply including an offshore research institution (who may not serve as the lead institution) in one of the donor countries for projects that might require technology transfer. The grants shall be used for purposes for which the RFP was issued and for the approved activities in the proposal. The TOR shall also be provided in the RFP by the donor in consultation with NIMO. The Federal and State components of the donor funds shall be derivable from the application of sharing formular from sub-section 5.4.1 and 5.4.2 respectively.

8.7.2 Project Management Arrangements

8.7.2.1 National Funding

Overall management of the grants shall be under the direction of the Council represented by NIMO. The NITTL shall propose the detail TOR for each national grant type for approval by NGIC. When approved, the NGIC shall working with the NITTL issue call for proposals whenever funds are available. The NITTL shall oversee the research activities to ensure that they meet the TOR of the grants and that expected objectives and outputs are achieved.

8.7.2.2 Donor Institutions Funding

The management of the grants shall be under the direction of the Council represented by NIMO. The donor institutions shall propose the TOR details and fund management arrangements in consultation with NIMO. On project approval by the donor institutions, the NGIC shall working with the NITTL issue call for proposals. The NITTL shall oversee the research activities to ensure that they meet the TOR while NIMO shall be responsible for ensuring that the grant is implemented in compliance with management arrangement and that expected objectives and outputs are achieved.

The competent authorities at the State level shall similarly follow the same approach for project management and funding at the state level.

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9 GLOSSARY

Accuracy	This is a relative measure of the exactness of an emission/removal estimate. Estimates should be "accurate" in the sense that they are systematically neither over nor under true emissions or removals, as far as can be judged, and that uncertainties are reduced as far as practicable.
Ambient Air Quality	Compounds emitted into the atmosphere from sources undergo atmospheric transport, mixing and photochemical transformation until they attain steady state atmospheric mixing values called ambient air concentrations (atmospheric mixing values) of the compounds in the atmosphere.
Area Sources	Sources that fall outside the point and line source categories are defined as area sources. Area sources can refer to sources over an administrative area or grid, which do not meet the definition of point or line sources.
Board	This means the Board of the National Council on Climate Change, Federal Republic of Nigeria and its highest policy making organ.
CO_2e	Means carbon dioxide equivalent emissions. It combines the climate-warming potential of different greenhouse gases into a single metric representing the emissions of all greenhouse gases estimated in the report, expressed as the equivalent amount of CO_2 that is emitted by the combined greenhouse gases.
Comparability	Estimates of emissions and removals reported in inventories should be comparable among Parties and between national teams which means that appropriate recommended source categories, methodologies, definitions and units for activity data and emissions factors are used and that the instructions in the latest IPCC Guidelines and IPCC Good Practice Guidance documents are followed.
Completeness	An inventory shall cover all sources and sinks in the full geographical area covered by the inventory (National, State, Municipality etc.), and all greenhouse and precursor gases included in the latest IPCC Guidelines for National Greenhouse Gas Inventories, in addition to other existing relevant source/sink categories which may be specific to the individual Parties to the UNFCCC (and therefore may not be included in the IPCC Guidelines).
Consistency	All inventories shall be internally consistent, which means that same methodologies and assumptions shall be used for all years and that emission estimates or removals from distinct sources that rely on the same type of information and assumptions shall be deduced from the same data sets.

Council	This means the National Council on Climate Change, Federal Republic of Nigeria comprising the board and the secretariat of the Council.
Criteria Air Pollutants	These are traditional air pollutants (primary or secondary) associated with point, line and area sources and usually used in establishing the air quality criteria of urban and rural areas. The Federal Ministry of Environment is yet to specify what constitutes CAPs in Nigeria. However, the following listing is recommended based on experiences elsewhere: Particulate matter (PM), including the total suspended particulate (TSP), as well as respirable fractions: PM_{10}, $PM_{2.5}$, and PM_{1}; Carbon monoxide (CO); Volatile Organic Compounds (VOC); Nitrogen dioxide (NO_2); Sulphur Dioxide (SO_2); and Ozone (O_3).
Emission Inventories	The process for establishing emissions from sources using standardized methods for any locality, state or country for the purposes of establishing trends and contribution by sector in an economy, managing risks associated with the emissions, identifying reduction opportunities, participating in voluntary or mandatory emissions management programmes, participating in emissions trading markets, and achieving recognition for early voluntary action.
Emissions from Sources	The mass of each array of compounds emitted from sources based on their associated emission rate (emissions per unit time) multiplied by time or based on the emission factor (emissions per activity) multiplied by the associated activities data (throughput x time) of the source. Emissions for GHGs would be established for CO_2, CH_4, N_2O, etc.
Excess Air	In undertaking stack emission measurements, the standard is to ensure that the plume has an oxygen content of 3% or that the emissions are reported at the standard plume-oxygen concentration of 3%.
F-Gases	Fluorinated greenhouse gases or F-gases, are a group of man-made, synthetic gases containing fluorine. They comprise Hydro-fluorocarbons (HFCs), Per-fluorocarbons (PFCs), Sulphur Hexafluoride (SF_6) and Nitrogen Trifluoride (NF_3). They are powerful greenhouse gases that contribute to greenhouse effect with global warming potentials (GWPs) much higher than that of carbon dioxide, and widely used in various applications including refrigeration, air conditioning, and other industrial processes.
GHG Precursors	Precursor gases are those primary air pollutants which do not directly induce global warming, but are involved in certain atmospheric reactions that lead to the formation of secondary substances that are radiatively active and affecting the

	atmospheric energy balance. Examples include: CO, SO_2, NO_x, VOC and PM.
Greenhouse Gases	Greenhouse gases are gases in the atmosphere emitted from natural, anthropogenic (human related) sources and from atmospheric photochemical reactions that leads to the modification of the atmospheric energy balance leading to greenhouse effect or global warming and subsequently to the modification of climate indices at global, regional or local scales beyond their established normal ranges of variabilities. They include Carbon dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O), Water vapour, Ozone, Hydro-fluorocarbons (HFCs), Per-fluorocarbons (PFCs), Sulphur Hexafluoride (SF_6), and Nitrogen Trifluoride (NF_3). However, where consideration is given only to anthropogenic sources, water vapour is usually not included because its concentration in the atmosphere is not known to be affected by human activities.
Line Sources	Emissions from transportation systems usually maintaining curvilinear trajectories such as roads, rivers, railways, and seaways and/or nodes such as parking lots, ports and airports. They generally comprise all the highways, urban extra-urban roads and all the main ports and airports are included.
National Inventory Cycle	National inventory activities at national and state levels shall be undertaken over a 24-month period during which the inventory shall start with a kick-off meeting and all inventories planning tasks, preparation and archival tasks, among others shall be finalized and end with a full inventory report submitted to the council on a pre-fixed date.
Nationally Determined Contributions	A Party's contributions to global GHG emissions and emissions reduction as prepared by the Party's national experts and institutions in compliance with IPCC Guidelines as basis for achieving the ultimate objective of the UNFCCC.
NOx	This means oxides of nitrogen, a group of reactive gases primarily consisting of nitric oxide (NO) and nitrogen dioxide (NO2), formed during combustion processes.
Point Sources	Fixed or stationary sources whose total annual emissions are above a pre-defined threshold as follows: CO_2≥500 tonnes/year; CO≥250tonnes/year; methane≥50tonnes/year; and other precursor gases≥20tonnes/year, measured under standard stack emission measurement conditions.
Reproducibility	An inventory report that meets the transparency requirement shall be so written with adequate details and assumptions that other teams can use such a report to reproduce the calculations

	and reach the same outcome and outputs for each source as well as for all GHG and precursor gases emissions.
Research Units	This mean research Units of universities and other research institutions and include Units of a Department, Departments, Research Centre/Institutes and excludes Consultancy Services Units.
Secretariat	This means the Secretariat of the National Council on Climate Change, Federal Republic of Nigeria. It is the management and administrative organ of the Council headed by the Director General and CEO who reports to the board.
Sinks	The process, activity or mechanism that removes GHGs, aerosols, or their precursors from the atmosphere.
Source Profile	The admixture or the concentrations of the array of compounds, pollutants or GHGs measured in the plume or stack of any source that is emitting substances into the atmosphere.
Sources	Refer to the activities and processes that release or emit greenhouse or precursor gases into the atmosphere, contributing to the greenhouse effect and global warming.
Tier 1 Approach	This is the simplest method, relying on IPCC default emission factors and requires only basic activities data.
Tier 2 Approach	This approach uses more elaborate methods and source-specific emission factors, often based on measurements, and requires more disaggregated activities data.
Tier 3 Approach	This is the most detailed approach, utilizing elaborate techniques and highly specific emission factors, and requires the most detailed data.
Transparency	The inventory should be reported in such a way that the activity data, methods and emission factors used as well as the underlying assumptions, emission calculations and how all data were archived are clearly documented so that users of the inventory can evaluate such information and have clear and unambiguous understanding of the inventory report. This also means that the use of confidential data should be kept to a minimum.
Vehicle Fleet	A vehicle fleet shall summarize the classes of vehicles on roads, in the waterways and in the air, classified according to vehicle weight, engine type and related technologies including emission control technologies, in such a way that every vehicle shall belong to one class of the fleet only.