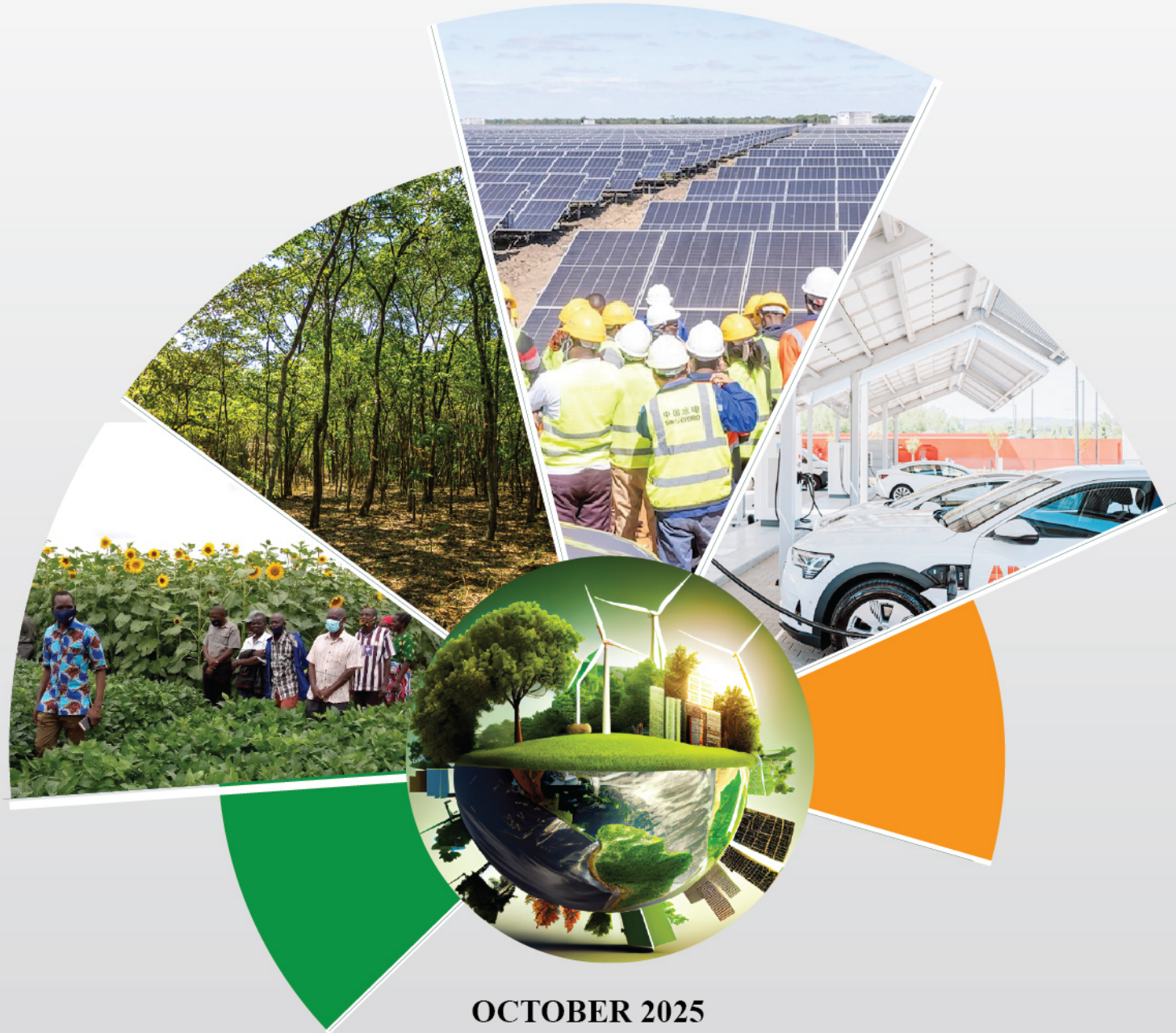
GOVERNMENT OF THE REPUBLIC OF ZAMBIA

ZAMBIA'S FIRST BIENNIAL TRANSPARENCY REPORT AND FOURTH NATIONAL COMMUNICATION

TO THE

UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE



OCTOBER 2025

Purpose

The First Biennial Transparency Report (BTR 1) and Fourth National Communication (NC4) for Zambia have been prepared in accordance with the requirements of the Enhanced Transparency Framework (ETF) under the Paris Agreement and United Nations Framework Convention on Climate Change (UNFCCC). This combined report provides a comprehensive, consistent, and up to date information on the country's climate actions, including greenhouse gas (GHG) emissions, mitigation and adaptation measures and the means of Implementation. It demonstrates the country's commitment to enhancing climate transparency and contributing to the global effort to address climate change.

The overall purpose of the BTR1 and NC4 is to enhance transparency, accountability, and mutual trust among Parties to the the Paris Agreement and the UNFCCC. The report aims to demonstrate Zambia's progress in implementing and achieving its Nationally Determined Contribution (NDC) targets and related commitments, in line with the national sustainable development priorities.

The main objectives of the BTR 1 and NC4 are to:

i. Track progress in the implementation of mitigation and adaptation actions
ii. Report national greenhouse gas (GHG) inventories, including emissions and removals by sources and sinks.
iii. Provide information on climate finance, technology transfer, and capacity-building needs as well as support received.
iv. Provide information on Transparency Framework needs and support received for Improvements
v. Highlight adaptation priorities, barriers, and actions undertaken to build resilience.
vi. Highlight other information relevant to the implementation to the Convention such as systematic observation, research, training and awareness.
vii. Inform national planning and international review processes, supporting evidence-based policy making and access to climate finance.

Foreword



Zambia continues to experience intensified impacts and effects of climate change. Rising temperatures, declining rainfall patterns, and more frequent extreme weather events such as droughts, floods and heatwaves are placing considerable pressure on communities, ecosystems and critical sectors of our economy. These challenges not only threaten environmental sustainability but also pose serious risks to the social-economic development aspirations of the country.

Zambia's first Biennial Transparency Report and the Fourth National Communication affirms Zambia's strong commitment to the Paris Agreement and the Enhanced Transparency Framework. The report provides a comprehensive account of our climate mitigation and adaptation priorities, policy responses, and progress in strengthening regulatory and institutional frameworks. All of which are fully aligned with national development priorities outlined in the vision 2030, Eighth National Development Plan (8NDP) and the Sustainable Development Goals (SDGs).

In response to the climate crisis, Zambia has embarked on a transformative journey that promotes low carbon, resilient economic growth, social inclusion, and efficient use of resources. Zambia is investing in strategic policy reforms such as the National Green Growth Strategy and innovative financing mechanisms aimed at accelerating access to clean and inclusive energy including mini-grid deployment and support for renewable energy and energy efficiency enterprises. Zambia is promoting investments in sustainable agriculture, strengthening forest and land management, and enhancing the resilience of infrastructure, water security and health systems. These efforts are aimed at catalysing productivity in key economic sectors.

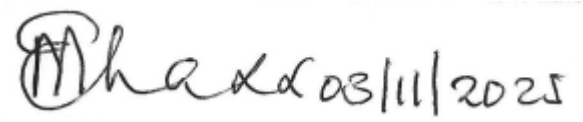
Zambia has made substantial progress in establishing a robust carbon market framework, underpinned by recent legal and institutional reforms. Key developments include the enactment of the Green Economy and Climate Change Act No. 18 of 2024, the formulation of a Carbon Market regulation Framework and supporting Statutory Instrument. These advancements, coupled with the country's growing engagement in Article 6 cooperative approaches and voluntary carbon markets, positions the country to mobilise climate finance, drive private sector participation and strengthen transparency and accountability in emissions reporting. Collectively these efforts contribute to the achievement of Zambia's climate change objectives and broader sustainable development goals.

Despite these important strides, challenges remain. We must overcome systemic barriers, scale up climate finance, and accelerate the deployment of technologies, research and innovations

that enable a just transition to a clean, green and resilient economy. Strengthening institutional capacities and forging inclusive, multi-stakeholder partnerships will be essential to unlocking solutions and ensuring that no one is left behind.

I wish to commend the innovation and resilience of communities and institutions leading climate action on the ground. I also extend my sincere appreciation to the Zambia Environmental Management Agency (ZEMA) for its leadership in coordinating the development of the report.

Zambia remains resolute in its pursuit of climate smart, inclusive and low carbon development pathway. Through enhanced transparency, multilateral cooperation, and sustained action, Zambia can build a resilient and sustainable future for all.



Hon. Mike Elton Mposha, MP
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The Government further acknowledges the valuable contributions of the Capacity Building Programme for Transparency (CBIT) and Global Support Programme (GSP), whose quality assurance processes enhanced the technical robustness and the credibility of this report.
The Government also commends the Zambia Environmental Management Agency (ZEMA) for its leadership in coordinating the development of the BTR1/NC4 report. ZEMA's role in convening technical experts and facilitating broad based multi- stakeholder engagement was instrumental to the successful completion of the report.

I extend my sincere appreciation to all Lead Authors and members of the technical working groups across the various thematic areas for their valuable contributions to Zambia's BTR1/NC4. I also wish to thank the Editors for compilation of the report.

Zambia remains firmly committed to enhancing its transparency framework, mobilising climate Finance and ensuring timely reporting to support climate action and sustainable development planning.

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List of Acronyms and Abbreviations

BTR	Biennial transparency report
CMA	Conference of the Parties serving as the meeting of the Parties to the Paris Agreement
CTF	Common tabular format
GHG	Greenhouse gas
IPCC	Intergovernmental Panel on Climate Change
ITMO	Internally transferred mitigation outcome
LULUCF	Land-Use, land-use change and forestry
MPGs	Modalities, procedures and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement
NDC	Nationally determined contribution
ODA	Official development assistance
OOF	Other official flows
QA/QC	Quality Assurance/Quality Control
REDD+	Reducing emissions from deforestation; reducing emissions from forest degradation; conservation of forest carbon stocks; sustainable management of forests; and enhancement of forest carbon stocks (decision 1/CP.16, para. 70)
8NDP	Eighth National Development Plan
AfDB	African Development Bank
AFOLU	Agriculture, Forestry and Other Land Use
AR	Assessment Report
Bn	Billion
BUR	Biennial Update Report
CCS	Carbon Capture and Storage
CHAZ	Churches Association of Zambia
CFM	Community Forest management
DMMU	Disaster management and Mitigation Unit
DOM	Dead Organic Matter
ETF	Enhanced Transparency Framework
EP-JSLP	Eastern Province Jurisdictional Sustainable Landscape project
EU	European Union
FAO	Food and Agriculture Organization
GCF	Green Climate Fund
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHGi	Greenhouse gas inventory
Gg	Giga gram
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GRZ	Government of the Republic of Zambia
HFO	Heavy Fuel Oils
ILUA	Integrated Land use Assessment

JFM	Joint Forest Management
LPG	Liquid Petroleum Gas
LWSC	Lusaka Water and Sanitation Company
MoA	Ministry of Agriculture
MoFL	Ministry of Fisheries and Livestock
MoH	Ministry of Health
MFNP	Ministry of Finance and National Planning
MGEE	Ministry of Green Economy and Environment
MLGHRD	Ministry of Local Government and Housing, and Rural Development
MRV	Monitoring, Reporting and Verification
MT	Metric tonnes
MW	Mega watts
MWDS	Ministry of Water Development and Sanitation
NE	Not estimated
NO	Not occurring
NSTC	National Science and Technology Council
NWP	Numerical Weather Prediction
PV	Photovoltaic
SARCOF	Southern African Regional Climate Outlook Forum
SASSCAL	Southern African Science Service Centre for Climate Change and Adaptive Land Management
SFM	Sustainable Forest Management
SNC	Second National Communication
SPAR6C	Support for Preparedness of Article 6 Cooperation
SRF	Strategic Research Fund
SSTC	South-South Triangular Cooperation
TACCC	Transparency, Accuracy, Consistency, Completeness and comparability
TJ	Terra joules
TNC	Third national Communication
TRALARD	Transforming Landscapes for Resilience and Development
UA	Uncertainty Analysis
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
WARMA	Water Resources Management Authority
WASH	Water, Sanitation and Health
WISER	Weather and Climate Information Services for Africa
WMO	World Meteorological organization
ZEMA	Zambia Environmental Management Agency
ZIFLP	Zambia Integrated Forest and Landscape Project
ZMD	Zambia Meteorological Department
ZMW	Zambian Kwacha
ZRA	Zambia Revenue Authority

Chemical Symbols

CH_4	Methane
CO2	Carbon dioxide
CO2 -eq	CO_2 equivalent
HFC	Hydrofluorocarbon
NMVOCs	Non-methane volatile organic compounds
N_2O	Nitrous oxide
NF_3	Nitrogen trifluoride
PFC	Perfluorocarbon
SF_6	Sulphur hexafluoride

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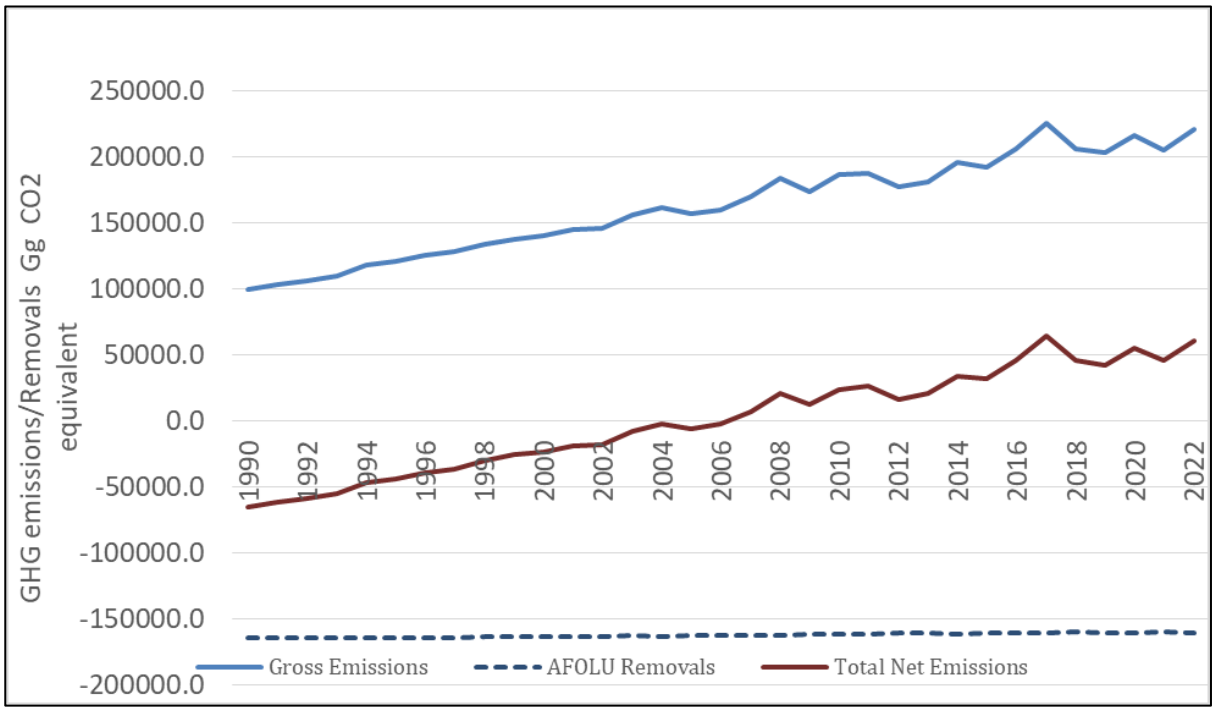
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Overview Chapter

National GHG Inventory

National GHG Inventory Summary is presented in the below figure.



National GHG Inventory Summary

Between 1990 and 2022, Zambia's gross Greenhouse Gas emissions more than doubled from 99,578.7 Gg CO_2eq to 220,462.1 Gg CO_2eq, reflecting a steady upward trend driven primarily by the Agriculture, Forestry and Other Land Use (AFOLU) and the energy sector, whose emissions increased nearly two to fourfold over the period, followed by gradual rises in industrial processes and product use (IPPU) and waste sectors. Throughout this period, the AFOLU sector has remained a substantial net carbon sink, removing between -164,745.1 Gg CO_2eq and -160,443.0 Gg CO_2eq annually. Although the AFOLU sink has shown a slight declining trend, it continues to offset a significant portion of emissions, highlighting its critical role in national climate mitigation.

At the same time, mitigation efforts in energy, industrial, and waste sectors have become increasingly important to curb the accelerating growth of gross emissions and complement the AFOLU sink. Sustained carbon sequestration from forests, croplands, and other land uses, combined with targeted emission reductions in other sectors, is essential for preserving climate resilience and supporting long-term sustainable development in Zambia.

Tracking NDC Progress

Presented in the table below is a summary of progress made in Tracking NDC.

Tracking NDC Progress

Component	Status / Details
Emission Reduction Target (2030)	25% unconditional; up to 47% conditional if supported, relative to 2010 BAU
Emission Reduction Since 2015	Since 2015, Zambia's emission reductions have increased steadily, rising from 732 Gg CO_2eq in 2016 to 9,609 Gg CO_2eq in 2023. Forestry and energy sectors contributed the most, with forestry growing from 16 Gg CO_2eq to 6,327 Gg CO_2eq and energy from 14 Gg CO_2eq to 2,555 Gg CO_2eq. Agriculture reductions were stable around 715–727 Gg CO_2eq annually. These reductions complement the AFOLU carbon sink and support Zambia's NDC mitigation targets.
Date of Updated NDC Submission	July 2021 (updated NDC, maintained previous targets) March 2025 Provisional NDC
Sectors Covered (Mitigation)	Energy; IPPU; AFOLU; Waste; plus Transport, Liquid Waste, Coal segments
Adaptation & Cross-cutting Priorities	Includes resilience in ecosystems, gender and youth, SDGs alignment
Implementation Framework (2023–2030)	Covers 11 sectors, 18 outcomes, 135 measures, 158 KPIs - costed at USD 17.2 billion
Budget and Financing	Implementation Framework Budget USD 17.2 bn
Support Mechanisms & MRV	Support from NDC Partnership in MRV strengthening, policy mainstreaming, green finance guidelines
Progress and Notes	Updated NDC did not increase ambition; actual reduction achievements since 2015 still to be reported

Climate Change Impacts and Adaptation Actions

Zambia is highly vulnerable to climate change, experiencing increasing temperatures, erratic rainfall, prolonged droughts, floods, and other extreme events. These climate stresses threaten agriculture, water resources, energy generation, health, infrastructure, forestry, fisheries, and biodiversity, with direct implications for food security, livelihoods, and economic development. recognising these risks, Zambia has developed sector-specific adaptation priorities aimed at building resilience, safeguarding livelihoods, and promoting sustainable development.

Zambia's adaptation strategies focus on promoting climate-smart agriculture, sustainable water and forest management, diversified renewable energy, resilient infrastructure, improved health systems, and strengthened governance across sectors. These measures are designed to reduce vulnerability, enhance preparedness for climate extremes, and provide co-benefits such as poverty reduction, ecosystem conservation, and alignment with the Sustainable Development Goals (SDGs). Presented in Table 2 are Climate Change Impacts and Adaptation Actions Summary.

Climate Change Impacts and Adaptation Actions Summary

No.	Sector	Climate Impacts	Adaptation Priorities
1	**Agriculture**	Droughts, erratic rainfall, crop failures, food insecurity, pests and diseases.	Diversification, climate-smart agriculture, drought-resilient crops, irrigation, post-harvest management, agroforestry, insurance schemes, and early warning systems.
2	**Water**	Reduced water availability, droughts, floods, pollution, and wetland degradation.	Water demand management, protection of wetlands, climate-smart infrastructure (dams, canals), wastewater recycling, IWRM/WEFE governance, and inter-basin transfers.
3	**Energy**	Reduced hydropower output due to droughts, reliance on biomass, energy insecurity.	Diversified energy mix, decentralised renewable systems, clean cooking, energy efficiency, and investment in less drought-prone hydro and renewable energy mapping.
4	**Health**	Increased climate-sensitive diseases (malaria, cholera), poor sanitation, and malnutrition.	Surveillance and response to climate-sensitive diseases, waste management, water quality monitoring, R&D, and improved nutrition awareness.
5	**Infrastructure**	Damage from floods, heat stress on roads/buildings, housing vulnerability.	Climate-resilient transport and housing, green buildings, climate-smart building codes, and regular maintenance of critical infrastructure.
6	**Livestock**	Drought-induced feed shortages, livestock diseases, reduced productivity.	Crop–livestock integration, disease control (including indigenous knowledge), forage production/storage, value chains, indigenous breeds, and livestock insurance.
7	**Fisheries & Aquaculture**	Rising water temperatures, reduced fish stocks, degraded breeding grounds, flooding.	Climate-smart aquaculture infrastructure, protection of breeding areas, low-carbon fish processing, alternative livelihoods, improved climate services, and use of indigenous fish species.
8	**Mining**	Land degradation, water stress, flooding of pits, dust and pollution risks.	Afforestation in mining areas, water recycling, tailings neutralization, dust suppression, flood-responsive pit design, and alternative energy use.
9	**Tourism & Wildlife**	Droughts affecting wildlife, habitat loss, species migration, infrastructure damage.	Climate-resilient Park infrastructure, improved water systems in protected areas, monitoring of priority species, community training, and PPPs in wildlife management.
10	**Forestry**	Deforestation, forest fires, biodiversity loss, declining carbon sinks.	Participatory forest management, preparation of management plans, sustainable forestry practices, and ecosystem/landscape-based approaches.

Financial, Technology Transfer and Capacity Needed and Mobilised

Zambia has made strides in identifying and prioritising its financial, technology transfer and capacity building support needs to implement its climate commitments, guided by national frameworks such as the Eight National Development Plan, NDC Implementation Framework and Technology Needs Assessment (TNA).

The TNA identified priority technologies in key sectors such as Agriculture, energy and water including Climate Smart Agriculture (CSA), Renewable Energy Systems (RES), Water harvesting solutions and Early Warning Systems (EWS). While the National Technology Business Centre (NTBC) operating under the Ministry of Technology and Science facilitates uptake and commercialization of climate technologies, linking local technology seekers with

international sources for wealth and employment creation, broader deployment however is hindered by limited access to climate finance, inadequate research and innovation.

Presented in the Table below are Funds Needed and Received for Financial, Technology Transfer and Capacity Building.

Funds Needed and Received for Financial, Technology Transfer and Capacity Building.

Area	Funds Needed USD	Funds Received USD
Financial	18,380,036,715	4,164,242,206.09
Technology Transfer	60,147,450.00	17,495,382,529.00
Capacity Building	638,514,130.00	3,525,728,076.09

Despite efforts made to mobilise resources from both multilateral and bilateral partners, including the adaptation and Green Climate Funds, this support is insufficient. relative to the scale of the country's climate ambition.

Scaling up support and addressing systemic barriers are critical to closing the implementation gap, strengthening resilience, and ensuring Zambia achieves its NDC and sustainable development goals. Enhance International cooperation, improved innovation systems will be essential to meet the country's climate ambition.

Chapter 1: National Circumstances

1.1 Overview of National Context

Zambia is a landlocked country located in Southern Africa, bordered by eight countries: Angola to the west; the Democratic Republic of the Congo to the north; Tanzania to the northeast; Malawi to the east; Mozambique to the southeast; Zimbabwe to the south; and Namibia and Botswana to the southwest. The country covers a total land area of approximately 752,612 square kilometres, with diverse landscapes that include high plateaus, hills, and river valleys [1].

As of 2022, Zambia's population was estimated at 19.6 million, with an annual growth rate of approximately 2.9%[1]. The population is predominantly youthful, with over 60% below the age of 25, creating significant demands on social services, education, and employment. While the majority of the population resides in rural areas, rapid urbanisation particularly in Lusaka and the Copperbelt provinces, contributed to increasing demand for infrastructure and energy services [1](Ibid).

Zambia is classified by the World Bank as a lower-middle-income country, with a Gross National Income (GNI) per capita of approximately USD 1,120 in 2022. The economy is highly dependent on the mining sector, especially copper production, which accounts for more than 70% of export earnings and a substantial share of government revenues. The economy also relies on agriculture, which employs the majority of the rural population and is crucial for food security, and services, particularly trade, telecommunications, and financial services [2].

Despite these economic drivers, Zambia remains vulnerable to macroeconomic challenges, including high public debt levels, inflationary pressures, and currency depreciation. These challenges have affected fiscal space and slowed the pace of public investment in critical sectors[2].

Zambia is highly vulnerable to climate variability and change, with significant implications for its development trajectory. The country experiences a tropical climate with three distinct seasons, but recent decades have seen increased climate-related hazards, such as droughts, floods, and rising temperatures. These events have had adverse impacts on agriculture, water availability and security, energy generation (hydropower), and health outcomes[3].

To address these challenges, Zambia is strengthening its policy and institutional frameworks for climate change. It ratified the Paris Agreement in 2016 and has submitted successive Nationally Determined Contributions (NDCs). Zambia has also developed a National Adaptation Plan (NAP) for 2023, a National Green Growth Strategy for 2024, and a National Climate Change Policy (2016). The country is actively mainstreaming climate actions into key sectoral policies and national development strategies. Further, Zambia enacted the Green

[1] Central Statistical Office (CSO) (2022): Zambia in Figures 2022. Government of the Republic of Zambia, Lusaka.
[2] World Bank. (2023). World Development Indicators: Zambia. https://data.worldbank.org/country/zambia
[3] United Nations Framework Convention on Climate Change (UNFCCC) (2025): Zambia's Third Nationally Determined Contribution (Provisional). https://unfccc.int.

Economy and Climate Change Act No. 18 of 2024 to enhance its climate change legal and regulatory framework [3](ibid).

Zambia has also institutionalized climate action through the Ministry of Green Economy and Environment, which coordinates national climate change responses and oversees implementation of the country's Transparency Framework under the Enhanced Transparency Framework (ETF) of the Paris Agreement. This Biennial Transparency Report (BTR) forms part of Zambia's commitment to tracking progress toward its climate goals, improving data quality, and informing national and international stakeholders on efforts to reduce greenhouse gas emissions and build resilience [3] (opcit).

1.2 Governance and Institutional Arrangements for Climate Action

Zambia's climate change agenda is coordinated by the Ministry of Green Economy and Environment (MGEE), which was established in 2021 as part of a strategic shift to integrate climate resilience, environmental sustainability, and green growth into national development plans. The creation of MGEE reflects Zambia's Government commitment to address climate change as both an environmental and developmental challenge, recognising its implications for poverty reduction, economic transformation, and long-term sustainability [4]

The Ministry serves as the focal point for the UNFCCC and other relevant multilateral environmental agreements. It is responsible for the formulation and oversight of national climate policies and strategies, including Zambia's NDCs, the NAP process, BTR and National Communications. Several specialized institutions and coordination bodies that support the implementation of Zambia's climate change agenda include:

- **Zambia Environmental Management Agency (ZEMA):** ZEMA, is Zambia's main environmental regulator, enforces environmental standards, oversees environmental impact assessments (EIAs), integrates climate risks into development planning, and monitors environmental compliance across sectors. ZEMA also plays a central role in coordinating the national Greenhouse Gas (GHG) Inventory and the preparation of Zambia's BTRs and National Communications (NC) to the UNFCCC. Further, ZEMA coordinates the Greenhouse Gas Inventory Management System (GHGiMS), a centralised system for collecting, managing, and reporting GHG emissions and removals as provided for in the Green Economy and Climate Change Act No 18 of 2024. It oversees climate data management and supports Zambia's reporting under the Enhanced Transparency Framework of the Paris Agreement. The Agency is currently developing an Integrated Measurement, Reporting and Verification (iMRV) System to enhance efficiency in climate reporting and a national Carbon Registry to support cooperative approaches and voluntary carbon market and trading.

[4] Ministry of Green Economy and Environment (MGEE) (2021): Ministerial Mandate and Strategic Priorities. Lusaka: Government of the Republic of Zambia.

- **Department of Green Economy and Climate Change (GECCD):** Operating under MGEE, the GECCD is responsible for the coordination, implementation, and monitoring of green economy and climate change policies, programmes, and projects. The department is also Secretariat to the Designated National Authority (DNA) for carbon market and trading and oversees capacity building, and stakeholder engagement across Government, Civil Society Organisations, and the Private Sector.

- **National Designated Authority (NDA) to the Green Climate Fund (GCF):** The NDA, housed within MGEE, is mandated to coordinate Zambia's engagement with the Green Climate Fund and the Adaptation Fund. It facilitates the development, approval, and submission of project proposals to the GCF and ensures alignment with national climate priorities. The NDA also leads the country's GCF Readiness and preparatory support activities to build institutional capacity for accessing climate finance. Zambia National Commercial Bank (ZANACO) has been accredited as a National Implementing Entity to the GCF to facilitate easy access to Climate Finance.

- **The Green Economy and Climate Change Technical Committee (GECCTC):** The GECCTC is a multi-sectoral technical coordination platform composed of senior representatives from key ministries and agencies, including energy, agriculture, water, infrastructure, health, planning, and finance among others. The GECCTC is the DNA for carbon markets and trading . It provides strategic guidance, ensures policy coherence, and facilitates the integration of climate change into national development plans and sector strategies.

- **The Council of Ministers:** This is the supreme decision-making body for overseeing climate change interventions in the country chaired by the Republican Vice President. The Secretariat is provided by the Permanent Secretary from the MGEE. The role of the Council of Ministers in the BTR and NC is to approve the report for submission to the United Nations Framework Convention on Climate Change (UNFCCC).
- **The Technical Committee:** This is the advisory body to the Council of Ministers on programme coordination and implementation chaired by the Ministry of Green Economy and Environment. In the context of BTR and NC the Committee reviews, validates and recommends the reports to the Council of Ministers for approval. The MGEE is the Chair of the Committee.

- **The Technical Working Groups (TWGs): In preparing the BTR1/NC4, existing TWGs** on GHG inventories, Mitigation, Adaptation and Means of Implementation comprising key Government sector lead institutions, Research, academia and civil society organisations were used. The role of the TWGs involved data collection and analysis, quality control and compilation of the draft reports. In addition, ZEMA identified experts to work with the technical working groups to draft respective chapters of the BTR/NC4.

In addition to central-level structures, Zambia has adopted a decentralised approach to climate change implementation. This is operationalized through Provincial and District Development Coordinating Committees, which serve as subnational coordination platforms. These committees enhance bottom-up planning, foster local ownership of climate actions, and facilitate the collection of local-level climate data and feedback for national reporting.

The institutional framework is further supported by a growing number of national and regional Research Institutions, Academia, Civil Society Organizations, Development Partners, and Private Sector Actors contributing to climate action, knowledge generation, and technology transfer.

This institutional arrangement enabled Zambia to operationalize its Enhanced Transparency Framework (ETF) commitments under the Paris Agreement and provides a basis for continuous improvement in tracking, reporting, and verifying climate actions, support needs, and outcomes. The approval of the BTR and NC is done by the Council of Ministers upon review and recommendation of the Technical Committee.

Below is a summary of the institutional arrangement for ETF reporting and the GHG Management System used in the preparation of the Zambia's BTR1/NC4 (Figure 1.1) and (Figure 1.2)

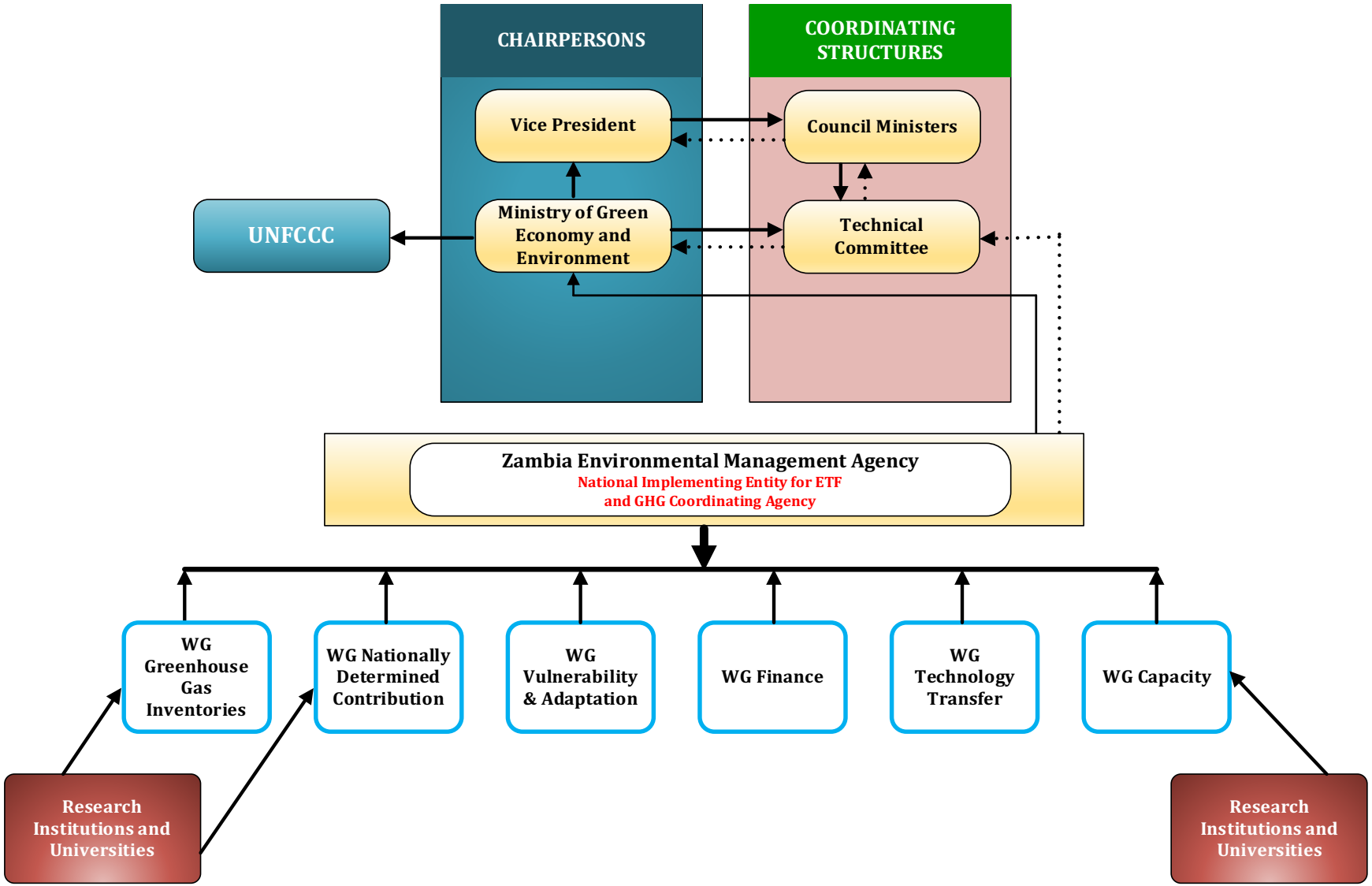


Figure 1-1: Institutional Arrangements for Enhanced Transparency Framework Reporting

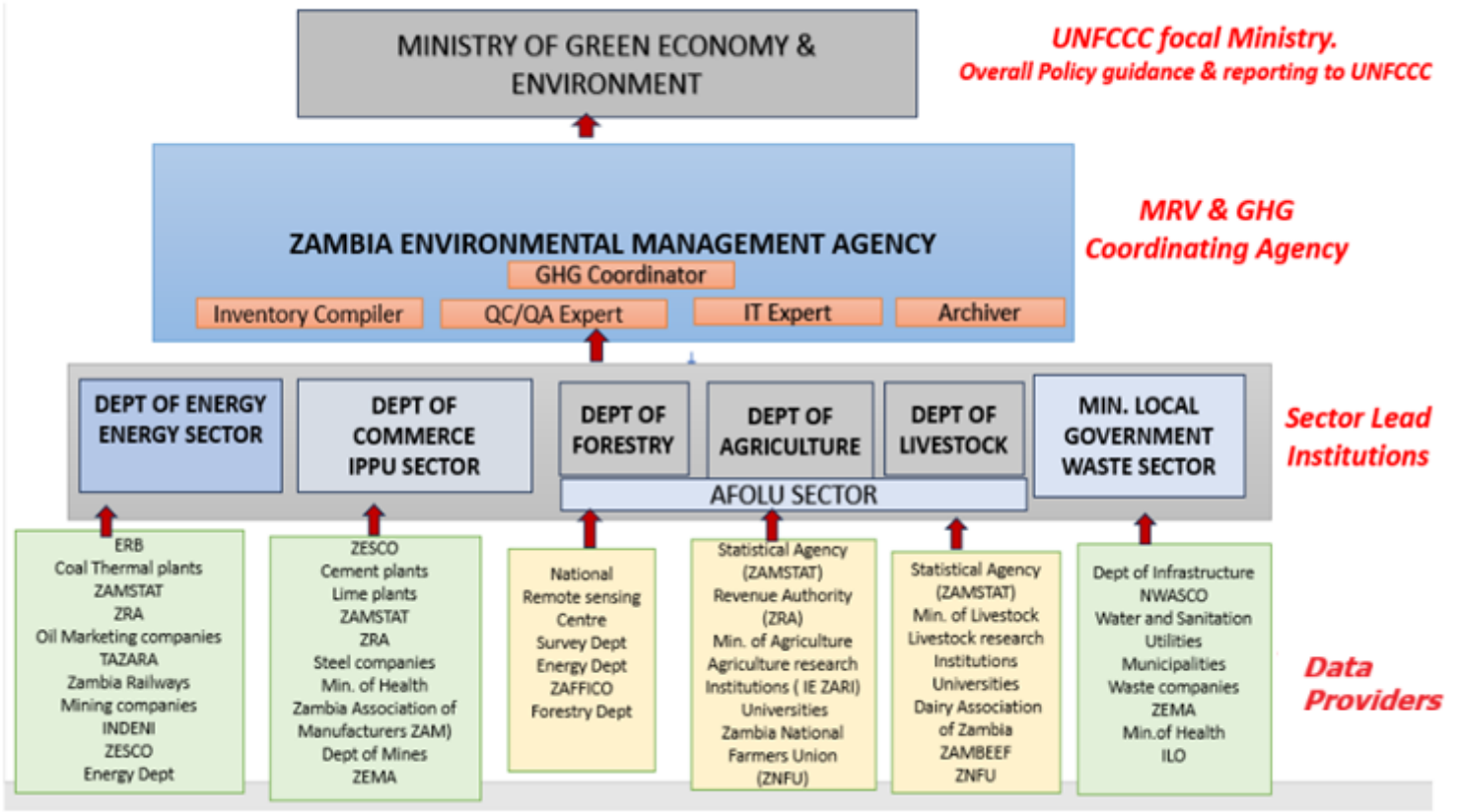


Figure 1-2: Institutional Arrangements for the GHG Management System

1.3 Economic Structure and Key Sectors

1.3.1 General Outlook

Zambia's economy is structurally diverse but remains heavily reliant on the mining sector, particularly copper, which contributes over 70% of the country's export earnings. This makes Zambia highly exposed to external shocks, such as fluctuations in global copper prices and demand trends. While the mining sector is a critical driver of Foreign Direct Investment, government revenue, and GDP growth, over-reliance on it highlights the urgent need for economic diversification and resilience-building[5]

Agriculture remains a vital component of the economy, contributing approximately 20% to the national GDP and supporting livelihoods for more than 60% of the population, especially in rural areas. The sector is primarily rain-fed and dominated by smallholder farmers, making it highly vulnerable to climate shocks such as droughts, floods, and erratic rainfall patterns. Key agricultural products include maize, soybeans, groundnuts, cotton, and horticultural produce, alongside livestock and fisheries. Agriculture plays a central role in food security, rural employment, and poverty reduction and holds significant potential for climate adaptation and mitigation if transformed through climate-smart practices and investment in value chains.

The manufacturing sector contributes modestly to GDP but holds strategic importance for value addition and job creation. It is largely driven by agro-processing industries, including food and beverage production, textiles, and basic consumer goods. Ongoing efforts by government to expand the manufacturing base through support for small and medium-sized enterprises (SMEs), development of Multi-Facility Economic Zones (MFEZs), and promotion of local value chains will enhance Zambia's economic resilience, reduce import dependency, and stimulate inclusive growth.

Zambia's energy sector is primarily hydro-based, with hydropower accounting for more than 80% of electricity generation. While this has historically ensured clean and affordable power, the country's growing vulnerability to droughts and reduced water availability has had a major impact on electricity supply and economic activity. This has highlighted the need for energy diversification, leading to a national drive to expand solar, mini-hydro, and other renewable sources, alongside investment in off-grid and mini-grid solutions to improve energy access in rural areas.

The service sectors play a dominant role in Zambia's economy, accounting for over 55% of GDP as of 2022. This sector includes wholesale and retail trade, tourism, transportation, telecommunications, and financial services. Tourism in particular presents opportunities for promoting domestic ecotourism, enhancing protection of national parks and game management areas, building resilience of the infrastructure and tourism sites. These contribute to domestic and foreign exchange generation given Zambia's abundant natural attractions such as the Victoria and Chishimba Falls among others. The financial sector has also expanded steadily, supporting investment and entrepreneurship, although limited access to affordable credit remains a constraint, particularly for rural populations and informal enterprises.

[5] Government of Zambia (2022): Eighth National Development Plan (8NDP) 2022–2026. Lusaka: Ministry of Finance and National Planning.

Zambia's labour market is characterized by a high level of informality, with over 80% of the working population engaged in informal employment. This is especially common in subsistence agriculture, small-scale trading, and informal service activities in urban areas. Formal employment is mainly concentrated in Private and Public sectors such as mining, finance, and large-scale retail. The dominance of informal employment restricts productivity, reduces access to social protection, and limits tax revenue mobilisation. Government has been addressing the informality challenges through provision of free education for all, promotion of vocational training, inclusive labour policies, and enterprise support to unlock the country's human capital and ensuring equitable growth.

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1.3.2 Trends in GDP Growth over the Past Decade (2012–2022)

Trends in GDP Growth Rate from 1990 to 2022

Zambia's economic performance has experienced both expansion and contraction, reflecting the interplay of commodity price volatility, climate variability, policy challenges, and global crises such as COVID-19[6]. In 1990, the economy contracted, with a growth rate of -0.48%, reflecting the economic instability of the time. (World Bank. (2023).

By 2000, growth had moderately recovered to 3.90%, signalling the beginning of an economic turnaround. The period between 2001 and 2010 marked a significant acceleration in growth, with GDP growth rate reaching 10.30% in 2010, driven by the construction, transport, and mining sectors, spurred by increased investment in the mining sector (Living Conditions Survey, ZamStats, 2000, 2010).

Between 2011 and 2016, however, the economic growth rate slowed down, and averaged 4.9%, due to weaker mining performance and domestic fiscal pressures exacerbated by the slump in the global copper pricing. Between 2017 and 2018, however, the economy stabilized with a GDP growth rate of 3.5% and 4.0% respectively, supported by improved agricultural output and stronger trade.

However, in 2019, growth declined sharply to 1.4% as copper production weakened and fiscal imbalances widened. The onset of the COVID-19 pandemic in 2020 led to Zambia's first economic contraction in decades, with GDP shrinking by 2.8% due to supply chain disruptions, lower global demand for copper, and restrictions on business activity.

A robust recovery emerged in 2021, with the economy rebounding by 6.2%. This was largely driven by a resurgence in mining, improved agricultural conditions, and post-COVID recovery in services. Growth remained strong in 2022 at approximately 5.2%, underpinned by strong performance in mining resulting from renewed investment and improved copper prices on the global stock markets.

[6]World Bank. (2023). Zambia Economic Monitor: Enhancing Economic Recovery through Greater Inclusion. Washington, DC: World Bank Group.

1.3.3 Sector Performance Overview for 2022

In 2022, Zambia's economy grew by an estimated 5.2%, driven primarily by strong performances in the Information and Communication, Transportation and Storage, Education, and Accommodation and Food Services sectors [7]. The Information and Communication sector led this growth, contributing 3.2 percentage points to GDP growth, supported by continued digital transformation, mobile network expansion and increased adoption of digital services. The Education and Transport sectors each contributed 1.2 percentage points with the latter registering a substantial 28.4 % year on year increase.

However, several sectors experienced contractions that moderated overall growth. The Agriculture, Forestry, and Fishing sector declined by 11%, subtracting 0.8 percentage points from GDP. This was largely due to adverse weather conditions including poor rainfall and extended dry spells, which negatively impacted food production and rural livelihoods. Similarly, the Mining and Quarrying sector contracted by 3.7%, contributing -0.4 percentage points to GDP, reflecting ongoing operational and regulatory challenges within the extractive industry.

On the upside, the Manufacturing sector grew by 4.7%, contributing 0.4 percentage points to GDP, largely due to the relaxation of COVID-19 restrictions which supported increased industrial activity. The Energy sector also registered growth, with electricity generation increasing by 9.5% and contributing 0.2 percentage points driven by the commissioning of two additional turbines at the Kafue Gorge Lower Power Station and increased regional electricity trade through the Southern African Power Pool.

Conversely, the Construction sector contracted by 8.8%, contributing -0.9 percentage points to GDP, primarily due to a slowdown in public infrastructure development and mining- related projects. The Information and Communication sector recorded the highest annual growth rate.

The Accommodation and Food Services sector experienced a strong rebounded, expanding by 74.7% and contributing 0.9 percentage points to GDP, reflecting a continued post pandemic recovery in tourism related activities. In contrast, the Financial and Insurance sector contracted by 1.8%, with a 0.1 percentage point impact on GDP. Overall, Zambia's 2022 growth pattern reflects a structural shift toward services and technology sectors**,** while extractive and primary industries continued to face systemic challenges.

Summary

Zambia's economic structure is anchored by mining, agriculture, services, and increasingly ICT and financial services. Over the past decade, the country weathered both internal and external shocks, including global commodity price volatility, the COVID-19 pandemic, and extreme weather events. While growth has been strong in recent years, particularly in services and mining, vulnerabilities in agriculture and energy, largely climate-induced, continue to pose risks to economic stability.

To achieve inclusive and climate-resilient growth, Zambia will need to deepen economic diversification, strengthen value chains in agriculture and manufacturing, invest in renewable energy, and formalize the labour market. Doing so will enhance productivity, build resilience

[7] National Accounts, ZAMSTATs 2022

to external shocks, and support the achievement of long-term development goals and commitments under the Paris Agreement.

1.4 Population Profile

The population in Zambia in 1990 was 7,383,097 with the rural population at 4,477,814 and urban population at 2,905,283 respectively. Between 2010 and 2022, the country experienced an average annual population growth rate of 3.4%. The survey reported 3,861,557 households, with an average household size of 5.1 persons. Zambia's population stood at 19,610,769 as of September 2022, representing a 49.8% increase compared to the population in 2010. The population is projected to continue growing at an average rate of 2.7% per annum while the total population is expected to double in the next 25 years. In 2022, the proportion of the population living in rural areas accounted for 60% as compared to the urban population which stood at 40%. The population density for Zambia increased from 9.8 persons per square kilometre in 1990 to 17.3 in 2010 and 27.1 in 2022 (Table 1.1).

Table 1-1: Population Size by Rural/Urban, Zambia 1990- 2022

	Population				
Year	1990	2000	2010	2022	% Change
Zambia	7,383,097	9,885,591	13,092,666	19,610,769	49.8
Rural	4,477,814	6,458,729	7,919,216	11,766,461	48.6
Urban	2,905,283	3,426,862	5,173,450	7,844,308	51.6

1.5 Geographical Profile

1.5.1 Location

Zambia is a landlocked country covering an area of 752,614 km^2 and lies between latitudes 8 and 18 degrees south and longitude 22 and 34 degrees east of Greenwich Meridian. The Country shares boarders with eight countries namely; Angola, Botswana, Democratic Republic of Congo, Malawi, Mozambique, Namibia, Tanzania and Zimbabwe. Zambia lies on a plateau with an altitude of between 300 and 1,800 m (Figure 3) [8].Zambia is divided into three major Agro-ecological Regions (AERs) (AER I, AER IIa, AER IIb and AER III) (Figure 3). The AERs are largely based on annual rainfall amounts but also integrate soils and other climatic characteristics[9])

[8] CIA (2024): The World Factbook: Zambia. Washington, DC: Central Intelligence Agency. https://www.cia.gov/the-world-factbook/countries/zambia/.

[9] Chabala, L. M., Mulolwa, A., Lungu, O. I., & Koala, S. (2013). Characterisation of agro-ecological zones in Zambia: Soil, climate and vegetation attributes. In S. Koala, T. Mamo, & A. Tabo (Eds.).

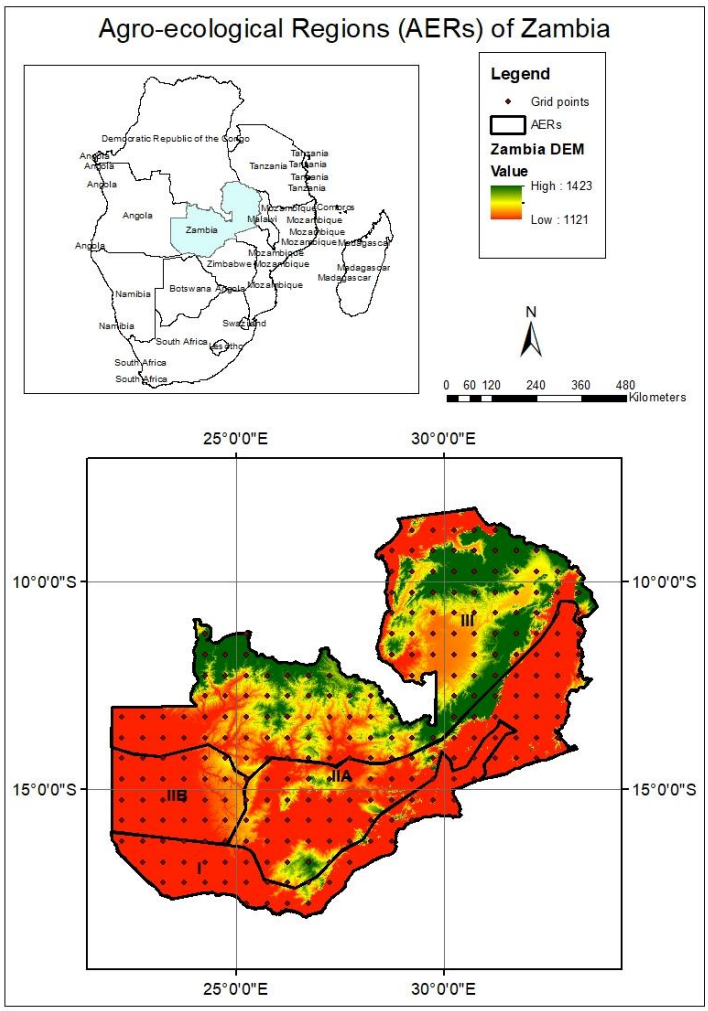


Figure 1-3: Map of Zambia showing the Agro-ecological Regions (AERs: AERI, AERIIa, AERIIb and AERIII). The DEM used in the map shows the elevation which range from 1120 to 1423 m above sea level.

1.5.2 Topography

Zambia has three main topographical features: mountains with an altitude of at least 1,500 meters; plateaus ranging from 900 to 1,500 meters; and lowlands with altitudes between 400 and 900 meters [10]. The country lies on the great plateau of central Africa, with an average altitude of approximately 1,200 meters. Zambia's topography is characterized by diverse landscapes that include plateaus, valleys, mountains, rivers, wetlands, and escarpments.

The Zambezi River, one of Africa's major rivers, originates in Zambia and forms the country's borders with Botswana, Namibia, Mozambique, and Zimbabwe. This river is renowned for the iconic Victoria Falls locally known as Mosi-O-Tunya which was designated a UNESCO World Heritage Site in 1989 and is considered one of the largest waterfalls in the world. The Central Plateau dominates the country's terrain, stretching from north to south with gently undulating highlands at an average elevation of 1,000 to 1,200 meters (3,280 to 3,940 feet) above sea level.
Parallel to the eastern border lies the Muchinga Escarpment, a prominent steep slope that separates the plateau from the lower-lying Luangwa Valley. This escarpment not only offers striking scenic views but also serves as a natural boundary between different ecological zones.

[10] Aregheore, E. M. (2006). Country Pasture/Forage Resource Profiles: Zambia. Rome: Food and Agriculture Organization of the United Nations (FAO). https://www.fao.org/ag/agp/agpc/doc/Counprof/Zambia/zambia.htm.

The Luangwa Valley itself, located in eastern Zambia, is a rift valley shaped by the Luangwa River. It is renowned for its abundant wildlife, including elephants, hippos, crocodiles, and numerous bird species, with South Luangwa National Park being a key attraction in the area. In the north eastern region of the country, the Bangweulu Swamps form an extensive wetland system composed of marshes, lagoons, and floodplains. These swamps are ecologically significant, providing a critical habitat for a wide range of bird species, including the rare and elusive shoebill stork. The Copperbelt, situated in north-central Zambia and north western regions, are notable for the rich deposits of copper, cobalt and nickel. This area is a hub of mining activity and plays a vital role in the national economy.

The Northern Highlands define the terrain in the northern part of the country, comprising of elevated and mountainous areas such as the Mafinga Hills and the Nyika Plateau. Finally, in the western region, the Barotse Floodplain formed by the Zambezi River stands out as a vast seasonal wetland. Recognized as a Ramsar site of high conservation value, the floodplain expands during the rainy season, supporting biodiversity and sustaining local livelihoods through agriculture and fishing.

1.5.2.1 Natural Resources and Ecosystems

Zambia is known for its rich biodiversity, encompassing a wide range of ecosystems and species. Some notable aspects of Zambia's biodiversity include:

1.5.2.1.1 National Parks

Zambia has a total of 20 National Parks, 36 Game Management Areas which cover 236,376km^2 which translate into 31.4% of the country's national coverage and 3 Sanctuaries namely Chembe Bird Sanctuary, and Sekula and Nchete Islands on Lake Kariba that contribute to the conservation of its biodiversity. National Parks include South Luangwa National Park, Kafue National Park, Lower Zambezi National Park, Liuwa Plain National Park, and Lochinvar National Park, among others[11] .

1.5.2.1.2 Fauna (Game and Fish Diversity)

Zambia's fauna estate comprises 224 mammal species, 74 amphibian species and over 490 fish species. It is particularly renowned for its populations of large mammals, including elephants, lions, leopards, cheetahs, giraffes, hippos, zebras, buffalos, and various antelope species such as kudu, impala, and wildebeest. The country is also known for its abundant avifauna, with over 750 species recorded.

Zambia's water bodies, including the Zambezi River, Lake Tanganyika, and Lake Mweru, support a rich diversity of fish species. The country is known for its freshwater fish, including the popular tiger fish, bream, catfish, and tilapia[12] .

1.5.2.1.3 Flora

Zambia's flora varies across its different regions. The country encompasses woodland savannahs, grasslands, miombo forests, wetlands, and riverine forests. The Kafue Flats and Bangweulu Swamps are notable wetland areas that support unique plant communities.

1.5.2.1.4 Endangered Species

Zambia is home to several endangered and vulnerable species. These include the African elephant, African wild dog, black rhinoceros, and various primate species such as the Angola

[11] Department of National Parks and Wildlife (DNPW) (2020): Zambia's National Parks and Game Management Areas. Lusaka: Ministry of Tourism and Arts, Government of the Republic of Zambia.
[12] Zambia Environmental Management Agency (ZEMA) (2012): State of the Environment Report *2012.* Lusaka: Government of the Republic of Zambia.

colobus and yellow baboon. Efforts are being made to protect and conserve these species through targeted conservation programs. The Government, along with non-governmental organizations and local communities, is actively involved in conservation efforts. These initiatives focus on habitat protection, anti-poaching measures, community-based conservation, and sustainable wildlife management[13] .

1.5.2.1.5 Forests

Zambia has three major vegetation formations namely closed forests, open woodland forests and grasslands. The closed forests are limited in extent, covering only about six per cent of the country. The most extensive closed forests are the *Cryptosepalum* and *Baikiaea* forests covering parts of North-Western provinces[14] .

Open woodland forests are the dominant vegetation formation in Zambia, covering 66% of the forested area [15]. There are four types of woodlands in the country, of which the most extensive is miombo. Miombo woodland covers 42% of the country and is characterized by the following genera: *Brachystegia, Julbernadia* and *Isoberlina*. This is followed by Kalahari woodlands, characterized by Mopane, Munga and Termitaria. Termitaria, or anthill vegetation, covers three per cent of the land, and is present in all regions of the country, except in areas of pure stands. It is classified according to its association with other vegetation types, such as Miombo Termitaria, Kalahari Termitaria, *Mopane Termitaria*, *Munga Termitaria*, Riparian Termitaria and Grassland Termitaria

In addition to natural forests, the Government, through the Department of Forestry, has established forest plantations that cover about 500 km^2, the majority of which are found in the Copperbelt province. Predominant species among the plantation are *Pinus kesiya*, *Pinus oocarpa,* and Eucalyptus[16].

1.6 Energy Profile

Zambia's electricity sector is predominantly dependent on hydropower, which constitutes over 80% of the country's total installed generation capacity. In 2022, Zambia's total installed capacity was recorded at 3,777.3 megawatts (MW), with hydropower plants contributing approximately 3,164.14 MW. This reflects the country's abundant river resources, including the Zambezi and Kafue rivers, which provide a reliable source of renewable energy. To diversify its energy mix and improve supply reliability, Zambia has integrated fossil fuel-based thermal power generation into its grid, including a 300 MW coal-fired power plant at Maamba Collieries and thermal plants fueled by heavy fuel oil (HFO) and diesel, contributing 110 MW from Ndola Energy and 84.80 MW from Copperbelt Energy Corporation (CEC), respectively. Additionally, the country has expanded its renewable portfolio by incorporating on-grid solar photovoltaic (PV) capacity, which accounted for 89.38 MW in 2022[17].

[13] Ministry of Lands and Natural Resources (MLNR) (2015): Zambia's Fifth National Report to the Convention on Biological Diversity. Lusaka: Government of the Republic of Zambia.
[14] Ministry of Tourism, Environment and Natural Resources (MTENR) (2003): National Biodiversity Strategy and Action Plan (NBSAP). Lusaka: Government of the Republic of Zambia.
[15] . Ministry of Tourism, Environment and Natural Resources (MTENR). (2002). Zambia National Action Programme for Combating Desertification. Lusaka: Government of the Republic of Zambia.
[16] Mukosha, R. and Siampale, A. (2009): Zambia Country Profile. Centre for International Forestry Research (CIFOR). https://www.cifor-icraf.org/publications/pdf_files/OccPapers/OP-113.pdf
[17]Energy Regulation Board (ERB) (2023): Annual Electricity Market Report 2022. Lusaka, Zambia.

Over the years, Zambia's electricity demand has steadily increased, with daily peak demand rising from about 1,700 MW in 1990 to approximately 2,300 MW in 2022. This growth reflects expanding economic activities, population growth, and increased electrification efforts. To meet this rising demand, Zambia's total national electricity generation capacity covering both on-grid and off-grid systems increased to 3,871 MW in 2024, up from 3,811 MW in 2023, signalling continued investments in generation infrastructure.

The diversification of Zambia's energy mix has been marked by the gradual addition of fossil fuel-fired thermal power plants. The introduction of heavy fuel oil (HFO) plants began in 2013, followed by the commissioning of coal-fired plants starting in 2016. These thermal plants provide essential backup and peaking power, especially during periods of reduced hydropower output caused by drought or seasonal variability (17).

In the petroleum sub-sector, Zambia has historically imported crude oil, which is refined domestically into various petroleum products such as petrol, diesel, kerosene, liquefied petroleum gas (LPG), bitumen, and others. From 1990 to 2021, the country refined a cumulative total of approximately 15,366,370 metric tons (MT) of crude oil at the Indeni refinery located in Ndola District, Copperbelt Province. Refining volumes have varied widely over the years, with a low of 16,850 MT recorded in 2000 and a peak of 701,330 MT in 2014[18].

National consumption of petroleum products has also experienced significant growth, rising steadily from around 384,360 MT in 1990 to 1,549,270 MT in 2022. This upward trend continued into 2023, with total consumption reaching 1,627,405.87 MT, up from 1,549,274.44 MT in the previous year. Among petroleum products, kerosene exhibited the highest growth rate at 370.4%, followed by Jet A-1 aviation fuel at 41.7%, and LPG at 13.3%, indicating rising demand across residential, transport, and industrial sectors.

Overall, Zambia's energy landscape reflects a gradual transition toward a more diversified and resilient electricity system, combining abundant hydropower resources with emerging thermal and solar capacities, alongside a growing petroleum sector to meet the country's expanding energy needs.

1.7 Climate Profile and Vulnerabilities

Zambia experiences a tropical climate characterized by three distinct seasons: a cool dry season from May to August, a hot dry season from September to November, and a rainy season from December to April. The country's climate is shaped by its tropical location and varied topography, which includes plateaus, river basins, and valleys [19]..

Climate change has led to rising average temperatures across Zambia, with projections indicating an increase between 1.5 and 3 degrees Celsius by 2050. This warming trend contributes to heat stress and disrupts natural and human systems. Alongside rising temperatures, Zambia faces erratic rainfall patterns marked by increased variability and unpredictability. This has resulted in a higher frequency and intensity of extreme weather events such as droughts and floods, which have become more common in recent years. For instance, the 2019 and 2020 droughts severely affected crop yields and water availability, while

[18] 18. Energy Regulation Board (ERB) (2023): Petroleum Sector Report 2022. Lusaka, Zambia: ERB.
[19] Zambia Meteorological Department (2020): Climate of Zambia. Lusaka, Zambia: Ministry of Transport and Communications.

floods in 2021 displaced thousands and damaged infrastructure in several provinces [20]. The country's key vulnerabilities lie in sectors that are particularly sensitive to climate variability. Agriculture, which employs over 60% of Zambia's population and contributes approximately 20% to the country's GDP, is highly susceptible to changing rainfall patterns. Erratic precipitation and prolonged dry spells have reduced crop productivity, threatening food security and rural livelihoods. Smallholder farmers, who constitute the majority of Zambia's agricultural workforce, remain especially vulnerable.

Water resources are under stress due to changing precipitation and increased evaporation rates. Declines in river flows and groundwater recharge have impacted water availability for domestic use, irrigation, industry, and hydropower generation. Hydropower, which supplies over 80% of Zambia's electricity, has been directly affected during drought periods, contributing to energy shortages and economic losses.

Health outcomes are also influenced by climate variability, with increased cases of vector-borne diseases such as malaria and waterborne illnesses like cholera reported in recent years. Rising temperatures exacerbate heat stress, particularly among vulnerable groups such as children and the elderly, while floods increase exposure to water contamination[21].

Critical infrastructure including roads, bridges, and buildings are vulnerable to climate extremes. Floods and storms have caused significant damage, disrupted transportation networks and essential services, and leading to costly repairs and reconstruction efforts[22].

To address these challenges, Zambia has developed and is implementing several adaptation strategies articulated in its National Adaptation Plan (NAP). Key adaptation projects under the NAP include the promotion of climate-smart agriculture techniques such as drought-resistant crop varieties and conservation farming to improve agricultural resilience. Water resource management projects focus on the development and rehabilitation of water storage infrastructure and the enhancement of watershed management to secure water supply. The NAP also supports the strengthening of health systems to cope with climate-sensitive diseases through improved surveillance and community health programs. Climate-resilient infrastructure initiatives under the NAP include the construction and upgrading of flood-resistant roads and bridges, as well as climate-proofing of public buildings. Additionally, the NAP emphasizes capacity building and the establishment of early warning systems for floods and droughts to enhance disaster preparedness and response. Community-based adaptation programs foster local participation and knowledge-sharing to promote sustainable land use and natural resource management[23].

1.8 National Development and Climate Policy Framework

Zambia's climate agenda is firmly embedded within its broader national development vision and aligned with regional and global frameworks to ensure a cohesive approach to sustainable

[20] European Commission, Knowledge for Policy. (2022). Climate risk and resilience: Unpacking the economic impacts of climate change in Zambia.
[21] World Health Organization (WHO). (2022). *Malaria in Zambia*. https://www.who.int/zambia
[22] https://documents.worldbank.org/en/publication/documents-reports/documentdetail/967111633124198924/zambia-country-environmental-analysis.
[23] Government of the Republic of Zambia. (2020). National Adaptation Plan (NAP) 2020-

growth and climate resilience. At the core of this alignment is Vision 2030[24], which sets the country's long-term ambition to become a prosperous middle-income nation by the year 2030. This vision guides all national planning and policy efforts, including climate-related strategies.

Supporting this vision is the 8th National Development Plan (8NDP) (2022–2026)[25] which outlines Zambia's medium-term priorities focused on inclusive economic growth, social development, and environmental sustainability. Climate change is integrated within the 8NDP as a cross-cutting issue, recognising its critical influence on sectors such as agriculture, water resources, health, and energy.

Zambia's commitments under the global climate framework are reflected in its successive Nationally Determined Contributions (NDCs), starting with NDC1.0[26] (30), followed by NDC 2.0[27], and most recently the provisional NDC 3.0[28]. These documents articulate Zambia's mitigation targets and adaptation goals, emphasizing low-carbon development pathways and resilience building consistent with the Paris Agreement.

Complementing these climate commitments are sector-specific policies and strategies such as the National Energy Policy (2019)[29], which promotes sustainable energy development and efficiency, and the Reducing Emissions from Deforestation and Degradation (REDD+)[30] Strategy, aimed at reducing emissions from deforestation and forest degradation while enhancing carbon sequestration. The National Adaptation Plan (NAP) also further strengthens Zambia's ability to anticipate and manage climate risks, particularly in vulnerable sectors and communities.

The country's climate agenda is also closely aligned with international development goals, notably the Sustainable Development Goals (SDGs)[31] , the African Union's Agenda 2063[32], and the Southern African Development Community (SADC) frameworks[33]. This multi-layered alignment ensures Zambia's climate action contributes meaningfully to regional integration, economic transformation, and sustainable development.

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[24]Republic of Zambia. (2006) Vision 2030: A Prosperous Middle-Income Nation by 2030. Government of the Republic of Zambia.

[25] Republic of Zambia (2022): Eighth National Development Plan (8NDP) 2022–2026. Ministry of National Development Planning, Zambia.

[26] NDC1 (First Nationally Determined Contribution) Republic of Zambia (2016): First Nationally Determined Contribution under the Paris Agreement. Ministry of Lands, Natural Resources and Environmental Protection, Zambia.

[27] NDC2 (Second Nationally Determined Contribution) Republic of Zambia. (2020). Updated Nationally Determined Contribution. Ministry of Lands and Natural Resources, Zambia.

[28] Provisional NDC3 (Third Nationally Determined Contribution) Republic of Zambia (2025): Provisional Third Nationally Determined Contribution. Ministry of Green Economy and Environment, Zambia.

[29] Energy Policy (2019) Republic of Zambia (2019): Energy Policy of Zambia. Ministry of Energy, Zambia.

[30] REDD+ Strategy Republic of Zambia (Year): REDD+ Strategy for Zambia. Ministry of Green Economy and Environment, Zambia.

[31] Sustainable Development Goals (SDGs) United Nations (2015): Transforming our world: The 2030 Agenda for Sustainable Development. United Nations.

[32] African Union Agenda 2063 African Union Commission (2015): Agenda 2063: The Africa We Want. African Union Commission. https://au.int/en/agenda2063

[33] Southern African Development Community (SADC) Frameworks Southern African Development Community (2019): SADC Regional Indicative Strategic Development Plan (RISDP). SADC Secretariat.

Central to operationalizing these ambitions is Zambia's National Climate Change Policy (2016)[34], which provide the strategic framework for mitigating greenhouse gas emissions and enhancing adaptation efforts across sectors. Building on this foundation, the recently enacted Green Economy and Climate Change Act No 18 of 2024[35] establishes a comprehensive legal framework that formalizes institutional roles, strengthens governance, and ensures accountability in climate action. The Act facilitates climate finance mobilization, robust monitoring and reporting, and inclusive stakeholder engagement, thereby advancing Zambia's climate resilience and sustainable development goals.

Together, these policies and frameworks reflect Zambia's integrated approach to addressing climate change, supporting sustainable growth, and fulfilling its national and international commitments.

1.9 Research, Systematic Observation, and Data Systems

Zambia has made significant progress in enhancing its national capacity for climate observation, modelling, forecasting, research, and data management, in line with commitments under the UNFCCC and the Paris Agreement's Enhanced Transparency Framework. These capabilities are essential for strengthening early warning systems, supporting climate-resilient development planning, and ensuring accurate and transparent reporting of greenhouse gas (GHG) emissions and removals.

The Zambia Meteorological Department (ZMD) is the lead agency for systematic climate observation and forecasting in the country[36] (40). It operates a network of more than 140 meteorological and agro-meteorological stations nationwide, approximately 40 percent of which have been upgraded to automated weather stations (AWS) capable of real-time data transmission. The remainder of the network consists of manual stations, many of which have been in operation for over three decades. Zambia's observation network is integrated into the World Meteorological Organization (WMO) Global Observing System, contributing to and benefiting from global climate data exchange. Through regional initiatives such as the Southern African Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL), over 30 hydro-meteorological stations have been installed, improving monitoring in underserved areas.

ZMD has expanded its modelling and forecasting capacity by adopting advanced numerical weather prediction (NWP) tools, including the Weather Research and Forecasting (WRF) Model for high-resolution short- to medium-term forecasts, and seasonal models through the Southern African Regional Climate Outlook Forum (SARCOF). These systems are complemented by downscaled climate models that provide localized projections. The department has also introduced impact-based forecasting, linking meteorological predictions to potential impacts on sectors such as agriculture, water resources, and disaster risk management. Operational outputs now include daily forecasts, seven-day weather outlooks, seasonal advisories, and agricultural bulletins. Capacity has been strengthened through targeted training, with more than 60 meteorologists and data analysts trained in climate modelling,

[34] Republic of Zambia (2016): National Climate Change Policy. Ministry of Lands, Natural Resources and Environmental Protection, Zambia.

[35] Climate Change Act of 2024, Republic of Zambia (2024): Climate Change Act. Ministry of Green Economy and Environment, Zambia.

[36] Zambia Meteorological Department (2023): About Us. Ministry of Green Economy and Environment, Government of Zambia.

downscaling techniques, and probabilistic forecasting under Weather and Climate Information Services for Africa (WISER) and Southern African Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL) programmes.

Despite these advancements, Zambia's systematic observation and modelling systems face several challenges. A significant portion of the observation infrastructure remains outdated, resulting in data gaps and inconsistencies. Station density is inadequate in some provinces, such as Western, Luapula, and parts of Muchinga, limiting the ability to capture micro-climatic variations. Data transmission from remote stations is often delayed due to limited telemetry and weak internet connectivity. There is also a shortage of highly specialized personnel in numerical modelling, data analytics, and equipment maintenance. Furthermore, reliance on project-based funding limits sustainability and data-sharing across institutions is hindered by incompatible formats, bandwidth constraints, and the absence of a centralised climate data platform. Advanced modelling also requires high-performance computing infrastructure, which remains limited in capacity.

To address these gaps, Zambia is undertaking a phased modernization of its observation network, including the installation of additional AWS units and satellite-linked telemetry systems. Partnerships with regional and global initiatives are being expanded to secure technical assistance, model outputs, and capacity building. Plans are also underway to develop a National Climate Data Management System to integrate datasets from multiple sectors and improve accessibility for both policymakers and researchers.

In parallel, Zambia has made notable strides in strengthening its research and data systems. The National Science and Technology Council (NSTC) manages the National Research Fund (NRF), which serves as the primary domestic funding mechanism for climate-related research and innovation. Since 2015, the NRF has supported more than 150 research projects with disbursements exceeding ZMW 80 million (approximately USD 4.2 million). Over 35 percent of these projects have focused on climate change adaptation and mitigation, covering themes such as climate-smart agriculture, renewable energy technologies, and ecosystem restoration [37].

On the GHG data front, Zambia has enhanced its National GHG Inventory System and Measurement, Reporting, and Verification (MRV) frameworks to improve the accuracy, transparency, and timeliness of emissions reporting. Between 2020 and 2024, more than 200 technical experts from government ministries, academia, and civil society were trained in applying the IPCC 2006 Guidelines, with a particular focus on the Agriculture, Forestry and Other Land Use (AFOLU) and Energy sectors (26). Data systems will be strengthened through the establishment of sectoral data-sharing protocols between the Zambia Environmental Management Agency (ZEMA) and Zambia Statistics Agency (ZamStats), Energy Regulation Board (ERB), Road Transport and Safety Agency (RTSA), Zambia Revenue Authority (ZRA) and sector ministries. The integration of geospatial datasets from remote sensing platforms has enhanced forest monitoring, land-use mapping, and agricultural productivity assessments. Furthermore, a centralised data repository for climate and GHG information will be developed to improve access for researchers, policymakers, and reporting processes.

[37] National Science and Technology Council of Zambia (2023): Strategic Research Fund Guidelines and Annual Reports. Ministry of Higher Education.

Zambia also benefits from strong regional and international collaboration. Through SASSCAL, the country has gained access to additional climate observation infrastructure, research grants, and specialized training. The Weather and Climate Information Services for Africa (WISER) programme has improved the delivery of climate services and enhanced technical skills in forecasting, seasonal outlook development, and stakeholder engagement[38] (42). Participation in WMO programmes ensures that Zambia's observation data contributes to global climate monitoring systems, thereby supporting both national and international decision-making.

Nevertheless, research and data systems continue to face constraints. Data fragmentation across institutions leads to duplication and information gaps. Long-term research funding is inadequate, and the availability of high-resolution historical datasets for climate modelling remains limited. The integration of indigenous and community-based knowledge into formal climate datasets is still underdeveloped, while data quality varies due to inconsistent measurement protocols and a lack of regular instrument calibration.

To overcome these barriers, Zambia is developing a National Climate Data Management Platform to standardize and centralize datasets. Efforts are being made to increase domestic budget allocations for climate research, strengthen partnerships with universities to promote postgraduate research in climate science and policy, and improve data interoperability with regional and global platforms[39].

Sustained investment in observation, modelling, forecasting, research, and data systems will be critical for enhancing Zambia's early warning capacity, improving evidence-based climate policy, and fulfilling its obligations under the Enhanced Transparency Framework of the Paris Agreement.

1.10 Support Needs and Enabling Environment

Zambia continues to face critical needs in several areas to effectively advance its climate change mitigation and adaptation goals. Key among these is capacity building in Measurement, Reporting, and Verification (MRV) systems, greenhouse gas (GHG) inventory compilation, and adaptation tracking. Strengthening technical expertise and institutional capabilities in these areas is essential to ensure accurate data collection, transparent reporting, and robust monitoring of progress towards Zambia's Nationally Determined Contributions (NDCs) and broader climate commitments.

In addition to technical capacity, Zambia requires sustained and increased financial support to facilitate the implementation of its NDC targets and the development of climate-resilient infrastructure. This financial assistance is vital to address investment gaps in sectors vulnerable to climate impacts, including energy, agriculture, water resources, and urban development. Funding will enable the scaling up of renewable energy projects, enhancement of adaptation infrastructure such as flood defences and irrigation systems, and the integration of climate considerations into national development planning.

[38] Weather and Climate Information Services for Africa (WISER) (2023): Programme Overview and Zambia Country Profile. UK Met Office and partner reports.
[39] SASSCAL and WISER Programme Reports (2022–2024): https://sasscal.org

Technology transfer remains a crucial enabler for Zambia's transition towards a low-carbon and climate-resilient economy. Particularly, advanced technologies for clean energy generation, energy efficiency improvements, and climate-smart agricultural practices are needed. Access to innovative technologies will support Zambia in diversifying its energy mix, improving crop yields under changing climatic conditions, and reducing emissions across key sectors.

Furthermore, enhanced access to international climate finance mechanisms such as the Green Climate Fund (GCF), the Global Environment Facility (GEF), and emerging market-based approaches under Article 6 of the Paris Agreement is imperative. Strengthening Zambia's ability to navigate and leverage these funding sources will accelerate the mobilization of resources necessary for transformative climate action. This includes improving proposal development capacities, meeting eligibility requirements, and fostering partnerships with multilateral and bilateral donors to maximize financial inflows and technical assistance.

In summary, advancing Zambia's climate agenda hinges on a multifaceted approach that combines capacity building, financial support, technology acquisition, and strategic engagement with global climate finance mechanisms.

Chapter 2: National GHG Inventory

2.1 Introduction

2.1.1 Background and Objectives

The preparation of the Zambia's national Greenhouse Gas inventory (GHG) forms a key component of country's s commitment obligations under the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement. This inventory forms part of Zambia's broader commitment to global climate action and supports the implementation of its Nationally Determined Contribution (NDC) submitted following the ratification of the Paris Agreement in 2016.

Under the Enhanced Transparency Framework established under Article 13 of the Paris Agreement, all Parties are required to provide transparent and consistent information on their GHG emissions and removals. As part of this obligation, Zambia is submitting its National GHG Inventory as a summary and a standalone component of the BTR1/NC4 report in line with Decision 18/ CMA1.

The chapter presents a comprehensive overview of Zambia's anthropogenic GHG Emissions by sources and removals by sinks for the period 1990 to 2022. The Inventory was prepared in accordance with the 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories along with the 2019 Supplement, as encouraged.

The data, methodologies and institutional arrangements used in compiling this inventory reflect Zambia's ongoing efforts to enhance transparency, build national capacity, and contribute meaningfully to global climate monitoring and reporting effort.

2.1.2 Inventory Planning and Management

The inventory preparation commenced in October 2023 and was completed in March 2025**.** The process to prepare the GHG inventory involved a series of structured steps to ensure Transparency, Accuracy, Consistency, Completeness and Comparability (TACCC). The steps included; Planning for the entire inventory process from data collection, data documentation, compilation of estimates, report writing, quality assurance, and finalization of the inventory report, archiving. Additional steps included identification of data gaps, compilation of an improvement plan, and setting timelines for respective activities. Data was collected from various data providers (i.e., government institutions, private sector, Civil Society Organizations (CSO) and academia).

The data collected was sorted, categorized and documented. The data documentation process involved provision of source and sink category information (classification of emission sources and removals based on the IPCC 2006 sectoral approach) , methodological choices and description (justification for the selection of estimation methods based on IPCC tiers 1,2,or 3 depending on the availability of data and sectoral requirements), listing of activity data (compilation of statistical and measured data essential for emissions estimations), identification of emission factors (use of default emission factors from the IPCC emission factor database or

country specific values where applicable) and uncertainty estimates (evaluation of data reliability, potential source of error and recommendations for reducing uncertainties).

On completion of data documentation, the respective sector compilers submitted the data documented for Quality Control (QC) to evaluate for completeness and accuracy. After QC of all activity data and emission factors, data was inputted into the IPCC software to generate GHG estimates for the time series 1990 to 2022.

Additional information and recommendations for future improvements were also documented into a National Inventory Improvement Plan. All data and documentation were archived in the GHG Management System. A draft GHGi report was compiled and subjected to Quality Assurance (QA) and comments incorporated. The tools used in the inventory preparation process included spreadsheets, IPCC 2006 Guidelines, and IPCC Software. Figure 2.1 illustrates the GHGi preparation process.

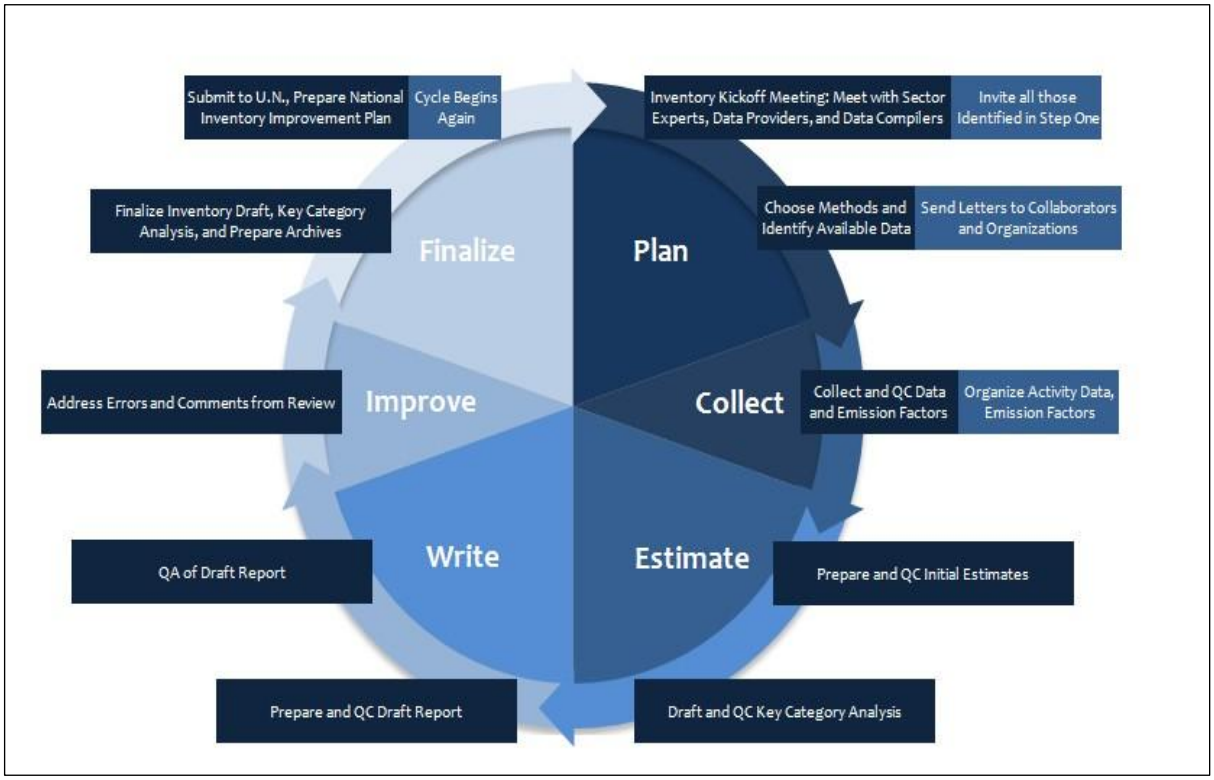


Figure 2-1: GHGi Preparation Process

2.1.3 Gases

The greenhouse gases covered in the Inventory included; Carbon dioxide (CO2), Methane (CH_4), Nitrous oxide (N_2O), Hydro fluorocarbons (HFCs) and Sulphur hexafluoride (SF_6). The objective of the GHGi was to determine Zambia's emission levels for 1990 to 2022 using the 2006 IPCC Guidelines, 2019 refinement of the 2006 IPCC Guidelines.

The report also covers precursor gases for sectors to include; energy, Industrial Processes and Product use, Agriculture Forestry and Other Land Use (AFOLU) and Waste. The precursor emissions were prepared in accordance with the European Monitoring and Evaluation Programme of the European Environment Agency (EMEP/EEA) air pollutant emission inventory guidebook 2023. Although they are not included in global warming potential-

weighted greenhouse gas emission totals, emissions of carbon monoxide (CO), oxides of nitrogen (NOx), non-methane volatile organic compounds (NMVOCs), and sulphur dioxide (SO_2) are reported in greenhouse gas inventories as they indirectly contribute to GHG formation, affecting GHG chemistry and lifespan in the atmosphere.

2.1.4 Activity Data Sources

The activity data for energy, IPPU, AFOLU and Waste used for the compilation of the GHGi for the period 1990 to 2022 was sourced from various data providers including, government Institutions, regulatory agencies, Private sector, non-governmental organizations and civil society .

IPPU
Activity data used in estimating GHG emissions from the IPPU was obtained from industries (Lubricants), CSO, Zambia Revenue Authority. Efforts were made to compare data from various sources and compile the most suitable data sets for use in emissions estimates. Efforts were made to check and verify the data from all sources to ensure good quality data was utilised in the inventory preparation from the IPPU sector.

AFOLU
Activity data used in estimating GHG emissions from the AFOLU was obtained from Forest Department (ILUA II data set), Ministry of Agriculture (MoA), ZamStats, and Zambia Revenue Authority (ZRA). Efforts were made to compare data from various sources and compile the most suitable data sets for use in emissions estimates. Efforts were made to check and verify the data from all sources to ensure good quality data was utilised in the inventory preparation from the AFOLU sector.

Waste
The data used for estimating emissions for solid waste disposal, incineration and open burning of waste were based on population, GDP and per capita waste generation. Data on population and per capita waste generation was obtained from ZamStats. Whilst part of the GDP data was obtained from ZamStats, the other data came from World Economy Report and the World Bank data base**.** Data on wastewater treatment and discharge was sourced from installed waste water treatment facilities and National Water and Sanitation Council (NWASCO). Default values for Biochemical Oxygen Demand (BOD) generation per capita were used.

2.1.5 Emission Factors Data Sources

The emission factors for the compilation of the GHGi for all sectors were obtained from the emission factor database using tier 1 methodologies with the exception of livestock subcategories - Dairy Cattle and Other Cattle and Land - based Categories where tier 2 emission factors were used. The sources of emission factors for Dairy Cattle and Other Cattle were drawn from the Livestock Sector Study - Assessment of Head, Sex and Age of different cattle categories supported by SPARC6. The Land - based categories emission factors were sourced from Integrated Land Use Assessment (ILUA) II Report.

2.1.6 Compilation

The National Greenhouse Gas Inventory (GHGi) was prepared using the 2006 IPCC Guidelines for National Greenhouse Gas Inventories and the subsequent 2019 refinements, in compliance with the Modalities, Procedures and Guidelines (MPGs) established under the Enhanced Transparency Framework (ETF) for action and support as referenced in Article 13 of the Paris Agreement (Decision 18/CMA.1).

The GHGi quantifies and reports emission sources and removals for the period 1990-2022, across four key sectors. The key sectors included Energy, Industrial Processes and Product Use, Agriculture Forestry and Other Land Use AFOLU) and Waste.

The 2006 IPCC Software and Emission Factor Database were used in preparing the inventory. Activity data used for the GHG emissions estimates for the energy sector were obtained from the energy balance. Currently, the country does not have country specific emission factors for energy, IPPU and waste sectors, for this reason, Tier 1 method and default emissions factors were used to estimate GHG emissions for the Energy, IPPU, and Waste sectors. Tier 2 method was employed for the Land and Cattle sub categories under AFOLU while Tier 1 was used for Aggregate Sources and Non-CO2 Emissions Sources on Land. For precursor emissions estimates, the emission factors were derived from the Emission Factor Database.

The precursor emissions were prepared in accordance with the EMEP/EEA air pollutant emission inventory guidebook 2023 for a comprehensive emission inventory. Although they are not included in global warming potential-weighted greenhouse gas emission totals.

2.1.7 Reporting Years

The reporting years for this inventory is from 1990 to 2022.

2.1.8 Uncertainties

Energy
The Uncertainty analysis for the year 2022 for the Energy sector was estimated using approach 1 and computed using the IPCC 2006 software. Generally, uncertainty for activity data from energy is ± 5%. Detailed uncertainty values are provided in Annex I. Base year for uncertainty assessment was 1990.

IPPU
The Uncertainty Analysis (UA) for the year 2022 for IPPU sector was estimated using approach 1 and computed using the IPCC 2006 software and is provided in Annex I. Uncertainty arose from the quantity of cement and lime produced. Slight differences were observed between data from the Zambia Revenue Authority (ZRA), ZamStats, and from manufacturers. As regards nitric acid and ammonia production data was obtained from factory records with uncertainty of ±2%. Data on steel production was obtained from ZRA and ZamStats database whose uncertainty was about ±5%. Data on lubricants were obtained from the Ministry of Energy database. Uncertainty for data on SF6 in electrical equipment was ±2% obtained from nameplate capacity from electricity utility companies.

The database for ZRA and ZamStats does not record numbers of refrigeration and air conditioning units by type. Only the mass of refrigeration and air conditioning units by type is

recorded for tax purposes. Thus, the data captured in the ZRA database is not suitable for inventory preparation. For this reason, the inventory preparation team devised a methodology to deduce the charge contained in the units by utilising the mass and number of units imported and correlating with standards charge content in the units. This approach gives room for significant estimations of the numbers and it is for this reason that the uncertainty was set at ±50. The emissions factors in the Uncertainty Analysis (UA) were calculated using the 2006 IPCC Software. The AD was calculated from confidence levels from source data providers, including ZamStats and industries. Where applicable, expert judgment was utilised to account for gaps in confidence level in the data.

AFOLU

The Uncertainty Analysis (UA) for the year 2022 for AFOLU sector was estimated using approach 1 and computed using the IPCC 2006 software and is provided in Annex I. Data for estimating emissions in the Land category was obtained from the ILUA data with uncertainty of ±5%. All the population data for Dairy, other cattle, Buffalo, Sheep, Goat, Swine and poultry were sourced from ZamStats.

Waste

The Uncertainty Analysis (UA) for the year 2022 for Waste sector was estimated using approach 1 and computed using the IPCC 2006 software and is provided in Annex I. Data for estimating emissions in the Waste sector was estimated from population, GDP, and other factors to include waste characterization. It was for this reason that the uncertainty was estimated to be ±50%. For wastewater activity data was obtained from installed waste water treatment facilities and National Water and Sanitation Council (NWASCO) , thus the uncertainty was estimated at ±30%.

2.1.9 Time-Series Consistency and Recalculations

Recalculations were made for the years 1990 to 2022 for all the sectors, as a result of the change of Global Warming Potential from Second Assessment Report (AR2) to Fifth Assessment Report (AR5). For livestock, country specific emission factors for enteric fermentation and manure management for Dairy Cows and Other cattle also necessitated the recalculations. The Livestock Sector Study "Assessment of Heads, Sex and Age of different Cattle Categories were undertaken under the Supporting Preparedness for Article 6 Cooperation Program (SPAR6C). In addition, improved data sets on forest areas affected by disturbances resulting from fires were used. The emissions for the entire timeline were recalculated due to change in Global Warming Potential from AR2 to AR5.

2.1.10 Quality Assurance and Quality Control

Quality control was conducted at three levels of the inventory process as follows:

a) Pre-inventory preparation: This involved cross checking the activity data collected from various data providers, compilation and cleaning of the data by the sectoral technical working group prior to inventory compilation.
b) Inventory preparation: This involved checking and verification of activity data and emissions factors and ensuring correct entry of figures in the software.
c) Post inventory preparation: This involved checking and verification of activity data, emission factors, and results of emissions in the report and common reporting tables.

Quality assurance was undertaken by the Capacity Building Initiative for Transparency and Global Support Program (CBIT GSP) and comments from review were incorporated in the final report.

2.1.11 Key Category Analysis

Key Category Analysis (KCA) was undertaken using approach 1, for both level and trend assessment, consistent with the IPCC guidelines. Key categories are identified using a pre-determined cumulative emissions threshold. Key categories are those that sum to 95% of the total level when summed together in descending order of magnitude.

According to Approach 1 Level Assessment, the Key Categories were Forestland Remaining Forest land, Forestland Land Converted to Grassland, Forestland Land Converted to Cropland, Enteric Fermentation, Energy Industries (Solid Fuels), Land Converted to Forest land, Road Transportation, Liquid Fuels, Lime production, Burning, and Other Sectors (Biomass solid) (Table 2-1). Detailed results of KCA are provided in Annex II.

Table 2-1: Summary of Key Category Analysis for Inventory Year 2022

IPCC Category code	IPCC Category	Greenhouse gas	Criteria
3.B.1.a	Forest land Remaining Forest land	CARBON DIOXIDE (CO2)	T1, L1
3.B.3.b	Land Converted to Grassland	CARBON DIOXIDE (CO2)	T1, L1
3.B.2.b	Land Converted to Cropland	CARBON DIOXIDE (CO2)	T1, L1
3.A.1	Enteric Fermentation	METHANE (CH4)	T1, L1
1.A.1	Energy Industries - Solid Fuels	CARBON DIOXIDE (CO2)	T1, L1
3.B.1.b	Land Converted to Forest land	CARBON DIOXIDE (CO2)	T1
1.A.3.b	Road Transportation - Liquid Fuels	CARBON DIOXIDE (CO2)	T1, L1
2.A.2	Lime production	CARBON DIOXIDE (CO2)	T1
3.C.1	Burning	NITROUS OXIDE (N2O)	T1,
3.C.1	Burning	METHANE (CH4)	T1, L1
1.A.4	Other Sectors - Biomass – solid	METHANE (CH4)	T1
1.B.1.c	Fuel transformation	METHANE (CH4)	L1

The notation keys: L = key category according to level assessment; T = key category according to trend assessment

2.1.12 Assessment of Completeness and Improvement Plan

The GHG emission inventory includes calculation of emissions from all relevant sources and sinks where data was available and are occurring in Zambia in accordance with the IPCC 2006 Guidelines. Completeness assessment was undertaken and appropriate notation provided in Table 2.2.

Table 2-2: General completeness of the Inventory

Sector	Category	Status	Challenges /Gaps to Achieve Completeness
Energy	1.C – Carbon dioxide Transport and Storage	Not Occurring (NO)	The current assessment did not include activities under 1.C, due to non-prevalence and/ or lack of activity data.
	I.A.3d Water Borne Navigation	Not estimated	Lack of activity data
IPPU	2.B Chemical Industry	Not Estimated	No emissions occurred in this category for the years 2005 to 2013 and 2015 and 2020 due to discontinuity in the production of ammonia and nitric acid in Zambia
IPPU	2.D - Non-energy use of fuels and solvents includes lubricants, paraffin wax and solvents	Not Estimated	Emissions from solvents and paraffin wax are not estimated due to a lack of activity data
IPPU	2.E Electronics industry	Not Estimated	No activity occurred under this category in Zambia from 1994 to 2016 and hence, emissions estimates were not calculated
IPPU	1.A.2 – Manufacturing industries and construction	Not Estimated	The Chemical Industry; activity data is insufficient from the current data sources. Other areas that need improvement in data collection are Textile and leather/ Paper and pulp, Food and Beverage, Wood and wood products. The activity data obtained from the ZRA and ZAMSTAT for many of these sectors is not consistent across the years. There is therefore need to harmonise data from these two sources.
			1. Limited activity data in fuel used as feedstock and lubricant consumption records. 2. Inconsistent/insufficient activity data. It was observed that non-ferrous metals present an inconsistent fuel *use* (majorly coal) reporting from the current data sources. Industry facilities produce ferro-alloys through integrated unit operations; it is difficult for data sources like CSO to keep a measure of exact production statistics of ferro-alloys.

			3. Industry specific information lies mainly within the individual manufacturing units. An annual Survey of manufacturing industries can be used as a prime source of information for the GHG estimations in the IPPU sector.
AFOLU	3B: Land	Estimated	There is a lack of emission factors by vegetation class.
AFOLU	3.C.1b – Biomass burning in Croplands	Estimated	Current data on crop residues—estimating how much is burned, foraged, or left in fields—is lacking. These amounts were estimated using expert judgment. This gap can be addressed through a survey to document farmers' crop residue management practices.
AFOLU - Aggregate Sources and Non-CO2 emissions from Land	3.C.2 – Liming	Estimated	Current lime data from MoA and ZamStats does not distinguish between dolomitic and calcitic types, and reported quantities are underreported, covering only small and medium-scale farmers. Future surveys should categorize lime by type and improve reporting accuracy.
AFOLU – Aggregate Sources and Non-CO2 emissions from Land	3.C.6 Indirect N_20 Emissions from Manure Management - leaching and runoff from land of N from urine and dung deposition from grazing animals	Not estimated	Lack of Activity Data
Waste	4.B Biological treatment of solid waste	Not estimated	Biological Treatment of Waste was non occurring due to the lack of activity data (Composting and anaerobic digestion at biogas facilities

2.2 Trends in Greenhouse Gas Emissions

2.2.1 Description of Emission and Removal Trends for Aggregated GHG Emissions and Removals

2.2.1.1 Emission Trends for GHG Emissions

In 2022, Zambia's total Gross GHG emissions (with AFOLU) stood at 220,462.1 $GgCO_2eq$, against 99,578.7 $GgCO_2eq$ in the 1990 base year representing an increase of 121%. The GHG removals (sink) reduced by 2.6% from -164,745.1 $GgCO_2eq$ in the current year (2022) to -160,443.0 $GgCO_2eq$ in the base year (1990). The net GHG emissions indicate that Zambia was a net Sink for the period 1990 to 2007 and a net source from 2007 to 2022 (Figure 2.2).

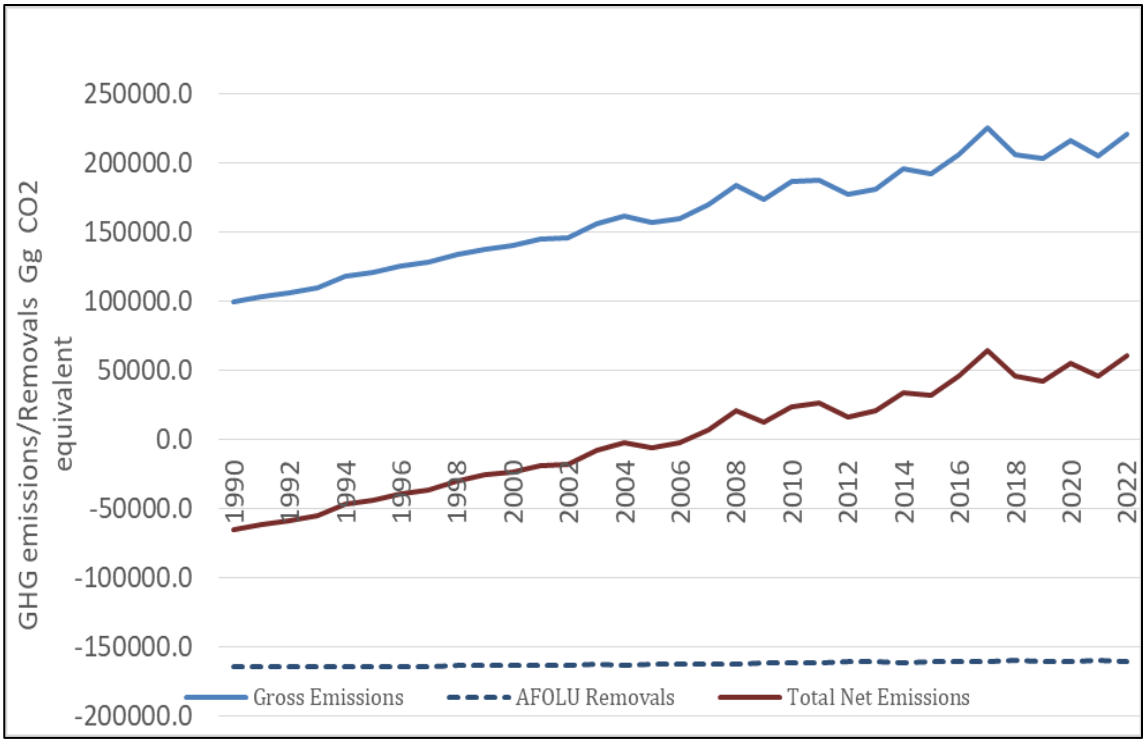


Figure 2-2: Trends of GHG Emissions and Removals

Zambia's GHG emissions without AFOLU amounted to 18,410.3 $GgCO_2eq$ in 2002 in comparison with 5,942.5 $GgCO_2eq$ in 1990 translating to an increase of 209.81%. The emissions increased steadily from 1990 to 2008 and continued to increase sharply from 2008 to 2022.

The details on quantities of total GHG emissions and removals (with and without AFOLU) for the period 1990 to 2022 are provided in Table 2.3

Table 2-3: Quantities of GHG Emissions and Removals for the period 1990 to 2022($GgC0_2eq$)

Sector	Gross Uptake/ Removals	Total AFOLU emissions	Energy	IPPU	Waste	Emissions Without AFOLU	Emissions with AFOLU	Net Emissions
1990	-164745.1	93636.2	3926.2	1161.3	855.0	5942.5	99578.7	-65166.4
1991	-164778.3	97855.7	3314.6	1140.8	872.8	5328.2	103184.0	-61594.3
1992	-164678.5	99987.5	4018.1	1151.3	890.9	6060.3	106047.8	-58630.7
1993	-164665.4	103284.3	3997.4	1176.9	909.2	6083.6	109367.9	-55297.5
1994	-164652.3	111924.7	3901.5	1153.3	927.8	5982.7	117907.3	-46744.9
1995	-164621.5	114609.9	3879.6	1096.5	946.7	5922.7	120532.6	-44088.9
1996	-164716.0	118853.9	3988.6	1088.0	965.8	6042.3	124896.2	-39819.8
1997	-164720.5	122109.8	4157.7	1084.0	965.8	6207.5	128317.3	-36403.2
1998	-163737.4	127357.0	3776.7	1065.1	1005.2	5847.1	133204.0	-30533.4
1999	-163510.9	131204.1	4139.5	1061.4	1025.1	6226.1	137430.2	-26080.7
2000	-163476.7	133699.6	4100.2	1081.6	1046.4	6228.2	139927.8	-23548.9
2001	-163345.8	137847.7	4450.2	1077.2	1066.8	6594.2	144441.9	-18903.9
2002	-163222.3	138702.3	4256.1	1111.9	1079.4	6447.4	145149.7	-18072.7
2003	-163076.9	148243.2	4829.1	1178.3	1109.2	7116.6	155359.7	-7717.1
2004	-163930.5	154401.8	4959.7	1242.5	1137.1	7339.3	161741.1	-2189.4
2005	-162841.0	148942.4	5295.9	1299.7	1161.9	7757.6	156700.0	-6141.0
2006	-162726.9	151059.1	6236.2	1308.6	1187.9	8732.7	159791.8	-2935.1
2007	-162909.9	161559.3	5848.2	1327.1	1215.0	8390.3	169949.6	7039.7
2008	-162327.8	174795.5	5808.9	1375.2	1243.5	8427.6	183223.1	20895.4
2009	-161498.4	164823.7	5917.5	1509.4	1273.5	8700.3	173524.0	12025.6
2010	-162184.5	176915.4	6222.2	1515.3	1304.5	9042.0	185957.4	23772.9
2011	-161887.0	178053.2	6807.6	1491.7	1336.2	9635.5	187688.7	25801.7
2012	-161045.4	166890.9	6725.7	1628.3	1373.7	9727.7	176618.6	15573.2
2013	-160900.5	170840.1	7094.4	1745.7	1412.3	10252.4	181092.6	20192.1
2014	-161451.7	184796.9	7598.2	1589.6	1459.3	10647.1	195444.0	33992.3
2015	-160609.0	181181.1	7458.3	1888.0	1527.8	10874.2	192055.3	31446.3
2016	-160414.2	192416.8	9860.4	2073.8	1607.3	13541.5	205958.3	45544.1
2017	-161171.1	210849.2	10681.6	1796.0	1648.0	14125.6	224974.8	63803.8
2018	-160176.9	189895.8	12456.4	1873.4	1682.7	16012.5	205908.2	45731.3
2019	-160881.9	186340.8	13316.1	1780.5	1783.5	16880.0	203220.8	42338.9
2020	-160737.2	198994.0	12834.1	1767.0	1882.6	16483.7	215477.7	54740.5
2021	-159743.1	187778.6	13615.0	1766.2	1980.7	17361.9	205140.5	45397.4
2022	-160443.0	202051.8	14571.4	1744.3	2094.6	18410.3	220462.1	60019.1

2.2.2 Emissions and Removals Trends by Gas

2.2.2.1 Sectorial GHG Emission Trends

In 2022, most of the GHG emissions existed as CO_2 (87%) followed by CH_4, (11%), and N_2O (2%). The contribution of SF_6 and HFC to the emissions was negligible. Sulphur hexafluoride (SF_6) has been largely negligible across all the years (Figure 2.3).

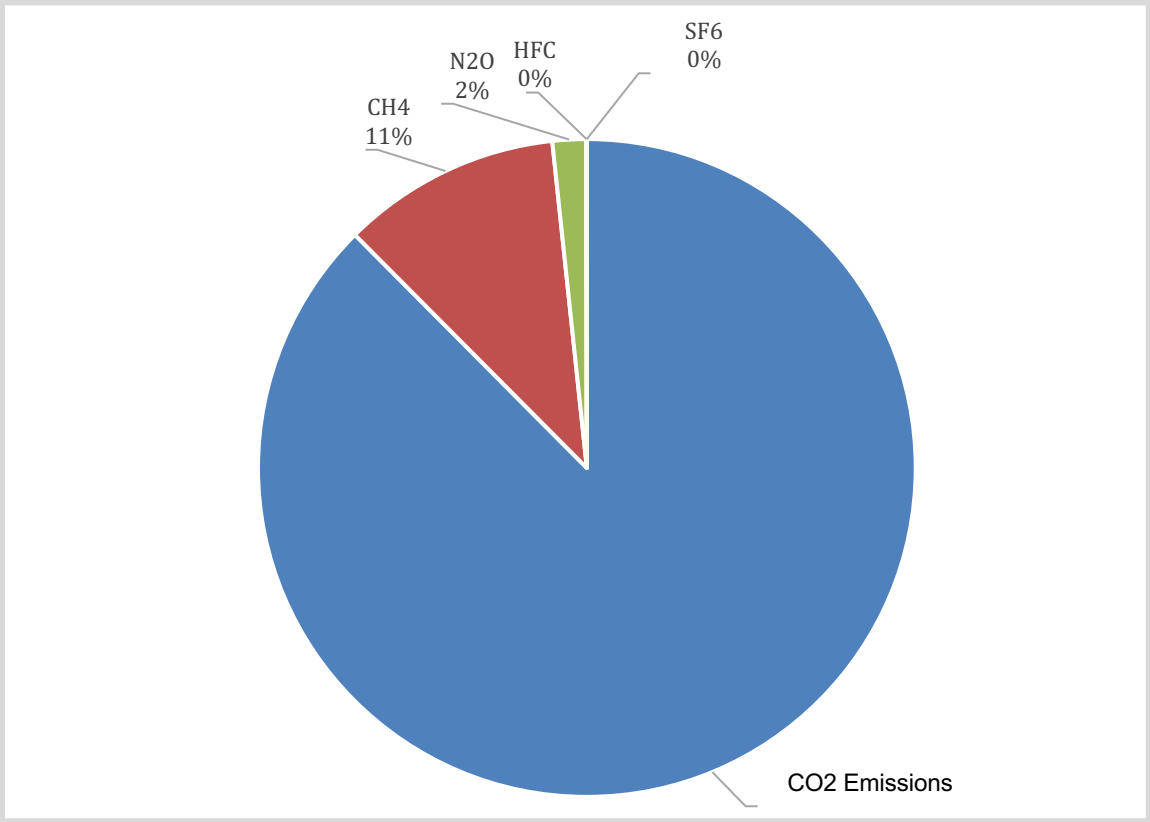


Figure 2-3: Share of GHG Emissions by Gas

The emissions of CO_2 increased from 88,549.0 $GgCO_2eq$ in the base year (1990) to 189,215.2 $GgCO_2eq$ in the current year (2022) representing a 113 % increase. In the same period, CH_4, N_2O, and HFCs increased from 9,437.3 $GgCO_2eq$, 633.2 $GgCO_2eq$, 0.2 $GgCO_2eq$ and 0.2 $GgCO_2eq$ in the base year 1990 to 23,296.7 $GgCO_2eq$, 3,561.6 $GgCO_2eq$ and 69.3 $GgCO_2eq$ in the current year 2022, respectively (Table 2.4).

Table 2-4: GHG Emission Trends by Gas (Gg CO2 eq) for the period 1990 to 2022

	CO_2 Emissions	CO_2 Removals	CH4	N2O	HFC	SF_6
1990	88549.0	-164745.1	9437.3	633.2	0.2	0.0005
1991	90565.5	-164778.3	10367.2	784.9	0.6	0.0010
1992	93072.8	-164678.5	10545.8	1134.0	0.9	0.0010
1993	95831.2	-164665.4	10782.6	1143.1	1.3	0.0109
1994	102392.5	-164652.3	11225.2	1326.8	1.6	0.0199
1995	104358.2	-164621.5	11240.0	1470.2	1.9	0.0199
1996	108166.0	-164716.0	11097.4	1674.7	2.3	0.0199
1997	109195.3	-164720.5	12807.8	1857.4	2.6	0.0199
1998	113043.7	-163737.4	13246.5	2012.7	3.0	0.0199
1999	115607.7	-163510.9	14155.0	2205.7	3.4	0.0199
2000	117638.1	-163476.7	13827.8	2501.5	3.8	0.0339
2001	121313.2	-163345.8	14359.5	2542.4	4.2	0.0339
2002	122201.9	-163222.3	13822.7	2652.2	4.7	0.0339
2003	131324.3	-163076.9	14267.8	2882.6	6.0	0.0339
2004	138566.2	-163930.5	13859.8	2892.5	8.2	0.0333
2005	126758.9	-162841.0	17293.2	3583.8	12.1	0.2264
2006	134956.3	-162726.9	16119.0	2779.3	16.2	0.2296
2007	145588.3	-162909.9	15619.9	2860.2	19.8	0.2296
2008	158030.7	-162327.8	16601.7	3058.3	26.1	0.2296
2009	148766.1	-161498.4	16664.7	2626.9	27.8	0.2296
2010	159966.0	-162184.5	16985.8	2939.9	29.8	0.3909
2011	162314.7	-161887.0	15916.6	2972.9	34.3	0.5052
2012	147584.9	-161045.4	19762.7	3140.8	42.5	0.5167
2013	150443.6	-160900.5	20012.2	3272.5	50.9	0.5167
2014	160790.7	-161451.7	25487.4	3013.2	50.7	0.6450
2015	159732.3	-160609.0	20425.6	4171.8	54.2	0.8983

2016	173947.9	-160414.2	21405.1	3339.5	54.0	0.9159
2017	190889.8	-161171.1	25974.3	2803.4	56.3	0.9159
2018	177671.6	-160176.9	20285.8	2727.0	63.3	0.9159
2019	168386.6	-160881.9	17008.0	3563.2	68.4	0.9159
2020	186452.1	-160737.2	19544.7	3059.0	68.6	0.9159
2021	175942.1	-159743.1	20813.1	3422.7	70.8	0.9159
2022	189215.2	-160443.0	23296.7	3561.3	69.3	0.9159

As represented in figure 2.4, emissions of all the gases (CO_2 , CH_4, N_2O, HFC and SF_6) increased steadily over the period under review.

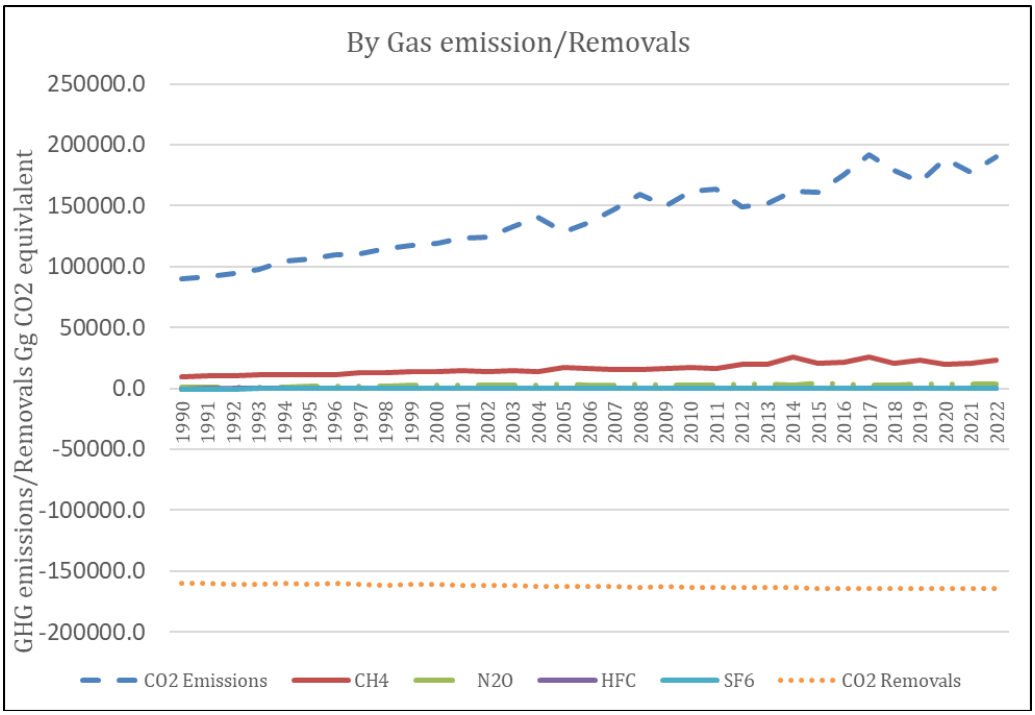


Figure 2-4: Emissions and Removals trends by Gas for the period 1990 to 2022

The primary source of CO_2 emissions in Zambia is the Agriculture, Forestry, and Other Land Use (AFOLU) sector, with the most significant contributions stemming from wood removals associated with timber harvesting, fuel-wood extractions and disturbances caused by wildfires.

Wood removals accounted for approximately 40% of the total CO_2 emissions, largely due to commercial logging and land conversion activities. These include the clearing of extensive forested land to facilitate agricultural expansion and infrastructure development.

Fuel-wood extraction accounted for around 30% of CO_2 emissions, driven predominantly by widespread dependence on wood fuel and charcoal for household energy needs in both rural and urban areas.

Wildfires and related environmental disturbances were responsible for the remaining 30% of emissions. These emissions are attributed to recurring fire events and are exacerbated by climate variability, prolonged dry spells, and ongoing deforestation, all of which increase the landscape's vulnerability to fire.

Figure 2.5, shows the contribution of Wood Removals and Disturbance to CO_2 emissions.

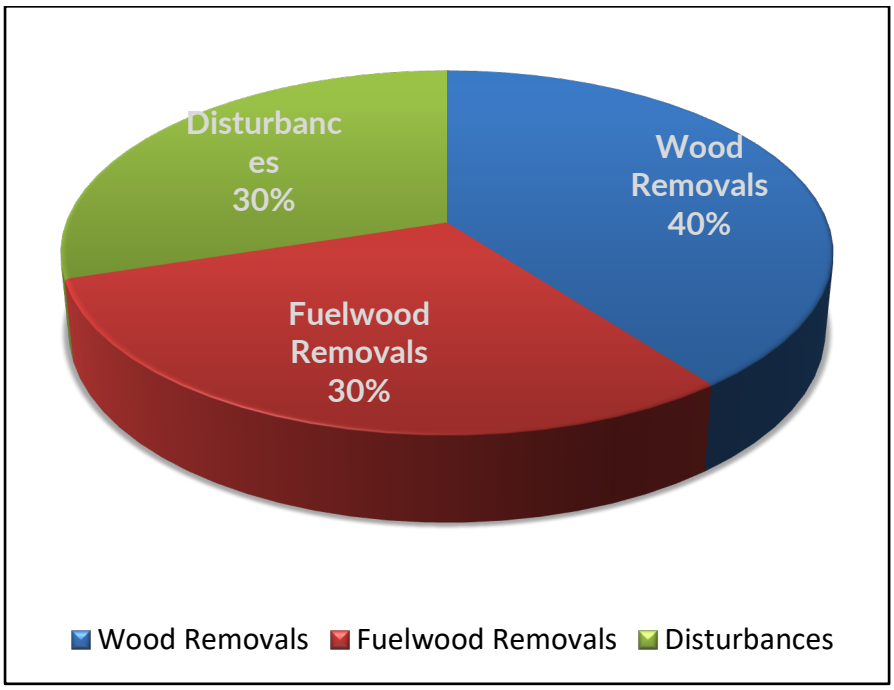


Figure 2-5: Contribution of Wood Removals and Disturbance to CO2 emissions

The energy sector is the second source of CO_2 emissions in Zambia, primarily driven by fossil fuel combustion for electricity generation. In contrast, the lPPU sector contributed the least CO_2 emissions, mainly from the mineral industry, reflecting the country's relatively low level of industrialization. Methane (CH_4) emissions were predominantly from enteric fermentation within the livestock sub-category.

Emissions from the waste sector were comparatively low, largely due to limited data availability and poor waste management practices.

Nitrous oxide (N_2O) emissions were mainly from aggregate sources and non-CO_2 emissions on land. The Key drivers of emissions included biomass burning on forest land, cropland and grassland, as well as both direct and indirect emissions from managed soils

Carbon dioxide (CO_2) removals, or sinks were primarily associated with forest land. However, these sinks declined significantly over the period from 1990 to 2022.

2.2.2.2 Precursor Gasses

In Zambia, the key precursor gases assessed in the current review include Carbon Monoxide (CO), Non-Methane Volatile Organic compounds (NMVOCs), Nitrogen Oxides (NOx), Sulphur Dioxide (SO_2), and Ammonia (NH_3). Between 1990 and 2022, emissions of NMVOCs, NOx, SO_2, and NH_3 increased steadily, while CO emissions rose sharply. The Agriculture, Forestry, and Other Land Use (AFOLU) sector was the dominant source, contributing 62% of emissions, followed by the energy sector at 38%. Emissions from industrial processes and product use (IPPU) and the waste sector remained minimal. sectoral trends in precursor gas emissions are illustrated in Figure 2.6.

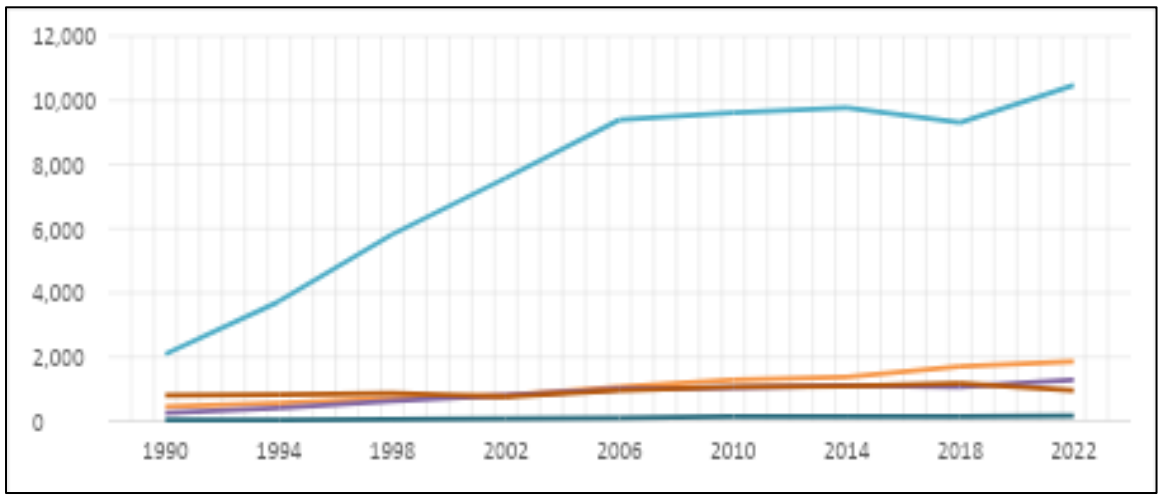


Figure 2-6: Trends of Precursor Emissions

As of 2022, CO accounted for the largest share of precursor gas emissions (71%), followed by NOx (13%), NMVOCs (9%), and SO_2 (6%), with NH_3 contributing the least (1%). Despite its small share, NH_3 emissions rose significantly from 34 $GgCO_2eq$ in 1990 to 168 $GgCO_2eq$ in 2022, translating to 400% increase. Similarly, CO_2 emissions increased, from 2,092 $GgCO_2eq$ to 10,467 $GgCO_2eq$ over the same period translating to an increase of approximately 400%. NOx and NMVOCs also saw sharp increases of 313% and 399%, respectively.

The rise in precursor emissions is largely attributed to increased fossil fuel combustion for electricity generation and transportation, as well as biomass burning particularly through inefficient technologies and open burning in land-use sectors.

2.2.3 Comparison of Emissions and Removals between BUR and BTR after Recalculation

A comparative analysis of GHG emissions by source and removals by sink, from the previous Biennial Update Report (BUR) and the current BTR 1/NC4 after recalculations was undertaken. The analysis revealed notable revisions in both estimates, enhancing the transparency of the country's net GHG assessment.

Between 2000 and 2016, the BTR consistently reported higher greenhouse gas (GHG) emissions and lower removals than the BUR. In 2016 for example, BUR emissions were approximately 126,758.30 $GgCO_2eq$, while BTR emissions for the same year rose to around 200,266.93 $GgCO_2eq$, showing a 58.0 % increase. On the other hand, BUR removals of about -136,266.80 $GgCO_2eq$, compared to a BTR more conservative -160,414.17 $GgCO_2eq$ reflected a 17.7 % reduction in estimated carbon sinks. This pattern was consistent across all years resulting in significantly higher net emissions. A comparison of emissions and removals between BUR and BTR after recalculation are presented in Figure 2.7 and Table 2.5.

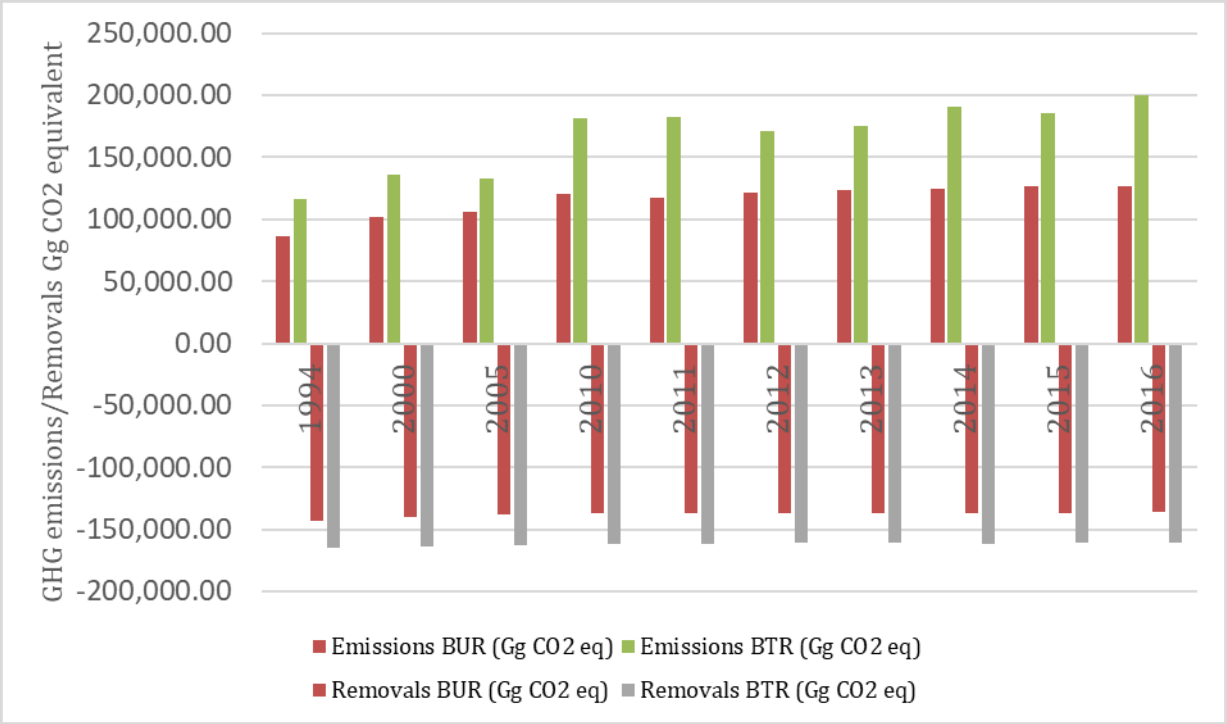


Figure 2-7: Comparison of BUR and BTR Emissions and Removals after Recalculation

These changes indicate that the BTR applied updated methodologies, enhanced data accuracy and adhered to more robust reporting guidelines in line with the enhanced transparency requirements under the Paris Agreement. Further, differences between the BUR and BTR estimates, highlight the ongoing improvements in Zambia's GHG inventory processes.

The BTR estimates, therefore establishes a more reliable benchmark for future monitoring and assessment of climate mitigation efforts, particularly in critical sectors such as AFOLU, where land use and management pose significant challenges. Table 2.5 highlights the comparison of BUR and BTR Emissions and Removals after recalculations.

Table 2-5: Comparison of BUR and BTR Emissions and Removals after Recalculation

Year	Emissions		Difference		Removals		Difference	
	BUR ($GgCO_2eq$)	BTR ($GgCO_2eq$)	$GgCO_2eq$	(%)	BUR ($GgCO_2eq$)	BTR ($GgCO_2eq$)	($GgCO_2eq$)	(%)
1994	86,063.20	116,793.93	30,730.73	280.1	-142,929.20	-164,652.27	21,723.07	-15.2
2000	102,236.80	135832.9	33,596.12	304.3	-139,624.20	-163,476.75	23,852.55	-17.1
2005	105,938.40	132,974.58	27,036.18	391.8	-138,259.00	-162,841.04	24,582.04	-17.8
2010	120,604.70	181,525.47	60,920.77	198.0	-137,322.90	-162,184.54	24,861.64	-18.1
2011	117,654.00	182,757.53	65,103.53	180.7	-137,213.60	-161,887.02	24,673.42	-18.0
2012	121,775.50	170,971.72	49,196.22	247.5	-137,020.90	-161,045.35	24,024.45	-17.5
2013	123,881.50	175,125.97	51,244.47	241.7	-136,828.20	-160,900.51	24,072.31	-17.6
2014	125,047.30	190,612.89	65,565.59	190.7	-136,635.50	-161,451.68	24,816.18	-18.2
2015	126,425.70	185,901.70	59,476.00	212.6	-136,442.80	-160,609.02	24,166.22	-17.7
2016	126,758.30	200,266.93	73,508.63	172.4	-136,266.80	-160,414.17	24,147.37	-17.7

2.3 Sectorial and Category-specific Trends

2.3.1 Sectoral GHG Emission Contribution Trends

Zambia's greenhouse gas (GHG) emissions are reported across four main sectors: Energy, Industrial Processes and Product Use (IPPU), Waste, and Agriculture, Forestry, and Other Land Use (AFOLU), which includes both emissions and removals. The AFOLU sector was by far the largest contributor, accounting for 91% of total GHG emissions. The energy sector followed with 7%, while the waste and IPPU sectors each contributed approximately 1% in 2022, (Figure 2.8).

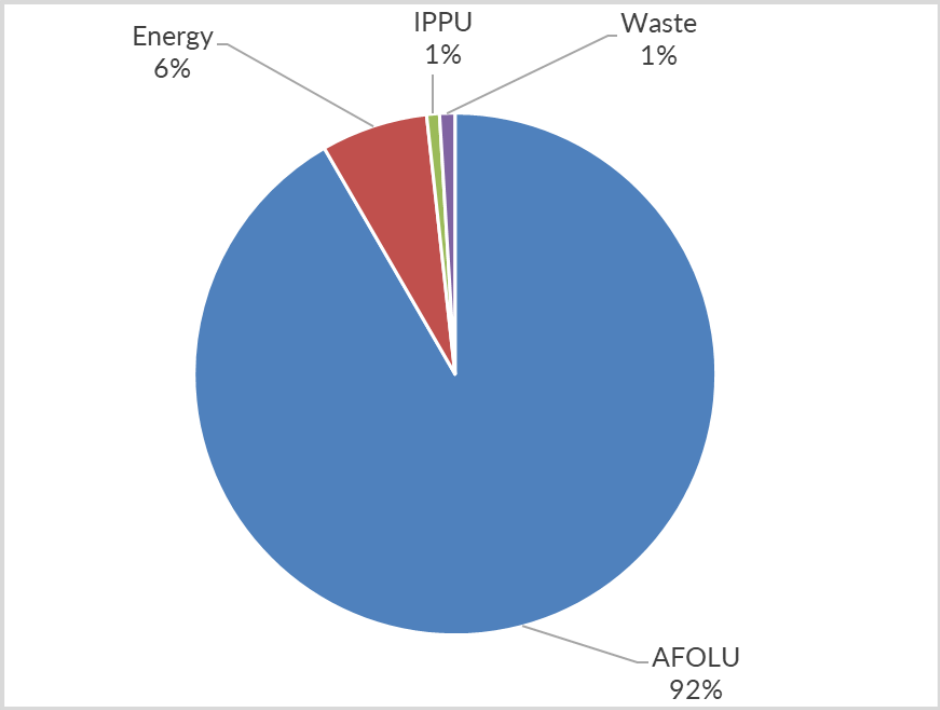


Figure 2-8: Emissions Contributed by Sector for 2022

This distribution of emissions remained consistent throughout the time series, from 1990 to 2022, with AFOLU being the dominant source, followed by energy, IPPU, and waste, indicating persistent trend in emissions.

2.3.1.1 Sectorial GHG Emission Trends

An overview of the trend of GHG emissions and removals for the period 1990–2022, indicated a decline in carbon sinks in 1990, followed by a progressive increase in net emissions from 2007 to 2022, with a peak observed in 2017. The upward trend in emissions is primarily attributed to increased utilization of fuelwood, driven by electricity load shedding, resulting from reduced hydro-electricity generation capacity during periods of drought and low water levels.

Figure 2.9 presents the trend of GHG emissions and removals for the period1990 to 2022.

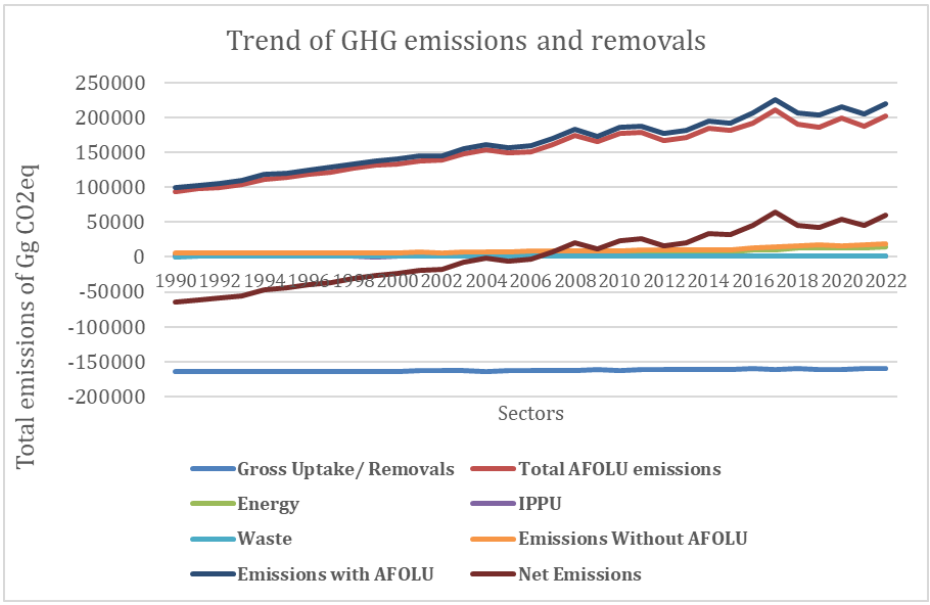


Figure 2-9: Trends of GHG emissions and Removals

The AFOLU sector, gross greenhouse gas (GHG) emissions rose steadily from 99,578.7 $GgCO_2eq$ in 1990 to 220,462.1 $GgCO_2eq$ in 2022 representing an increase of 121%. A notable surge in emissions occurred in 2014, largely due to increased wood removals from timber harvesting, fuel-wood extraction and disturbances (wildfires, pest outbreaks and land degradation). Similarly, emissions from the energy sector increased by 271% over the same period, rising from 3,926.2 $GgCO_2eq$ in 1990 to 14,571 $GgCO_2eq$ in 2022.

Gross carbon uptake / removals declined slightly, from -164,745.1 $GgCO_2eq$ in 1990 to -160,443.0 $GgCO_2eq$ in 2022 attributed to stability in electricity supply and reduced usage of fuel-wood. Figure 2.10 shows total emissions with AFOLU and Gross uptake/removals.

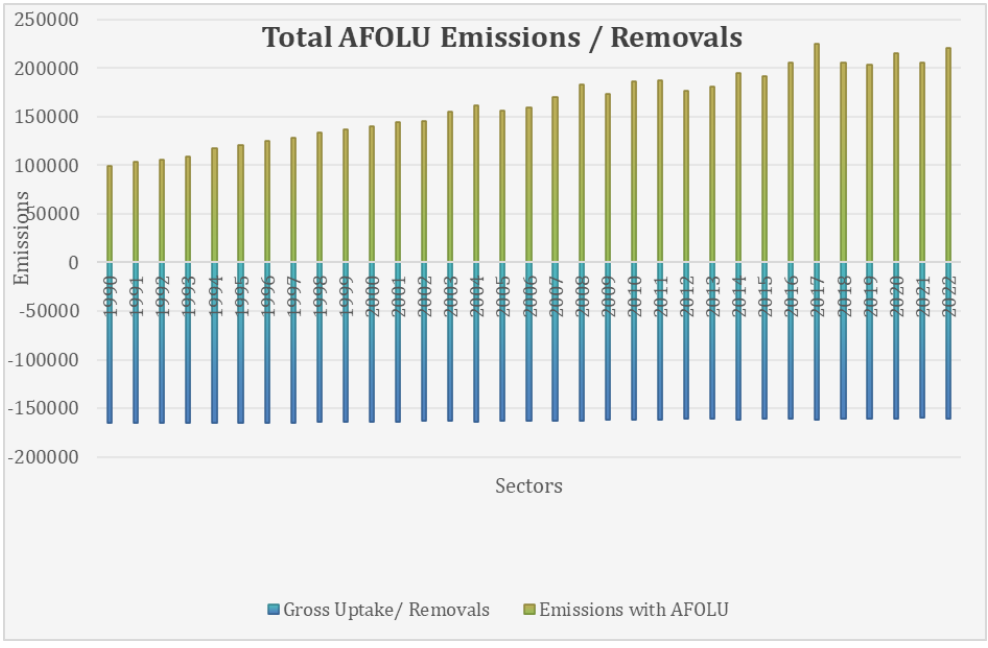


Figure 2-10: Total Emissions with AFOLU and Gross uptake/removals

The Energy sector emissions increased gradually between 1990 and 2012, followed by a gradual rise from 2013 onwards. This increase is attributed to expanded fossil fuel use for electricity generation, including the commissioning of a residual fuel-based power plant in 2013 and a coal-fired power plant in 2016.

The Emissions from the IPPU and waste sectors also increased during the review period by 50% and 145%, respectively (Figure 2.11).

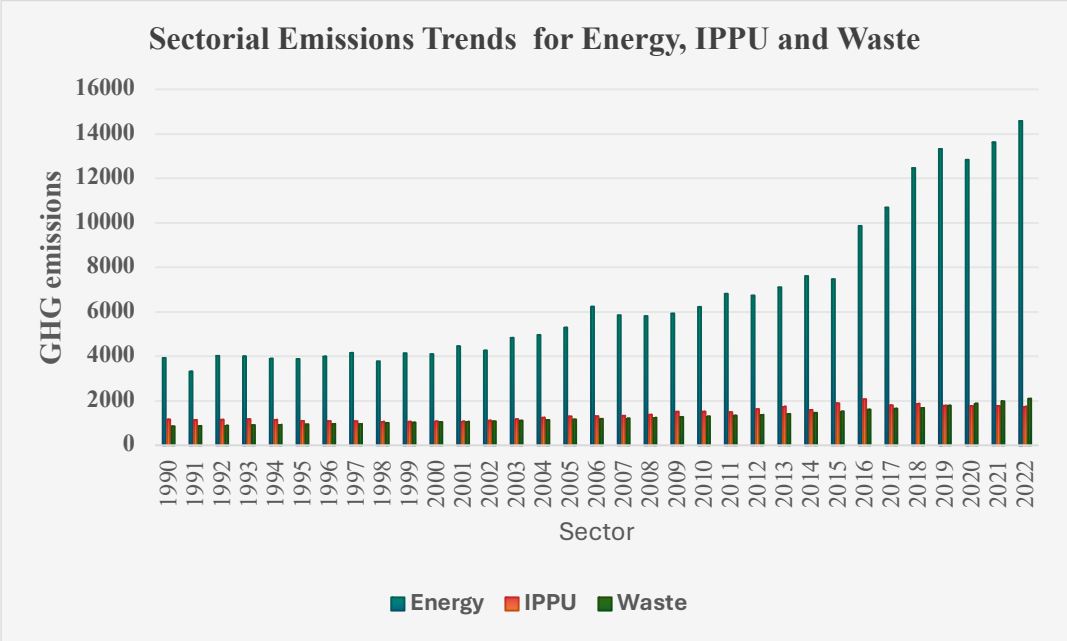


Figure 2-11: Sectorial Emissions Trends for Energy, IPPU and Waste

In 2022, The total emissions and removals reported for AFOLU were 202,051 $GgCO_2eq$, Energy 14,571.4 $GgCO_2eq$, IPPU 1,744.3 $GgCO_2eq$, and Waste 2,094.6 $GgCO_2eq$.

The total emissions excluding AFOLU amounted to 18,410.3 $GgCO_2eq$, while total emissions including AFOLU were 220,462.1 $GgCO_2eq$. Considering removals from land use and forestry activities, the net emissions for 2022 were estimated at 60,019.1 $GgCO_2eq$.

AFOLU sector remained the dominant source of emissions**,** largely driven by activities such as land-use change and deforestation. The Energy sector ranked as the second-largest contributor, mainly due to fuel combustion in transport and industrial processes. The IPPU and Waste sectors contributed relatively smaller shares to total emissions.

A summary of Zambia's anthropogenic GHG emissions and removals by sector, for the period 1990 to 2022 is presented in Table 2.6 and a summary of total emissions and removals across all the IPCC sectors, categories and sub categories for 2022 are provided in Table 2.7.

Table 2-6: A Summary of Zambia's anthropogenic GHG emissions and removals by sector, for the period 1990 to 2022($GgCO_2eq$)

Sector	Gross Uptake/ Removals	Total AFOLU emissions	Energy	IPPU	Waste	Emissions Without AFOLU	Emissions with AFOLU	Net Emissions
1990	-164745.1	93636.2	3926.2	1161.3	855.0	5942.5	99578.7	-65166.4
1991	-164778.3	97855.7	3314.6	1140.8	872.8	5328.2	103184.0	-61594.3
1992	-164678.5	99987.5	4018.1	1151.3	890.9	6060.3	106047.8	-58630.7
1993	-164665.4	103284.3	3997.4	1176.9	909.2	6083.6	109367.9	-55297.5
1994	-164652.3	111924.7	3901.5	1153.3	927.8	5982.7	117907.3	-46744.9
1995	-164621.5	114609.9	3879.6	1096.5	946.7	5922.7	120532.6	-44088.9
1996	-164716.0	118853.9	3988.6	1088.0	965.8	6042.3	124896.2	-39819.8
1997	-164720.5	122109.8	4157.7	1084.0	965.8	6207.5	128317.3	-36403.2
1998	-163737.4	127357.0	3776.7	1065.1	1005.2	5847.1	133204.0	-30533.4
1999	-163510.9	131204.1	4139.5	1061.4	1025.1	6226.1	137430.2	-26080.7
2000	-163476.7	133699.6	4100.2	1081.6	1046.4	6228.2	139927.8	-23548.9
2001	-163345.8	137847.7	4450.2	1077.2	1066.8	6594.2	144441.9	-18903.9
2002	-163222.3	138702.3	4256.1	1111.9	1079.4	6447.4	145149.7	-18072.7
2003	-163076.9	148243.2	4829.1	1178.3	1109.2	7116.6	155359.7	-7717.1
2004	-163930.5	154401.8	4959.7	1242.5	1137.1	7339.3	161741.1	-2189.4
2005	-162841.0	148942.4	5295.9	1299.7	1161.9	7757.6	156700.0	-6141.0
2006	-162726.9	151059.1	6236.2	1308.6	1187.9	8732.7	159791.8	-2935.1
2007	-162909.9	161559.3	5848.2	1327.1	1215.0	8390.3	169949.6	7039.7
2008	-162327.8	174795.5	5808.9	1375.2	1243.5	8427.6	183223.1	20895.4
2009	-161498.4	164823.7	5917.5	1509.4	1273.5	8700.3	173524.0	12025.6
2010	-162184.5	176915.4	6222.2	1515.3	1304.5	9042.0	185957.4	23772.9
2011	-161887.0	178053.2	6807.6	1491.7	1336.2	9635.5	187688.7	25801.7
2012	-161045.4	166890.9	6725.7	1628.3	1373.7	9727.7	176618.6	15573.2
2013	-160900.5	170840.1	7094.4	1745.7	1412.3	10252.4	181092.6	20192.1
2014	-161451.7	184796.9	7598.2	1589.6	1459.3	10647.1	195444.0	33992.3
2015	-160609.0	181181.1	7458.3	1888.0	1527.8	10874.2	192055.3	31446.3
2016	-160414.2	192416.8	9860.4	2073.8	1607.3	13541.5	205958.3	45544.1
2017	-161171.1	210849.2	10681.6	1796.0	1648.0	14125.6	224974.8	63803.8
2018	-160176.9	189895.8	12456.4	1873.4	1682.7	16012.5	205908.2	45731.3
2019	-160881.9	186340.8	13316.1	1780.5	1783.5	16880.0	203220.8	42338.9
2020	-160737.2	198994.0	12834.1	1767.0	1882.6	16483.7	215477.7	54740.5
2021	-159743.1	187778.6	13615.0	1766.2	1980.7	17361.9	205140.5	45397.4
2022	-160443.0	202051.8	14571.4	1744.3	2094.6	18410.3	220462.1	60019.1

Table 2-7: Summary Reporting Table of emissions for 2022

Categories	Emissions (Gg)			Emissions CO_2 Equivalents (Gg)					Emissions (Gg)				
	Net CO_2 (1)(2)	CH_4	N_2O	HFCs	PFCs	SF_6	NF_3	Other halogenated gases with CO_2 equivalent conversion factors (3)	Other halogenated gases without CO_2 equivalent conversion factors (4)	NOx	CO	NMVOCs	SO_2
Total National Emissions and Removals	30098.83196	832.024	13.439	69.281	NO	0.916	NO	0	0				0
1 - Energy	10814.96656	151.404	1.3506	0	0	0	0	0	0				0
1.A - Fuel Combustion Activities	10814.93171	61.1622	1.1722	0	0	0	0	0	0				0
1.A.1 - Energy Industries	3540.255757	0.39475	0.1027							0	0	0	0
1.A.2 - Manufacturing Industries and Construction	3491.873011	1.55351	0.0903							0	0	0	0
1.A.3 - Transport	3139.099967	0.56459	0.2567							0	0	0	0
1.A.4 - Other Sectors	618.0440151	58.6488	0.7224							0	0	0	0
1.A.5 - Non-Specified	25.65895952	0.00055	0.0001							0	0	0	0
1.B - Fugitive emissions from fuels	0.034849048	90.2416	0.1784	0	0	0	0	0	0				0
1.B.1 - Solid Fuels	0.034849048	90.2416	0.1784										0
1.B.2 - Oil and Natural Gas	NO	NO	NO										0
1.B.3 - Other emissions from Energy Production	NO	NO	NO										0
1.C - Carbon dioxide Transport and Storage	NO	NO	NO	NO	NO	NO	NO	NO	0				0
1.C.1 - Transport of CO2	NO									0	0	0	0
1.C.2 - Injection and Storage	NO									0	0	0	0
1.C.3 - Other	NO									0	0	0	0

2 - Industrial Processes and Product Use	1674.067205	0	0	69.281	0	0.916	0	0	0	0	0	0	0
2.A - Mineral Industry	1635.971265	0	0	0	0	0	0	0	0	0	0	0	0
2.A.1 - Cement production	512.93476									0	0	0	0
2.A.2 - Lime production	1123.036505									0	0	0	0
2.A.3 - Glass Production	NO									0	0	0	0
2.A.4 - Other Process Uses of Carbonates	NO									0	0	0	0
2.A.5 - Other (please specify)	NO	NO	NO							0	0	0	0
2.B - Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	0	0	0	0
2.B.1 - Ammonia Production	NO									0	0	0	0
2.B.2 - Nitric Acid Production			NO							0	0	0	0
2.B.3 - Adipic Acid Production			NO							0	0	0	0
2.B.4 - Caprolactam, Glyoxal and Glyoxylic Acid Production			NO							0	0	0	0
2.B.5 - Carbide Production	NO	NO								0	0	0	0
2.B.6 - Titanium Dioxide Production	NO									0	0	0	0
2.B.7 - Soda Ash Production	NO									0	0	0	0
2.B.8 - Petrochemical and Carbon Black Production	NO	NO								0	0	0	0
2.B.9 - Fluorochemical Production				0					0	0	0	0	0
2.B.10 - Hydrogen Production	NO	NO	NO							0	0	0	0
2.B.11 - Other (Please specify)	NO	NO	NO							0	0	0	0
2.C - Metal Industry	19.2525004	0	0	0	0	0	0	0	0	0	0	0	0
2.C.1 - Iron and Steel Production	19.2342004	NO								0	0	0	0

2.C.2 - Ferroalloys Production	NO	NO								0	0	0	0
2.C.3 - Aluminium production	NO				NO				NO	0	0	0	0
2.C.4 - Magnesium production	NO									0	0	0	0
2.C.5 - Lead Production	0.0183									0	0	0	0
2.C.6 - Zinc Production	NO									0	0	0	0
2.C.7 - Rare Earths Production	NO									0	0	0	0
2.C.8 - Other (please specify)	NO	NO	NO							0	0	0	0
2.D - Non-Energy Products from Fuels and Solvent Use	18.84344	NO	NO	NO	NO	NO	NO	NO	NO	0	0	0	0
2.D.1 - Lubricant Use	18.84344									0	0	0	0
2.D.2 - Paraffin Wax Use	NE									0	0	0	0
2.D.3 - Solvent Use										0	0	0	0
2.D.4 - Other (please specify)	NO	NO	NO							0	0	0	0
2.E - Electronics Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	0	0	0	0
2.E.1 - Integrated Circuit or Semiconductor			NO							0	0	0	0
2.E.2 - TFT Flat Panel Display			NO							0	0	0	0
2.E.3 - Photovoltaics										0	0	0	0
2.E.4 - Heat Transfer Fluid										0	0	0	0
2.E.5 - Other (please specify)	NO	NO	NO		NO	NO			0	0	0	0	0
2.F - Product Uses as Substitutes for Ozone Depleting Substances	0	0	0	69.281	0	0	0	0	0	0	0	0	0
2.F.1 - Refrigeration and Air Conditioning				69.281		NO			0	0	0	0	0
2.F.2 - Foam Blowing Agents										0	0	0	0

2.F.3 - Fire Protection										0	0	0	0
2.F.4 - Aerosols										0	0	0	0
2.F.5 - Solvents										0	0	0	0
2.F.6 - Other Applications (please specify)										0	0	0	0
2.G - Other Product Manufacture and Use	NO	NO	NO	NO	NO	0.916	NO	NO	NO	0	0	0	0
2.G.1 - Electrical Equipment						0.916			NO	0	0	0	0
2.G.2 - SF6 and PFCs from Other Product Uses						NO			NO	0	0	0	0
2.G.3 - N2O from Product Uses			NO							0	0	0	0
2.G.4 - Other (Please specify)	NO	NO	NO							0	0	0	0
2.H - Other										0	0	0	0
2.H.1 - Pulp and Paper Industry	NO	NO	NO							0	0	0	0
2.H.2 - Food and Beverages Industry	NE	NE	NE							0	0	0	0
2.H.3 - Other (please specify)	0	0	0							0	0	0	0
3 - Agriculture, Forestry, and Other Land Use	17609.37835	605.85	12.086	0	0	0	0	0	0	141.481	3042.596	0	0
3.A - Livestock	0	482.976	0.2394	0	0	0	0	0	0	0	0	0	0
3.A.1 - Enteric Fermentation		465.058								0	0	0	0
3.A.2 - Manure Management		17.9183	0.2394							0	0	0	0
3.B - Land	17488.5645	0	0	0	0	0	0	0	0	0	0	0	0
3.B.1 - Forest land	-11942.96438									0	0	0	0
3.B.2 - Cropland	8505.389243									0	0	0	0
3.B.3 - Grassland	20522.53528									0	0	0	0
3.B.4 - Wetlands	41.57970432									0	0	0	0

3.B.5 - Settlements	362.0246464									0	0	0	0
3.B.6 - Other Land	NE									0	0	0	0
3.C - Aggregate sources and non-CO2 emissions sources on land	120.8138552	122.874	11.847	0	0	0	0	0	0	141.481	3042.596	0	0
3.C.1 - Burning	0	116.483	7.6177							141.481	3042.596	0	0
3.C.2 - Liming	8.18191									0	0	0	0
3.C.3 - Urea application	112.6319452									0	0	0	0
3.C.4 - Direct N2O Emissions from managed soils			3.7323							0	0	0	0
3.C.5 - Indirect N2O Emissions from managed soils			0.4957							0	0	0	0
3.C.6 - Indirect N2O Emissions from manure management			0.0012							0	0	0	0
3.C.7 - Rice cultivation		6.39114								0	0	0	0
3.C.8 - CH4 from Drained Organic Soils		NE								0	0	0	0
3.C.9 - CH4 from Drainage Ditches on Organic Soils		NE								0	0	0	0
3.C.10 - CH4 from Rewetting of Organic Soils		NE								0	0	0	0
3.C.11 - CH4 Emissions from Rewetting of Mangroves and Tidal Marshes		NE								0	0	0	0
3.C.12 - N2O Emissions from Aquaculture			NE							0	0	0	0
3.C.13 - CH4 Emissions from Rewetted and Created Wetlands on Inland Wetland Mineral Soils		NE								0	0	0	0
3.C.14 - Other (please specify)	0	NE	0							0	0	0	0
3.D - Other	0	0	0	0	0	0	0	0	0	0	0	0	0
3.D.1 - Harvested Wood Products	NE									0	0	0	0

3.D.2 - Other (please specify)	NO	NO	NO							0	0	0	0
4 - Waste	0.419842129	74.77	0.0023	0	0	0	0	0	0	0	0	0	0
4.A - Solid Waste Disposal		52.6554								0	0	0	0
4.B - Biological Treatment of Solid Waste		NO	NO							0	0	0	0
4.C - Incineration and Open Burning of Waste	0.419842129	0.18783	0.0023							0	0	0	0
4.D - Wastewater Treatment and Discharge		21.9268	0							0	0	0	0
4.E - Other (please specify)	NO	NO	NO							0	0	0	0
5 - Other	0	0	0	0	0	0	0	0	0	0	0	0	0
5.A - Indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3			NE							0	0	0	0
5.B - Indirect CO2 emissions from the atmospheric oxidation of CH4, CO and NMVOC	NE									0	0	0	0
5.C - Other	NO	NO	NO					0	0	0	0	0	0
Memo Items (5)													
International Bunkers	87.2539668	0.00061	0.0024	0	0	0	0	0	0	0	0	0	0
1.A.3.a.i - International Aviation (International Bunkers)	87.2539668	0.00061	0.0024							0	0	0	0
1.A.3.a.i - Indirect N2O emissions from the atmospheric deposition of nitrogen in NOX and NH3			NE										
1.A.3.a.i - Indirect CO2 emissions from the atmospheric oxidation of CH4, CO and NMVOC	NE												

1.A.3.d.i - International water-borne navigation (International bunkers)	NE	NE	NE							0	0	0	0
1.A.3.d.i - Indirect N2O emissions from the atmospheric deposition of nitrogen in NOX and NH3			NE										
1.A.3.d.i - Indirect CO2 emissions from the atmospheric oxidation of CH4, CO and NMVOC	NE												
1.A.5.c - Multilateral Operations	0	0	0	0	0	0	0	0	0	0	0	0	0
1.A.5.c - Indirect N2O emissions from the atmospheric deposition of nitrogen in NOX and NH3			0										
1.A.5.c - Indirect CO2 emissions from the atmospheric oxidation of CH4, CO and NMVOC	0												

The key category analysis undertaken revealed that Land use was the dominant source of emissions within the AFOLU sector, subsequently the energy industry within the energy sector was the second largest source of emissions. Under the IPPU sector the mineral industry was the highest emitting source and solid waste disposal was the main source of emissions in the waste sector, driven by population increase and GDP.

In 2022, the sub-sectoral contributions to net national GHG emissions and removals as shown in Table 2.8 (Key Category Analysis).

Table 2-8: Percentage contribution to overall GHG emissions by sub- category for the year 2022

Category	Emissions ($GgCO_2eq$)	Percentage contribution (%)
1.A.1 - Energy Industries	3578.5	1.91
1.A.2 - Manufacturing Industries and Construction	3559.3	1.90
1.A.3 - Transport	3222.9	1.72
1.A.4 - Other Sectors	1611.0	0.86
1.A.5 - Non-Specified	25.7	0.01
1.B.1 - Solid Fuels	2574.1	1.38
2.A - Mineral Industry	1636.0	0.87
2.B - Chemical Industry	0.0	0.00
2.C - Metal Industry	19.3	0.01
2.D - Non-Energy Products from Fuels and Solvent Use (6)	18.8	0.01
2.E - Electronics Industry	0.0	0.00
2.F - Product Uses as Substitutes for Ozone Depleting Substances	69.3	0.04
2.G.1 - Electrical Equipment	0.9	0.00
3.A.1 - Enteric Fermentation	13021.6	6.96
3.A.2 - Manure Management (1)	565.0	0.30
3.B.1 - Forest land-Emissions	148473.3	79.38
3.B.2 - Cropland	7,453.578	3.98
3.B.3 - Grassland	20,247.722	10.82
3.B.4 - Wetlands	41.580	0.02
3.B.5 - Settlements	362.025	0.19
3.B.6 - Other Land	0.0	0.00
3.C.1 - Burning	5280.3	2.82
3.C.2 - Liming	0.0	0.00
3.C.3 - Urea application	0.0	0.00
3.C.4 - Direct N2O Emissions from managed soils (3)	989.0	0.53
3.C.5 - Indirect N2O Emissions from managed soils	131.4	0.07
3.C.6 - Indirect N2O Emissions from manure management	0.3	0.00
3.C.7 - Rice cultivation	178.9	0.10
4.A - Solid Waste Disposal	1474.4	0.79
4.B - Biological Treatment of Solid Waste	0.0	0.00
4.C - Incineration and Open Burning of Waste	6.3	0.00
4.D - Wastewater Treatment and Discharge	613.9	0.33

2.3.2 Energy

2.3.2.1 Overview

This section provides respective emissions, activity data, emission factors and methodologies for energy categories. The IPCC 2006 guidelines broadly classify energy-related activities into 3 main categories, namely: fuel combustion activities (1.A), fugitive emissions from fuels (1.B) and Carbon dioxide transport and storage (1.C). The categories covered in the emissions estimate for energy are: i) fuel Combustion (i.e., Energy Industries, Manufacturing Industries and Construction, Transport, Other Sectors and Non-Specified), (ii) Fugitive emissions from fuels (i.e., Solid Fuels-Coal mining and handling and Fuel transformation) (iii) Carbon dioxide transport and storage (1C) - (Transport of CO2, Injection and Storage and Others).

2.3.2.2 Methodology and Emission Factors

Tier 1 was used in the emissions estimate of all the categories including; energy industries (1.A.1), manufacturing industries and construction (1.A.2), transport (1.A.3), other sectors (1.A.4) and non-specified (1.A.5) and (1.B) Fugitive emissions from fuels (1.B.1) Solid Fuels for Coal mining and handling and Fuel transformation

A simple methodological approach (based on tier 1 of the IPCC guidelines) was used to estimate emissions. It involved multiplying activity data with emission factor. Tier 1 approach was used, instead of high tiers, owing to limitations in activity data and unavailability of country-specific emission factors.

Emissions = Activity Data (AD) * Emissions Factor (EF) Equation 2.1

Tier 1 of the IPCC 2006 guidelines was used to estimate fugitive emissions, for solid fuels as well as petroleum refining.

Global average method for surface mines was used as shown in equation 2.2:

$$Methane\ Emissions = CH_4\ Emission\ Factor\ X\ Surface\ Coal\ Production\ X\ Conversion\ Factor$$

Equation 2.2

Where units are: Methane Emissions (Gg year-1); CH4 Emission Factor (m^3 tonne-1); Surface Coal Production (tonne year-1); Emissions Factor: Low CH_4 Emission = 0.3 m3 tonne-1 Average CH_4 Emission Factor = 1.2 m^3 tonne-1 High CH_4 Emission Factor = 2.0 m^3 tonne-1.

2.3.2.3 Activity Data

Zambia's energy sector has evolved significantly, primarily due to the country's enduring efforts to improve energy access and supply, since its independence in 1964. The country depends on several energy resources, such as biomass, petroleum (which is wholly imported), coal (sub-bituminous coal produced locally while the other coal types are imported), hydro, and solar, for various socio-economic activities. These include agriculture, energy industry, construction, manufacturing, mining, transport, commercial, and residential, among others. Zambia's energy demand has steadily increased over the years driven by socio-economic changes, including population growth from

approximately 8 million in 1990 [40] to 20 million in 2022[41] and an annual growth rate of 2.7% per annum. Further, Zambia's GDP grew by over $25 billion from $3.3 billion in 1990 to $29.2 billion in 2022[42], while the annual copper production almost doubled from 400 kilotons to 764 kilotons[43] during the same period, despite slight fluctuations in production between 2021 and 2022. Zambia's total energy consumption (biomass, coal, and petroleum) by sector increased steadily and doubled from 151,958.98 TJ in 1990 to 322,014.93 TJ in 2022 as shown in Figure 2.12.

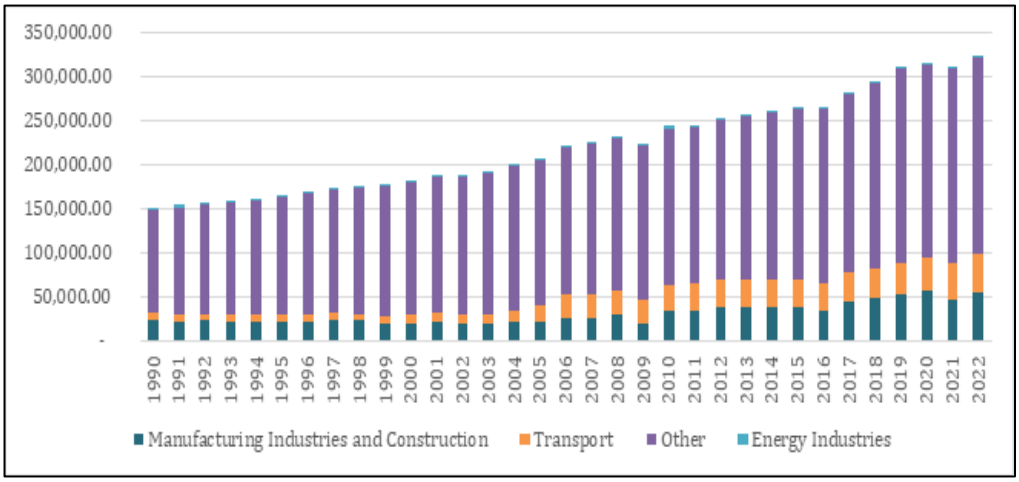


Figure 2-12: Energy Consumption by Sector (TJ)

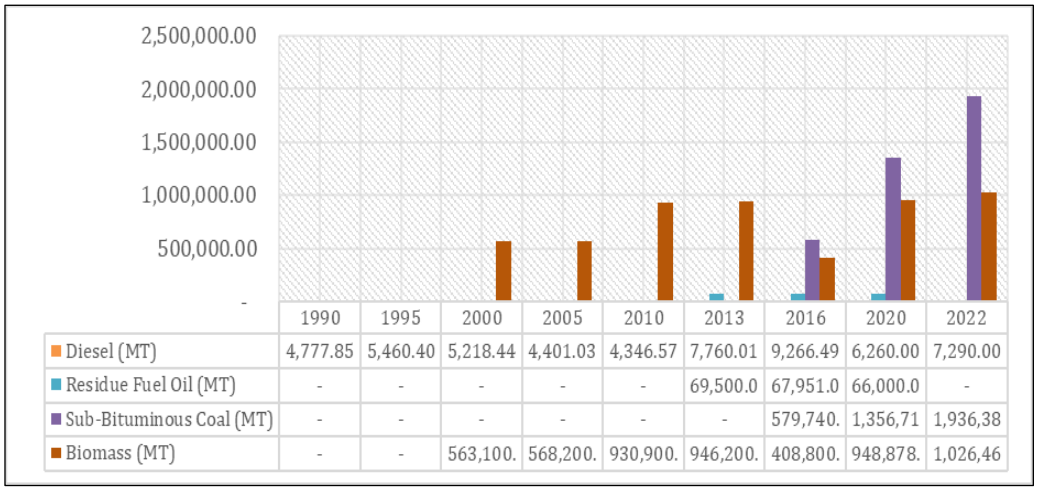
The following sub-sections provide details on the energy trends for the various categories including energy industries, manufacturing industries and construction, transport and other energy-consuming sectors.

(i) Energy Industry

This category covered fuel combustion in energy production industries including electricity generation and petroleum refinery. Zambia predominantly depended on hydro, taking up over 80% of the country's installed capacity, as a source of electricity. In 2022, the country's total installed capacity was 3,777.3 MW, with 3,164.14 MW being hydro, 300 MW from coal-fired power plant, 110 MW from HFO, 84.80 MW from diesel and 89.38 MW from on-grid solar PV[44]. The daily peak demand for electricity increased from 1,700 MW in 1990 to 2,300 MW in 2022. Despite having a higher installed capacity, Zambia could not generate enough electricity to meet its demand in some years and this was attributed to the country's over dependency on hydro which was prone to climate variability and changes, particularly extended droughts[45]. Zambia diversified its energy mix by adding electricity produced from fossil fuel- fired thermal power plants, i.e., from HFO (starting in 2013) and coal (starting in 2016) to the national grid. The electricity

[40] Population of Zambia 1990 - PopulationPyramid.net
[41] https://www.zamstats.gov.zm/2022-census/
[42] https://www.macrotrends.net/global-metrics/countries/ZMB/zambia/gdp-gross-domestic-product
[43] Production Figures – Zambia Chamber of Mines
[44] esr2023.pdf
[45] Press-statement-on-the-electricity-situation-in-zambia-at-government-complex-12.06.2024.pdf

from biomass was auto-generated by Zambia Sugar Plc from bagasse (a waste product from sugarcane processing) while diesel-based generation has been from small isolated systems including a backup system at Copperbelt Energy Corporation (CEC). Figure 2.13 shows the quantities (in MT) of various fuels used for electricity generation during the period under review.



	1990	1995	2000	2005	2010	2013	2016	2020	2022
Diesel (MT)	4,777.85	5,460.40	5,218.44	4,401.03	4,346.57	7,760.01	9,266.49	6,260.00	7,290.00
Residue Fuel Oil (MT)	-	-	-	-	-	69,500.0	67,951.0	66,000.0	-
Sub-Bituminous Coal (MT)	-	-	-	-	-	-	579,740.	1,356,71	1,936,38
Biomass (MT)	-	-	563,100.	568,200.	930,900.	946,200.	408,800.	948,878.	1,026,46

Figure 2-13: Fuel Consumption in Electricity Generation

(ii) Petroleum Refining

During the period under review, Zambia imported and refined crude oil into petroleum products (i.e., petrol, diesel, kerosene, liquefied petroleum gas, bitumen and other products). The country's annual consumption of petroleum products steadily increased from about 384,360 MT in 1990 to 1,549,270 MT in 2022. A total of 15,366,370 MT of crude oil was refined from 1990 to 2021, with the minimum being 16,850 MT in 2000 and the maximum of 701,330 MT in 2014 as provided in Figure 2.14.

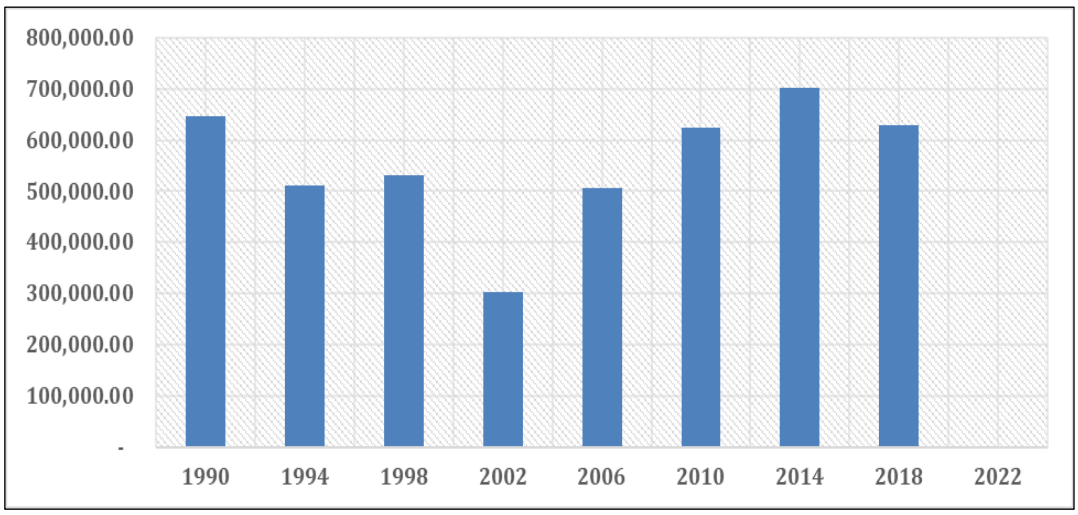
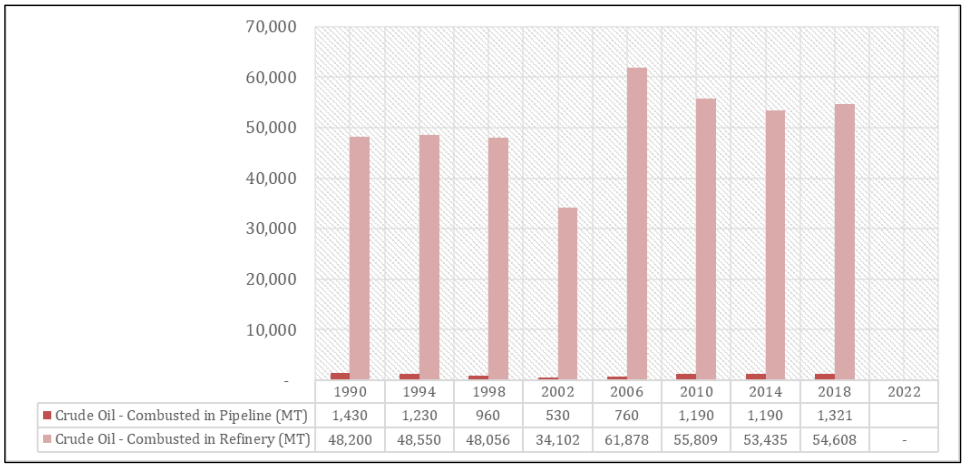


Figure 2-14: Quantities of Crude Oil Refined

The crude oil was delivered from Dar-es-Salaam in Tanzania to the Indeni Refinery plant in Zambia, through a 1,710 km-long pipeline (design capacity of 1,100 kilo tonnes per year), owned by TAZAMA. The pipeline has a total of 7 pumping stations (5 stations located in Tanzania and 2 in Zambia. Significant quantities of crude oil were combusted as fuel in pumping (pipeline transport) and refinery processes, as shown in Figure 2.15.



	1990	1994	1998	2002	2006	2010	2014	2018	2022
Crude Oil - Combusted in Pipeline (MT)	1,430	1,230	960	530	760	1,190	1,190	1,321	
Crude Oil - Combusted in Refinery (MT)	48,200	48,550	48,056	34,102	61,878	55,809	53,435	54,608	-

Figure 2-15: Quantities of Crude Oil Consumed in Pipeline Transport and Refinery Processes

In 2000, Indeni Refinery experienced a fire at one of the units resulting in reduced or no production at the refinery. In 2021, the refinery was put on care and maintenance in readiness for it to have a different business model. The short fall from local production was met through imports of finished petroleum products based on prevailing demand/ requirements for the products.

In 2022, the government revised the petroleum supply policy by switching from the importation and local refining of crude oil to importing finished petroleum products. This policy switch marked a major change in Zambia's energy landscape, which had historically relied on the conversion of primary energy resources into secondary ones. As a result, TAZAMA pipeline was converted from transporting crude oil to refined low-sulphur diesel, and repositioning Indeni Refinery from a processing facility to an Oil Marketing Company (OMC)[46]. Other petroleum products were thereafter mainly transported by road tankers.

(iii) Manufacturing Industry and Construction

The manufacturing industries and construction sector in Zambia comprises several sub-sectors (i.e., mining, quarry, steel production, cement production, food and beverage processing, etc.) and consumes various types of fuels, including biomass, coal and petroleum (diesel, petrol, Heavy Fuel Oil (HFO), etc.). In the years under consideration, the mining and quarry industry remained the most energy consuming sub-sector with

1. [46] Petroleum-Sector-Diagnostics-Policy-Brief.pdf

significant fuel consumption also recorded in construction and unspecified industries. Generally, the manufacturing industries and construction sector recorded a steady increase in energy consumption over the period 1990 to 2022. Figure 2.16 shows the trend of energy consumption by fuel types in the manufacturing industries and construction sector in TJ.

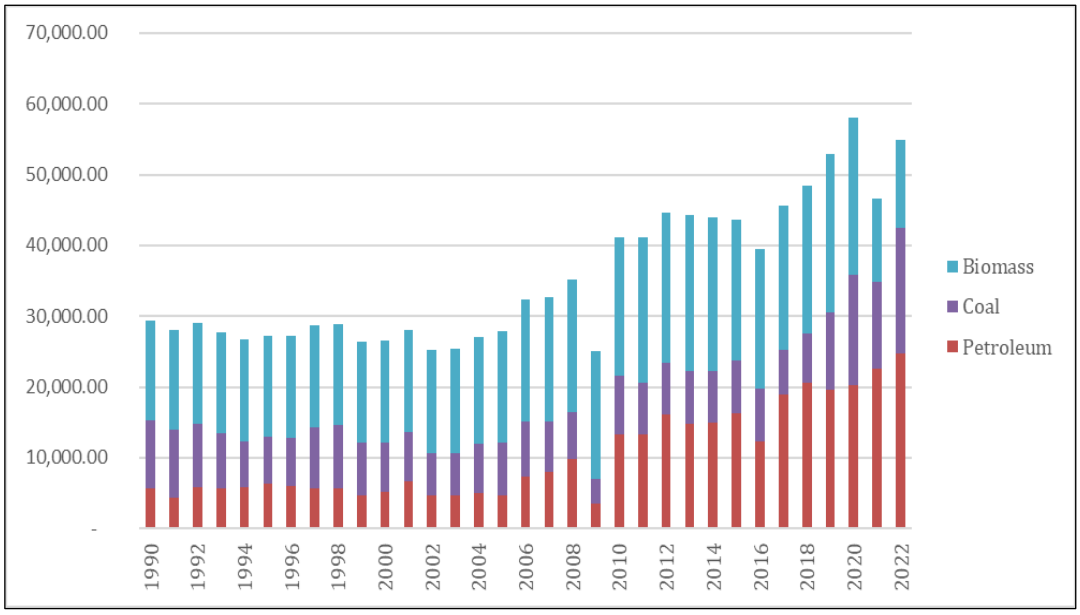


Figure 2-16: Trend of Energy Consumption in the Manufacturing Industries and Construction Sector in TJ

The decrease in energy consumption, observed in some years i.e., 2009, 2016 and 2021, was due to slow down in the country's economic activity. The reduction in energy consumption in 2021 was also due to the effect of COVID-19 on the country's economy.

The production of steel, manganese and cement in Zambia also expanded significantly during the period under review. Cement production was relatively low in the 1990s but marked a substantial growth in later years (starting from 2010). The quantity of cement produced increased by 8.4% to 3.5 million tonnes in 2022[47] . Similarly, there was a significant increase in investments in steel and manganese production.

(iv) Transport

The transport sector in Zambia comprises several modes including aviation, road, railway, water-borne navigation and pipeline transportation systems. During the period under review, road transport remained the most prevalent mode of transportation and accounted for the highest share of fuel consumption, particularly diesel and motor spirit (petrol). The number of automobiles under the transport sector increased, with the population of vehicles having grown by 45% between 2015 and 2022 (from 663,543 to 960,237)[48],

[47] Zambia's annual cement production increased by +8.4% | CCF2Up

2. [48] RTSA Report, 2023

while consumption of petroleum products (diesel and motor spirit) increased from 134.92 kilo tonnes in 1990 to 985.57 kilo tonnes in 2022.

The sub-sector also recorded an in-flow of a limited number of electric vehicles. On the other hand, the aviation sub-sector comprised domestic flights, which consumed only about 7.5% of Zambia's total Jet A1 supply (on average) during the period under review, and international aviation (consumed about 92.5% of Jet A1). Zambia also used aviation gasoline for aviation during the period under consideration. Figure 2.17 shows the trend on energy consumption by various modes of transport in TJ.

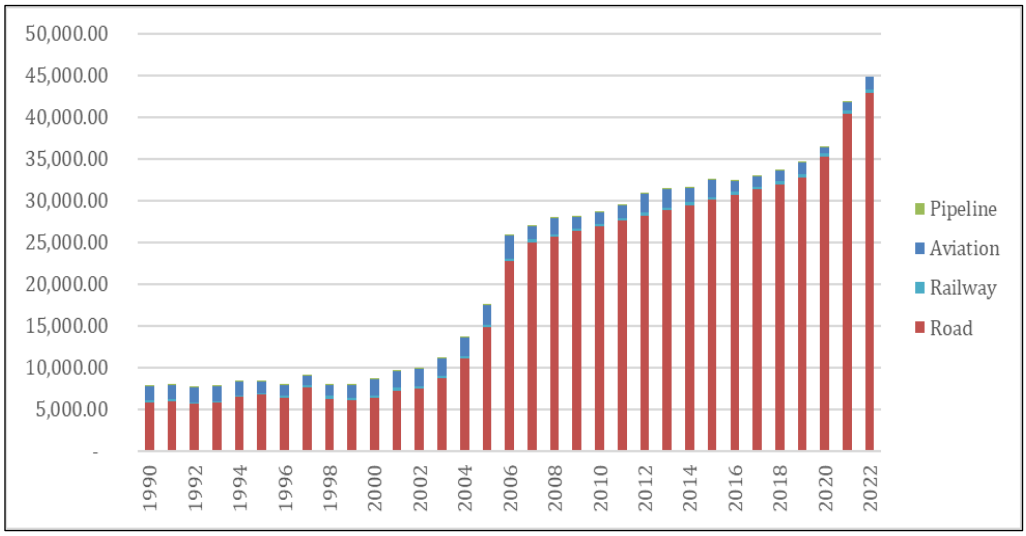


Figure 2-17: Trend of Energy Consumption by Various Modes of Transport in TJ

(v) Other – Agriculture, Residential and Commercial Sectors

This sector includes the formal and informal sector such as agriculture, residential, and commercial, among others. The residential sub-sector accounted for fuel consumption through domestic activities, i.e., cooking and heating needs by households and consumed fuels like biomass (charcoal, firewood, etc.) and liquid fuels (LPG and kerosene). Similarly, the commercial sub-sector accounted for fuel consumed to undertake commercial activities by the various entities, i.e., businesses, public and private institutions. The agriculture sub-sector accounted for fuel (diesel) consumed through agricultural activities, such as powering machinery and equipment for crop production as well as fisheries and livestock management. It also accounts for fuel (firewood) consumed in drying kilns for fish and crops (mainly tobacco). Figure 2.18 shows the trend of energy consumption (in TJ) by various sub-sectors from 1990 to 2022.

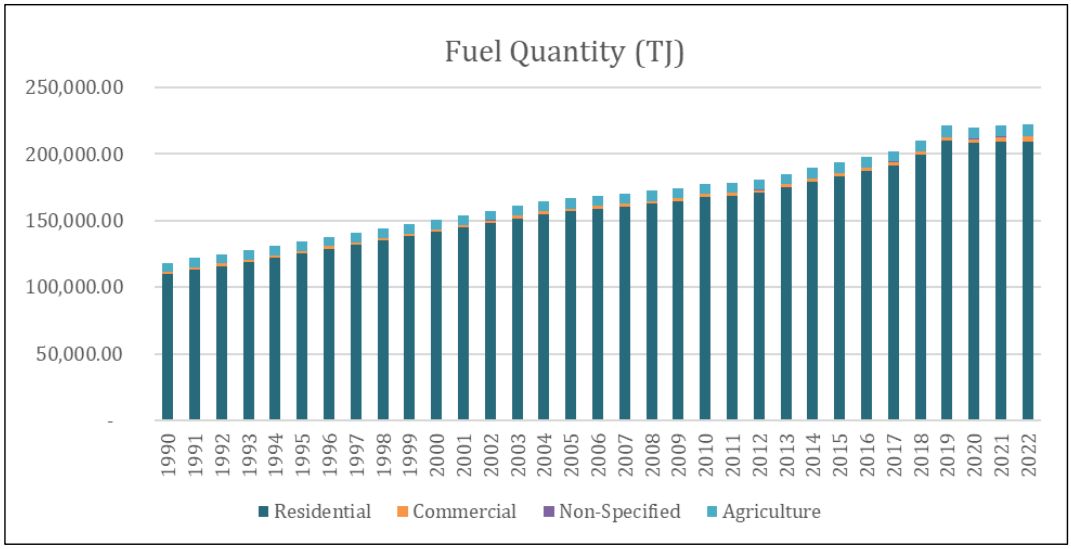


Figure 2-18: Trend of Energy Consumption (in TJ) by Various Sub-Sectors from 1990 to 2022

(vi) Coal Production

Zambia mines coal from both open pit and underground mines. Coal mining activities increased during the period under review, with addition of new coal mines. The production of coal increased from about 400 kilo tonnes in 1990 to over 1800 kilo tonnes in 2022 as shown in Figure 2.19.

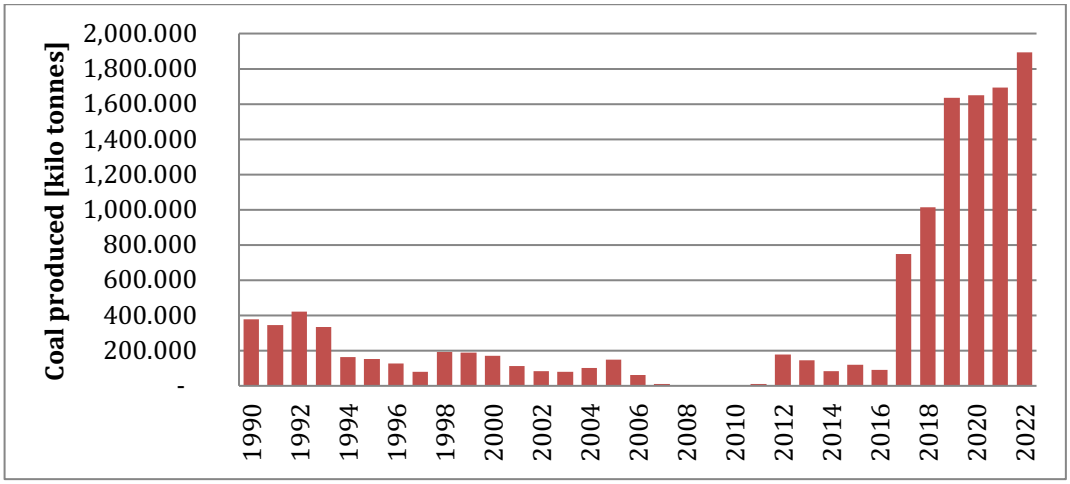


Figure 2-19: Coal Production from 1990 to 2022

Coal production was low prior to 2016 and thereafter, production increased significantly up to 2022. The increase in coal production can be attributed to the increased coal consumption especially for electricity generation and supply to the mines for processing heat.

(vii) Charcoal Production

In Zambia, production of charcoal is rampant primarily driven by high demand, especially in urban areas. Annual production of charcoal increased by 260% from 619.6 kilo tonnes in 1990 to 2,229.8 kilo tonnes in 2022 as presented in Figure 2.20.

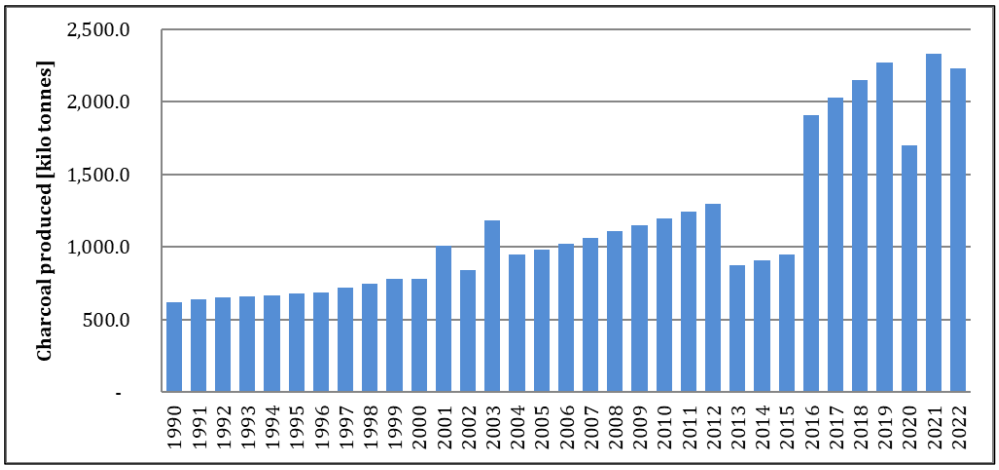


Figure 2-20: Charcoal Production (kT) from 1990 to 2022

Charcoal production exhibited fluctuating patterns, with noticeable dips and spikes as shown in (Figure 2.20). The declines were largely associated with periods of economic slowdown (characterised by shrinking GDP), while the spikes coincided with phases of economic growth.

2.3.2.4 Emissions Trends in Energy Sector

Generally, emissions from the energy sector are increasing in Zambia. Energy emissions increased from 3,926.2 $GgCO_2eq$ in 1990 to 14,571.4 $GgCO_2eq$ in 2022. The key emitting sources in the energy sector were fuel combustion activities and fugitive emissions from solid fuels. The fuel combustion and fugitive emissions increased from 3,208.7 $GgCO_2eq$ and 717.5 $GgCO_2eq$ in 1990 to 11,997.4 $GgCO_2eq$ and 2,574.1 $GgCO_2eq$ in 2022 respectively. The trend is attributed mainly to an increase in consumption of petroleum products driven by increase in economic activities and vehicle population. Figure 2.21 presents emission trends in the energy sector, Table 2-9 provides details of emissions for categories in the energy sector and Table 2-10 presents a summary of Energy Sector Sub-Category Emissions by Gas for the year 2022 (Gg).

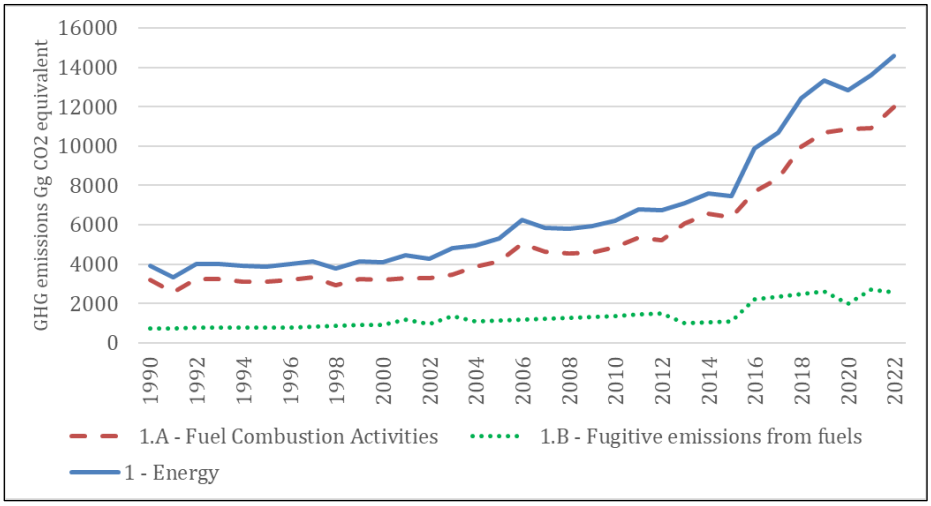


Figure 2-21: Emission Trends in the Energy Sector

Table 2-9: Emissions for Categories in the Energy Sector with the Exclusion of Carbon Storage and Capture($GgCO_2eq$)

Categories	1 - Energy	1.A - Fuel Combustion Activities	1.B - Fugitive emissions from fuels
1990	3926.2	3208.7	717.5
1991	3314.6	2570.3	744.2
1992	4018.1	3263.0	755.0
1993	3997.4	3232.3	765.1
1994	3901.5	3127.2	774.4
1995	3879.6	3094.9	784.7
1996	3988.6	3190.8	797.8
1997	4157.7	3328.4	829.2
1998	3776.7	2913.1	863.6
1999	4139.5	3242.4	897.1
2000	4100.2	3204.4	895.8
2001	4450.2	3286.8	1163.4
2002	4256.1	3282.3	973.8
2003	4829.1	3463.1	1366.0
2004	4959.7	3867.3	1092.4
2005	5295.9	4160.3	1135.7
2006	6236.2	5055.8	1180.4
2007	5848.2	4620.6	1227.5
2008	5808.9	4532.2	1276.7
2009	5917.5	4589.2	1328.3
2010	6222.2	4840.6	1381.6
2011	6807.6	5370.5	1437.1
2012	6725.7	5230.5	1495.2
2013	7094.4	6083.4	1011.0
2014	7598.2	6546.3	1051.9
2015	7458.3	6364.9	1093.4
2016	9860.4	7663.6	2196.9
2017	10681.6	8345.0	2336.6
2018	12456.4	9974.8	2481.6
2019	13316.1	10691.3	2624.8
2020	12834.1	10863.8	1970.3
2021	13615.0	10923.9	2691.1
2022	14571.4	11997.4	2574.1

Table 2-10: Energy Sector Sub-Category Emissions by Gas for the year 2022 (Gg)

	Emissions(Gg)						
Categories	**CO_2**	**CH_4**	**N_2O**	**NOx**	**CO**	**NMVOCs**	**SO_2**
1 - Energy	10814.9	124.599	1.01	0.156	490.556		
1.A - Fuel Combustion Activities	10814.865	34.3571	0.832				
1.A.1 - Energy Industries	3540.2558	0.39475	0.103				
1.A.1.a - Main Activity Electricity and Heat Production	3540.2558	0.39475	0.103				
1.A.1.a.i - Electricity Generation	3540.2558	0.39475	0.103				
1.A.1.a.ii - Combined Heat and Power Generation (CHP)							
1.A.1.a.iii - Heat Plants							
1.A.1.b - Petroleum Refining							
1.A.1.c - Manufacture of Solid Fuels and Other Energy Industries	NO	NO	NO				
1.A.1.c.i - Manufacture of Solid Fuels	NO	NO					
1.A.1.c.ii - Other Energy Industries							
1.A.2 - Manufacturing Industries and Construction	3491.873	1.55351	0.09				
1.A.2.a - Iron and Steel							
1.A.2.b - Non-Ferrous Metals							
1.A.2.c - Chemicals							
1.A.2.d - Pulp, Paper and Print							
1.A.2.e - Food Processing, Beverages and Tobacco	EE	EE	EE				
1.A.2.f - Non-Metallic Minerals							
1.A.2.g - Transport Equipment							
1.A.2.h - Machinery							
1.A.2.i - Mining (excluding fuels) and Quarrying	2174.2863	0.25385	0.039				
1.A.2.j - Wood and wood products							
1.A.2.k - Construction	91.696881	0.00372	7E-04				

1.A.2.l - Textile and Leather							
1.A.2.m - Non-specified Industry	1225.8898	1.29593	0.051				
1.A.3 - Transport	3139.0338	0.56459	0.257				
1.A.3.a - Civil Aviation	16.786503	0.00012	5E-04				
1.A.3.a.i - International Aviation (International Bunkers) (1)							
1.A.3.a.ii - Domestic Aviation	16.786503	0.00012	5E-04				
1.A.3.b - Road Transportation	3091.1649	0.56273	0.244				
1.A.3.b.i - Cars	3091.1649	0.56273	0.244				
1.A.3.b.i.1 - Passenger cars with 3-way catalysts							
1.A.3.b.i.2 - Passenger cars without 3-way catalysts							
1.A.3.b.ii - Light-duty trucks							
1.A.3.b.ii.1 - Light-duty trucks with 3-way catalysts							
1.A.3.b.ii.2 - Light-duty trucks without 3-way catalysts							
1.A.3.b.iii - Heavy-duty trucks and buses							
1.A.3.b.iv - Motorcycles							
1.A.3.b.v - Evaporative emissions from vehicles							
1.A.3.b.vi - Urea-based catalysts							
1.A.3.c - Railways	31.082357	0.00174	0.012				
1.A.3.d - Water-borne Navigation							
1.A.3.d.i - International water-borne navigation (International bunkers) (1)							
1.A.3.d.ii - Domestic Water-borne Navigation							
1.A.3.e - Other Transportation							
1.A.3.e.i - Pipeline Transport							
1.A.3.e.ii - Off-road							
1.A.4 - Other Sectors	618.04402	31.8437	0.382				
1.A.4.a - Commercial/Institutional	470.14545	0.06283	0.004				
1.A.4.b - Residential	39.882998	29.6379	0.308				

1.A.4.c - Agriculture/Forestry/Fishing/Fish Farms	108.01557	2.14294	0.07				
1.A.4.c.i - Stationary	0	2.13689	0.028				
1.A.4.c.ii - Off-road Vehicles and Other Machinery	108.01557	0.00605	0.042				
1.A.4.c.iii - Fishing (mobile combustion)							
1.A.5 - Non-Specified	25.65896	0.00055	1E-04				
1.A.5.a - Stationary	25.65896	0.00055	1E-04				
1.A.5.b - Mobile							
1.A.5.b.i - Mobile (aviation component)							
1.A.5.b.ii - Mobile (water-borne component)							
1.A.5.b.iii - Mobile (Other)							
1.A.5.c - Multilateral Operations (1)(2)							
1.B - Fugitive emissions from fuels	0.034849	90.2416	0.178	0.156	490.556		
1.B.1 - Solid Fuels	0.034849	90.2416	0.178	0.156	490.556		
1.B.1.a - Coal mining and handling	0.034849	0.38069					
1.B.1.a.i - Underground mines	0						
1.B.1.a.i.1 - Mining							
1.B.1.a.i.2 - Post-mining seam gas emissions							
1.B.1.a.i.3 - Abandoned underground mines	0						
1.B.1.a.i.4 - Flaring of drained methane or conversion of methane to CO2							
1.B.1.a.ii - Surface mines	0.034849	0.38069					
1.B.1.a.ii.1 - Mining	0.034849	0.38069					
1.B.1.a.ii.2 - Post-mining seam gas emissions	0	0					
1.B.1.a.ii.3 - Abandoned surface mines	0	0					
1.B.1.b - Uncontrolled combustion and burning coal dumps							
1.B.1.c - Fuel transformation	0	89.8609	0.178	0.156	490.556		
1.B.1.c.i - Charcoal and Biochar production		89.8609	0.178	0.156	490.556		
1.B.1.c.ii - Coke production							
1.B.1.c.iv - Gasification transformation	0	0	0				

1.B.2 - Oil and Natural Gas							
1.B.2.a - Oil							
1.B.2.a.i - Venting							
1.B.2.a.ii - Flaring				A			
1.B.2.a.iii - All Other							
1.B.2.a.iii.1 - Exploration							
1.B.2.a.iii.2 - Production and Upgrading							
1.B.2.a.iii.3 - Transport							
1.B.2.a.iii.4 - Refining							
1.B.2.a.iii.5 - Distribution of oil products							
1.B.2.a.iii.6 - Other							
1.B.2.b - Natural Gas							
1.B.2.b.i - Venting							
1.B.2.b.ii - Flaring							
1.B.2.b.iii - All Other							
1.B.2.b.iii.1 - Exploration							
1.B.2.b.iii.2 - Production							
1.B.2.b.iii.3 - Processing							
1.B.2.b.iii.4 - Transmission and Storage							
1.B.2.b.iii.5 - Distribution							
1.B.2.b.iii.6 - Other							
1.B.3 - Other emissions from Energy Production	NO	NO	NO				
1.C - Carbon dioxide Transport and Storage	NO	NO	NO				
1.C.1 - Transport of CO2	NO	NO	NO				
1.C.1.a - Pipelines	NO						
1.C.1.b - Ships	NO						
1.C.1.c - Other (please specify)	NO						
1.C.2 - Injection and Storage	NO	NO	NO				
1.C.2.a - Injection	NO						
1.C.2.b - Storage	NO						

In 2022, the most significant gas in the energy sector was CO_2 with 70%, followed by CH_4 with 28% and the least was N_2O with 2%. Figure 2.22 presents emissions by gas for 2022.

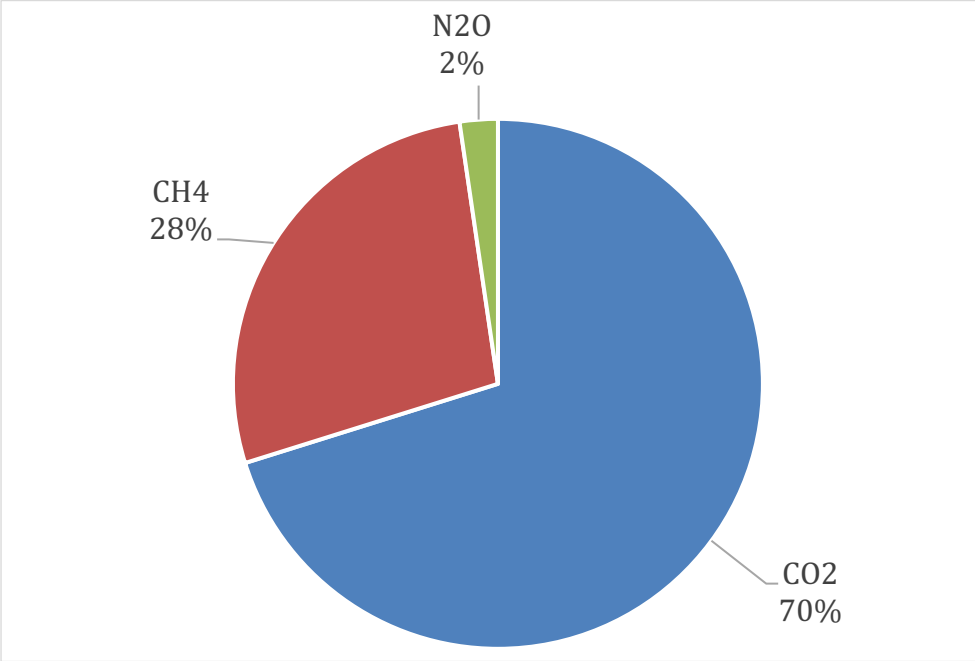


Figure 2-22: Emissions by Gas for the Energy Sector for 2022

Provided in Figure 2.23 are trends of emissions by gas $GgCO_2eq$ in the energy sector and respective percentage contribution. Across the time series CO_2 has been the major contributor to the emissions.

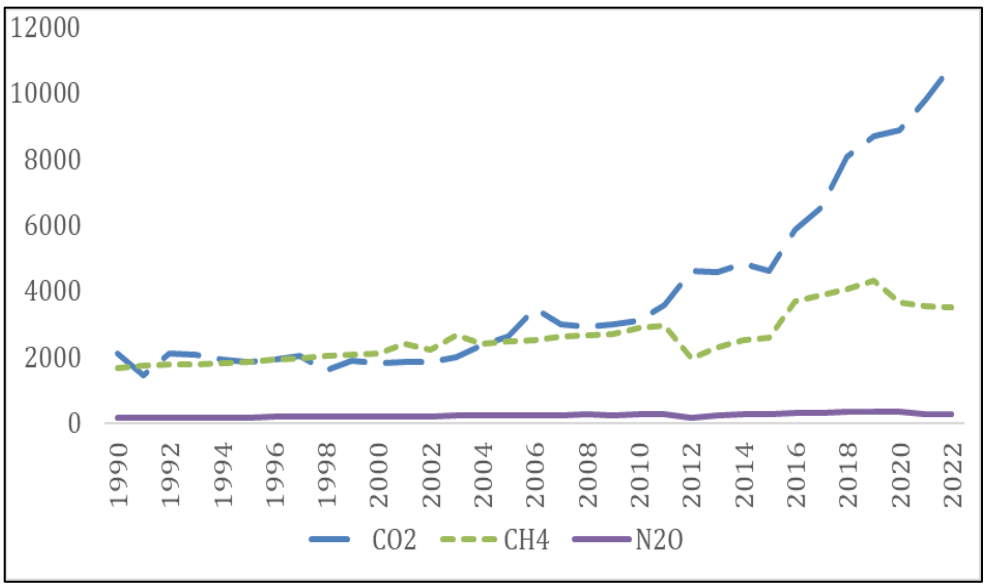


Figure 2-23: Emission s trends by gas ($GgCO_2eq$)

2.3.2.5 Emissions based on Reference Approach

Reference and sectoral approaches were used to estimate the CO_2 emissions from the energy sector for 2022. Provided in Table 2.11 is a comparison made of CO_2 emissions between the two approaches. Table 2.11 Comparison of CO_2 emissions between Sectoral and Reference approach for 2022.

Table 2-11: Comparison of CO_2 emissions between Sectoral and Reference approach for 2022

	Reference Approach				Sectoral Approach		Difference	
Fuel Type	**Apparent Consumption (TJ)**	**Excluded consumption (TJ)**	**Apparent Consumption (excluding non-energy use and feedstocks) (TJ)**	**CO_2 Emissions (Gg)**	**Energy Consumption (TJ)**	**CO_2 Emissions (Gg)**	**Energy Consumption (%)**	**CO_2 Emissions (%)**
Aviation Gasoline	83.7	0.0	83.7	5.9	83.8	5.9	-0.053	-0.005
Bitumen	0.0	0.0	0.0	0.0			0.000	0.000
Crude Oil	0.0	0.0	0.0	0.0			0.000	0.000
Ethane	0.0	0.0	0.0	0.0			0.000	0.000
Gas/Diesel Oil	46287.4	0.0	46287.4	3428.3	46240.5	3426.4	0.101	0.056
Jet Gasoline	0.0	0.0	0.0	0.0			0.000	0.000
Jet Kerosene	152.9	0.0	152.9	10.91	152.8	10.9	0.065	0.060
Liquefied Petroleum Gases	1257.7	0.0	1257.7	79.3	1249.9	78.9	0.624	0.580
Lubricants	0.0	0.0	0.0	0.0			0.000	0.000
Motor Gasoline	22136.7	0.0	22136.7	1534.1	22147.2	1534.8	-0.047	-0.047
Naphtha	0.0	0.0	0.0	0.0			0.000	0.000
Natural Gas Liquids	0.0	0.0	0.0	0.0			0.000	0.000
Orimulsion	0.0	0.0	0.0	0.0			0.000	0.000
Other Kerosene	6918.2	0.0	6918.2	497.2	6925.4	497.9	-0.104	-0.150
Other Petroleum Products	0.0	0.0	0.0	0.0			0.000	0.000
Paraffin Waxes	0.0	0.0	0.0	0.0			0.000	0.000

Petroleum Coke	0.0	0.0	0.0	0.0			0.000	0.000
Refinery Feedstocks	0.0	0.0	0.0	0.0			0.000	0.000
Refinery Gas	0.0	0.0	0.0	0.0			0.000	0.000
Residual Fuel Oil	705.0	0.0	705.0	54.5	745.5	57.7	-5.441	-5.481
Shale Oil	0.0	0.0	0.0	0.0			0.000	0.000
White Spirit and SBP	0.0	0.0	0.0	0.0			0.000	0.000
Anthracite	0.0	0.0	0.0	0.0			0.000	0.000
Blast Furnace Gas	0.0	0.0	0.0	0.0			0.000	0.000
Brown Coal Briquettes	0.0	0.0	0.0	0.0			0.000	0.000
Coal Tar	0.0	0.0	0.0	0.0			0.000	0.000
Coke Oven Coke / Lignite Coke	0.0	0.0	0.0	0.0		0.0	0.000	0.000
Coke Oven Gas	0.0	0.0	0.0	0.0			0.000	0.000
Coking Coal	3592.4	0.0	3592.4	339.8	3592.4	339.8	0.000	0.000
Gas Coke	0.0	0.0	0.0	0.0			0.000	0.000
Gas Works Gas	0.0	0.0	0.0	0.0			0.000	0.000
Lignite	0.0	0.0	0.0	0.0			0.000	0.000
Oil Shale / Tar Sands	0.0	0.0	0.0	0.0			0.000	0.000
Other Bituminous Coal	9277.7	0.0	9277.7	877.7	9276.6	877.6	0.011	0.011
Oxygen Steel Furnace Gas	0.0	0.0	0.0	0.0			0.000	0.000
Patent Fuel	0.0	0.0	0.0	0.0			0.000	0.000
Sub-Bituminous Coal	41447.1	0.0	41447.1	3981.7	41466.6	3984.9	-0.047	-0.082
Natural Gas (Dry)	0.0	0.0	0.0	0.0			0.000	0.000
Industrial Wastes	0.0	0.0	0.0	0.0			0.000	0.000
Municipal Wastes (no biomass fraction)	0.0	0.0	0.0	0.0			0.000	0.000
Waste Oils	0.0	0.0	0.0	0.0			0.000	0.000
Peat	0.0	0.0	0.0	0.0			0.000	0.000

The emission estimates from both approaches were comparable within a variation range of up to ±5.5%. This is slightly above the acceptable variation (±5%) and is attributed to lack of a robust mechanism to assure accurate capturing and documenting of fuel consumption in the residual fuels.

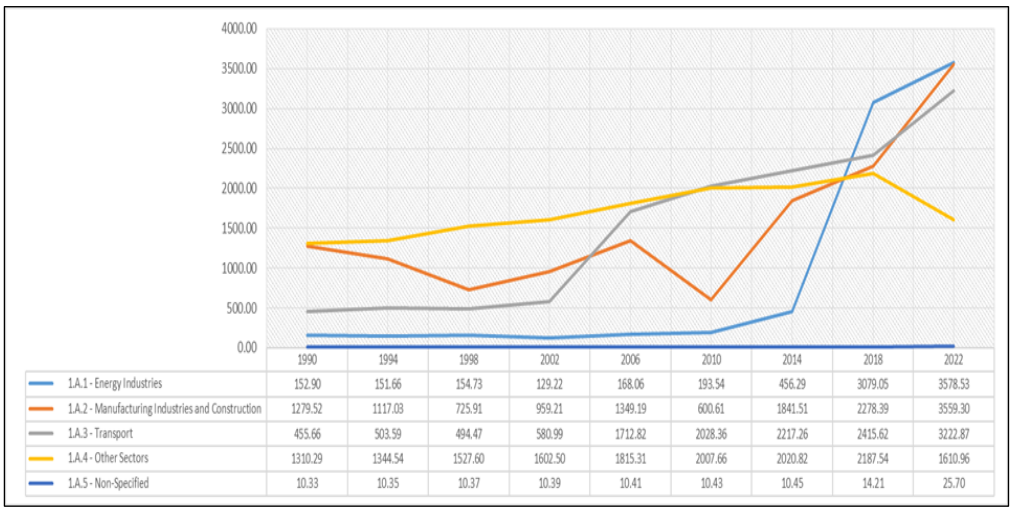
2.3.2.6 Emissions from Energy Categories

This section provides respective emissions, activity data, emission factors and methodologies for energy categories. The IPCC 2006 guidelines broadly classify energy-related activities into 3 main categories, namely: fuel combustion activities (1.A), fugitive emissions from fuels (1.B) and Carbon dioxide transport and storage (1.C).

Fuel Combustion Activities

In 2022, Zambia's major contributor to emissions under the fuel combustion activity was energy industries with 29.8% followed by manufacturing industries and construction with 29.6%. Transport was third with 26.8% and other sectors including commercial, institutional, residential, Agriculture, Forestry, Fishing contributed 13.4%.

GHG emissions from energy industries increased gradually from 152.9 $GgCO_2eq$ in 1990 to 456.3 $GgCO_2eq$ in 2014 and recorded a rapid increase to 3,578.5 $GgCO_2eq$ in 2022. Emissions from manufacturing industries and construction increased from 1990 and 2022 while emissions in the transport sector increased during the same period. Emissions in other sectors increased by 23%. Figure 2.24 shows the trend of emissions for categories in the energy sector ($GgCO_2eq$).



	1990	1994	1998	2002	2006	2010	2014	2018	2022
1.A.1 - Energy Industries	152.90	151.66	154.73	129.22	168.06	193.54	456.29	3079.05	3578.53
1.A.2 - Manufacturing Industries and Construction	1279.52	1117.03	725.91	959.21	1349.19	600.61	1841.51	2278.39	3559.30
1.A.3 - Transport	455.66	503.59	494.47	580.99	1712.82	2028.36	2217.26	2415.62	3222.87
1.A.4 - Other Sectors	1310.29	1344.54	1527.60	1602.50	1815.31	2007.66	2020.82	2187.54	1610.96
1.A.5 - Non-Specified	10.33	10.35	10.37	10.39	10.41	10.43	10.45	14.21	25.70

Figure 2-24: Trends of Emissions for Categories in the Energy Sector ($GgCO_2eq$.)

Fugitive Emissions from Fuels

In the Zambian context, fugitive emissions come from charcoal production and coal mining as well as handing activities (under 1.B.1. Solid Fuels) and petroleum refining (under 1.B.2. Oil and Natural Gas). During the period under review, fugitive emissions from solid fuels (charcoal production and coal mining) increased from 713.1 $GgCO_2eq$ in 1994 to 2,574.07 $GgCO_2eq$ in 2022. In 2022, and across the time series, the major contributor to emissions from solid fuels

was charcoal production, representing 99.6%. The increase in emissions was driven by the growth in demand for charcoal, leading to increased production. Similarly, coal production increased with introduction of new mines, resulting in increased fugitive emissions from solid fuels.

As regards fugitive emissions from petroleum refining, emissions have been varying over the time period. In 2022 petroleum refinery ceased operation in Zambia and for that reason, there were no emissions from this source in 2022. Table 2.12 provides the details of the quantities of fugitive emissions for Zambia for the period 1990 to 2022.Table 2-12 Trends of Emissions from Fugitive Emissions.

Table 2-12: Trends of Emissions from Fugitive Emissions($GgCO_2eq$)

Year	Solid Fuels	Oil and Natural Gas
	Emissions ($GgCO_2eq$)	
1990	713.15	4.35
1991	740.57	3.67
1992	750.84	4.20
1993	761.31	3.79
1994	770.92	3.44
1995	781.67	3.01
1996	794.98	2.85
1997	826.43	2.79
1998	860.08	3.56
1999	895.80	1.27
2000	895.69	0.11
2001	1161.87	1.54
2002	971.76	2.02
2003	1362.94	3.04
2004	1089.13	3.24
2005	1132.96	2.71
2006	1177.75	2.65
2007	1224.56	2.98
2008	1273.47	3.22
2009	1324.41	3.94
2010	1377.39	4.20
2011	1432.57	4.49
2012	1490.78	4.40
2013	1007.29	3.74
2014	1047.19	4.71
2015	1089.25	4.18
2016	2193.20	3.65
2017	2332.68	3.94
2018	2477.35	4.21
2019	2620.34	4.47
2020	1967.89	2.37
2021	2690.75	0.36
2022	2574.07	0.00

2.3.2.7 Precursor gases Emissions in Energy Sector

Emissions of precursor gases (i.e., NOx, CO, NMVOC and SO_2) in the energy sector increased steadily from 1990 to 2014. Beyond 2014, NOx, CO, NMVOC emissions continued to increase gradually until 2022. On the contrary, SO_2 emissions reduced slightly in 2022. This reduction is attributed to reduced activities on the refinery of crude. Figure 2.25 shows the trend of precursor gases emissions in the energy sector by gas.

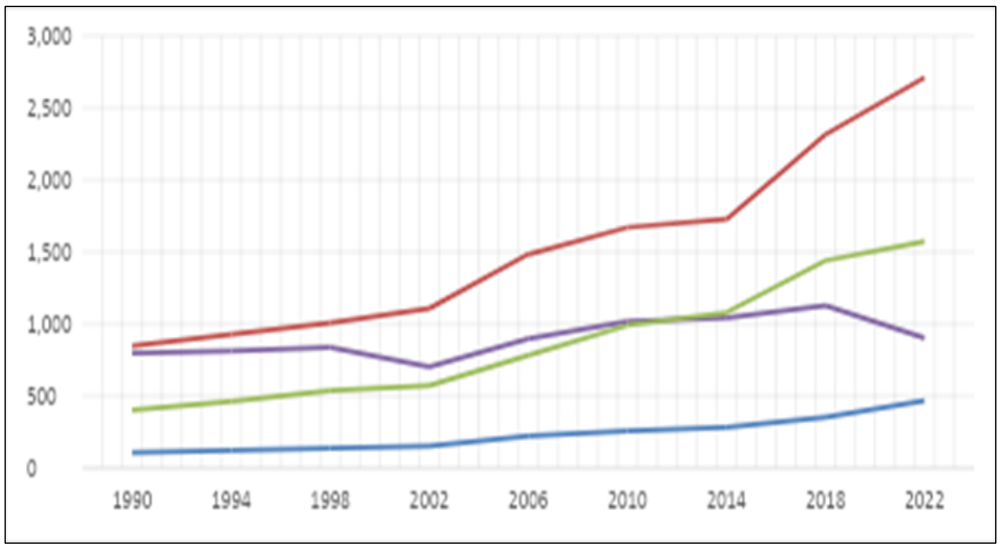


Figure 2-25: Trends of Precursor Gas Emissions in the Energy Sector by Gas

2.3.2.8 Quality Assurance/Quality Control Measures Applied

Activity data used in estimating GHG emissions from the energy sector was sourced from the energy balance reports. To confirm and verify data, data providers sources such as Energy Regulation Board, Oil Marketing Companies, Indeni oil refinery, Maamba Collieries, Railway Companies, Central Statistics Office and Zambia Revenue Authority were collected and compared. Efforts were made to check, analyse and verify the quality of activity data from all sources to ensure good quality data was utilised to estimate GHG emissions in the the energy sector.

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2.3.2.9 Energy Sector Uncertainties

The Uncertainty analysis for the year 2022 for the Energy sector was estimated using approach 1 and computed using the IPCC 2006 software. Generally, uncertainty for activity data from energy is ± 5%. Detailed uncertainty values are provided in Annex I and the base year for uncertainty assessment was 1990.

2.3.2.10 Planned Improvements

Provided in Table 2.13 are gaps and planned improvements for the energy sector.

Table 2-13: Gaps and planned improvements for the energy sector

NO.	GAPS	RECOMMENDATIONS
1	Lack of a single institution officially responsible for coordinating national energy statistics.	Designate the Ministry of Energy (MoE) as the lead entity and formalize roles and responsibilities of all other relevant entities involved in energy statistics (e.g., Energy Regulation Board (ERB), Zambia Revenue Authority (ZRA) and Zambia Statistics Agency (ZamStats)) through MOUs. Establish governance and harmonize definitions.
2	No available data on fuel consumption from marine transportation.	Introduce structured reporting requirements for marine operators and ports.
3	Difficulty in obtaining and disaggregating aviation fuel consumption (Avgas and Jet A1).	Establish standardized reporting templates with aviation authorities and fuel suppliers.
4	No confidentiality protocols for sensitive energy data.	Develop confidentiality guidelines and data-sharing agreements.
5	Inconsistencies between national energy balance data and UN Statistical Division figures.	Conduct data reconciliation and align methodologies with international standards.
6	Energy statistics and GHG inventory findings are not clearly linked to policymaking.	- Create formal policy feedback mechanisms using statistical outputs. - Further to the inclusion of the NDA, the framework should address all inconsistencies.
7	Limited coverage of biomass/wood fuel and consumption data in ERB balance reports.	Fund periodic surveys and develop a biomass energy accounting system.
8	Lack of digitalized and centralised data storage systems for energy statistics.	Develop a national digital energy data platform with real-time access and backup.
9	High staff turnover among personnel trained in energy statistics and GHG reporting.	Implement continuous capacity-building programmes and establish knowledge transfer protocols.
10	Misalignment between national energy balance categories and IPCC Guidelines.	Align classifications and integrate IPCC-compliant structures in future transparency reports.
11	Limited private sector participation in data provision.	Introduce mandatory reporting rules for private OMCs, industrial users, and large consumers.

2.3.2.11 Carbon capture and storage (CCS)

Carbon capture and storage (CCS) is a chain process that involves the capture, compression of CO2 (usually at a large industrial installation) and transportation to a storage location and its long-term isolation from the atmosphere. There are no activities occurring in Zambia under this category and hence there were no emissions estimates undertaken.

2.3.3 Industrial Processes and Product Use (IPPU)

2.3.3.1 Overview

Zambia's industrial processes and product use (IPPU) sector is characterized by activities in mineral industry (2.A), chemical industry (2.B), metal industry (2.C), non-energy products from fuels and solvent use (2.D), product uses as substitutes for Ozone depleting substances (2.F) and other product manufacture and use (2.G). Within the mineral industry, Zambia is involved in cement and lime production. Zambia also produces nitric acid and ammonia (under chemical industry), zinc, lead and steel (metal industry) while also consuming lubricants, using refrigeration and air conditioning, and producing electrical equipment.

Broadly, macroeconomic performance improved in 2016. Real GDP is estimated to have grown by 3.4% compared to 2.9% in 2015[49]. In 2023, estimates suggest that real GDP growth reached 5.4%, up from 5.2% in 2022. The out-turn was on account of positive performance in the Information and Communication technology and construction sectors. Contraction in the Agriculture, Forestry and Fishing and Mining and quarrying industries weighed negatively on growth. In terms of shares of the GDP in nominal terms, the Wholesale and Retail trade industry had the largest proportion at 18.6 percent. The Mining and Quarrying, Construction and Transportation and Storage industries accounted for 13.7 percent, 12.4 percent and 11.3 percent, respectively[50].

This was attributed to operational impediments at some mines and low ore grades. Manufacturing growth slowed down to 1.5 percent in 2023 from 4.7 percent in 2022. This was largely on account of depreciation of the Kwacha against major convertible currencies which led to an increase in imported intermediate goods. Notwithstanding, the slowdown, high growth was positive in the pulp and paper products and the non-metallic products sub-sectors.

Zambia has a high propensity for consumption of manufactured goods. Domestic demand factors provide ready local markets for manufactured goods while the country's membership to regional organizations such as the Common Market for Eastern and Southern Africa (COMESA) and the Southern African Development Community (SADC) provides export markets in the region for the value-added manufactured products. The priority areas for investment in the sector include; food processing, textiles and clothing, mineral processing, chemical products, engineering, leather products, electrical goods, pharmaceutical products and packaging materials. Zambia is also endowed with mineral deposits for the production of other chemical products such as cement, adhesives and explosives, as well as; glass, batteries, argon gas, sulphuric acid, paints, cosmetics, soaps and detergents.

Zambia has a variety of minerals which are exported as raw materials. At present there is minimal value addition being made to these mineral exports which include; copper, iron and steel, cobalt, gold, zinc, manganese and other minerals. Zambia has a high demand for imports of electronic goods in the country. Cotton is grown, ginned and spun in Zambia at industrial sites with state-of-the-art spinning, weaving and processing factories as well as warehouses. The European Union is a major export market for the textile products from Zambia, with South Africa and Mauritius being other potential markets. There are a limited number of

[49] Bank of Zambia Annual Report 2016
[50] 2023, ANNUAL ECONOMIC REPORT, MINISTRY OF FINANCE AND NATIONAL PLANNING

manufacturing companies and pharmaceutical trading companies in the country. The majority of essential health drugs are still being imported[51].. Currently most packaging materials used by manufacturing companies in the country are imported from the Republic of South Africa, China, India and Europe.

2.3.3.2 Methodology and Emission Factor

Mineral Industry

Under this sub-category, estimates were based on the Tier 1 method (Equation 2.3). For cement production, estimates were based on clinker production estimates inferred from cement production data. Further, correcting factors were applied for imports and exports of clinker.

$$\boldsymbol{CO_2\ Emissions = [\Sigma(M_{c,i}\ x\ C_{Cl,i}) - Im + Ex]\ x\ EF_{Clc}} \qquad \text{Equation 2.3}$$

Where; $M_{c,i}$ = mass of cement produced of type i, tonnes, $C_{Cl,i}$ = clinker fraction of cement type i, fraction, Im - imports for consumption of clinker, tonnes, Ex - exports of clinker, tonnes; EF_{Clc} = emission factor for clinker, tonnes CO_2 /tonne clinker; Emissions factor for clinker =0.4985 tonne CO_2 /tonne of clinker; clinker fraction in cement=0.95

For lime, default emission factor and national level lime production data was used.

$$CO_2 = \sum_i \quad EFlimei\ X\ Ml,i\ \boldsymbol{X\ CFlkd,\ I\ X\ Ch,i\ )} \qquad \text{Equation 2.4}$$

Where:

CO_2 Emissions = emissions of CO_2 from lime production, tonnes; $EF_{lime,i}$ = emission factor for lime of type i, tonnes CO_2 /tonne lime(0.75 tonne of CO_2 /tonne of lime high calcium lime); $M_{l,i}$ = lime production of type i, tonnes; $CF_{lkd,i}$ = correction factor for LKD for lime of type i, dimensionless; $C_{h,i}$ = correction factor for hydrated lime of the type i of lime, dimensionless; i = each of the specific lime types.

For non-metallurgical magnesia production, estimates were based on the amount of products manufactured, along with emission factors that represent the amount of CO_2 emitted per unit of mass. The Tier 1(equation 2.5) method assumes that only limestone and dolomite are used as carbonate input in industry, and allows for the use of a default fraction of limestone versus dolomite consumed.

$$\boldsymbol{CO_2\ Emissions = M_c\ x\ (0.85EF_{ls} + 0.15EF_d} \qquad \text{Equation 2.5}$$

Where:
CO_2 Emissions = emissions of CO_2 from other process uses of carbonates, tonnes; M_c = mass of carbonate consumed, tonnes; EF_{ls} or EF_d = emission factor for limestone or dolomite calcination, tonnes CO_2 /tonne carbonate (0.43971 tonnes CO_2 /tonne of carbonate).

[51] ZDA, manufacturing sector profile in Zambia

Chemical Industry

The Tier 1 method was used for estimating emissions CO_2 emissions from ammonia production which requires the default emissions factor and data on national production of NH_3 (Equation 2.6).

$$CO_{2\ Emissions} = \left(AP\ x\ FR\ xCCF\ x\ COFx\ \frac{44}{12}\right) - RCO_2 \qquad \text{Equation 2.6}$$

Where: $CO_{2\ Emissions}$ = emissions of CO_2 , kg; AP = ammonia production, tonnes; FR = fuel requirement per unit of output, GJ/tonne ammonia produced (FR=42.5 GJ/tonne); CCF = carbon content factor of the fuel, kg C/GJ (CCF=21 kg C/GJ); COF = carbon oxidation factor of the fuel, fraction (COF=1); RCO_2 = CO_2 recovered for downstream use (urea production), kg Ammonia production and emission factors can be obtained from national statistics

Similarly, Tier 1 method was also used for nitric acid emissions estimate which requires default emission factor and nitric acid production data. Equation 2.7 provides N_2O emissions from nitric acid production – Tier 1.

$$N_2O_{Emissions} = EF\ X\ NAP \qquad \text{Equation 2.7}$$

Where: $N_2O_{Emissions}$ = N_2O emissions, kg; EF = N_2O emission factor (default), kg N_2O/tonne nitric acid produced (EF=9 kg N_2O/tonne nitric acid); NAP = nitric acid production, tonnes.

Metal Industry

Tier 1 method was used to estimate emissions across the metal industry mainly from lead, iron and steel production. In Zambia, emissions result from the recycling of iron and steel using the Electric Arc Furnace (EAF) method. Equation 2.8 was used to estimate CO_2 emissions from iron and steel production.

$$CO_{2\ non\ energy\ emissions} = BOF\ x\ EF_{BOF} + EAF\ X\ EF_{EAF} + OHFX\ EF_{OHF} \quad Equation\ 2.8$$

$CO_{2\ non\ energy\ emissions}$ = emissions of CO_2 to be reported in IPPU Sector, tonnes BOF= quantity of BOF crude steel produced, tonnes EAF = quantity of EAF crude steel produced, tonnes OHF = quantity of OHF crude steel produced, tonnes; EF= emission factor, tonnes CO_2 /tonne produced (EF=0.08 tonnes CO_2 /tonne steel produced).

Emissions estimates from Lead were derived using equation 2.8 where default emission factors were multiplied by lead production.

$$CO_2 = DS\ X\ EF_{DS} \qquad \text{Equation 2.9}$$

CO_2 = CO_2 emissions from lead production, tonnes; DS = quantity of lead produced by Direct Smelting, tonnes; EF_{DS} = emission factor for Direct Smelting, tonne CO_2 /tonne lead produced (EF =0.25 tonne CO_2 /tonne lead product).

Non-Energy Products from Fuels and Solvent Use

Tier 1 method (equation 2.10) was used for estimating CO_2 emissions from Non-Energy Product Uses. In this method, the default emissions factor is composed of carbon content factor and the factor that represents the fraction of fossil fuel carbon that is Oxidised During Use (ODU).

$$CO_2 = \sum_i (NEU_i \; x \; CC_i \; x \; ODU_i) * \frac{44}{12} \qquad \text{Equation 2.10}$$

CO_2 = CO_2 emissions CO_2 Emissions from non-energy product uses, tonne CO_2; NEU_i = non-energy use of fuel i, TJ; CC_i = specific carbon content of fuel i, tonne C/TJ (CC=20kg C/GJ); ODUi = ODU factor for fuel (ODU=0.2); fraction 44/12 = mass ratio of CO_2 /C.

Electronics Industry

No activity occurred under this category in Zambia from 1990 to 2022 and hence, emissions estimates were not calculated.

Products Used as Substitutes for Ozone Depleting Substances

The Tier 1a/b method back-calculates the development of banks of a refrigerant from the current reporting year to the year of its introduction. Equation 2.11 was used to estimate emission.

$$E_{lifetime,\ t} = B_t \; x \; \frac{x}{100}$$

Equation 2.11

$E_{lifetime,\ t}$ = amount of HFC emitted during system operation in year t, kg Bt = amount of HFC banked in existing systems in year t (per sub-application), kg x = annual emission rate (i.e., emission factor) of HFC-134a of each sub-application bank during operation, accounting for average annual leakage and average annual emissions during servicing, percent (0.1%), Assume life of equipment=20 years; percentage of gas destroyed at the end of life = 0%.

Other Product Manufacture and Use

Tier 1 method was used in which emissions are estimated by multiplying default regional emission factors by the SF6 consumption of equipment and the capacity of the equipment at each lifecycle stage.

$$Equipment\ Use\ Emissions = \sum Nameplate\ capacity\ of\ equipment\ installed\ X\ Use\ emission\ factor$$

Equation 2.12 Emission factor = 0.002

2.3.3.3 Activity Data

Activity data for IPPU was collected from industries, ZRA and ZAMSTATS and this include; Clinker production Lime, Refrigeration Charge in refrigeration and air conditioning, Sulphur Hexafluoride (SF_6) in electrical equipment, Iron and Steel production, Lead Production, Zinc Production, Nitric acid production and Lubricant. The use of Nameplate capacity was used in estimating the emissions for SF6 in use of electrical equipment. Table 2-14 presents the activity data for IPPU.

Table 2-14: Activity Data for IPPU

Year	Clinker production (tonnes)	Lime (tonnes)	Refrigeration Charge (tonnes)	Sulphur Hexafluoride (SF6) (tonnes)	Iron and Steel (tonnes)		Amount of Lead Production (tonne)	Amount of Zinc Production (tonne)	Nitric acid production (tonnes)	Lubricant
					Direct Reduced Iron	Electric Arc Furnace				
1990	286606	1174525.86	1.86	0.00		10896.0	10600	4100	23663	
1991	286750	1175116.07	2.04	0.01		10901.4	6500	2700	20641	
1992	286894	1175706.29	2.24	0.01		10906.9	7300	2600	24438	
1993	287038	1176296.5	2.45	0.07		10912.4	5600	1600	28523	
1994	287182	1176886.72	2.69	0.12		10917.9	100		23054	
1995	287326	1177476.93	2.95	0.12		10923.3			13648	
1996	287470	1178067.14	3.23	0.12		10928.8			12984	
1997	287614	1178657.36	3.54	0.12		10934.3			9425	
1998	287758	1179247.57	3.88	0.12		10939.8			3928	
1999	287902	1179837.79	4.26	0.12		10945.3			1996	
2000	295140	1180428	4.67	0.21		10950.7			8497	
2001	272156	1211140.08	5.12	0.21		10956.2			1827	
2002	302080	1241852.16	5.61	0.21		10961.7			0	
2003	372936	1272564.24	10.28	0.21		10967.2			1603	
2004	450807	1303276.32	16.09	0.20		10972.6			0	
2005	511537	1333988.4	20.54	1.38		10978.1			0	

2006	483840	1361329.32	27.88	1.40		10983.6			0	
2007	466938	1388670.24	31.40	1.40		10989.1			0	
2008	508253	1416011.16	47.55	1.40		10994.5			0	
2009	730815	1443352.08	29.23	1.40		11000.0			0	
2010	697219	1470693	31.95	2.38		18546.0			0	
2011	991559	1225646.72	46.24	3.07		48690.0			0	
2012	1120074	1305950.5	68.53	3.14		68042.0			0	
2013	1208844	1387148.52	75.53	3.14		90423.0			0	
2014	1439260	1024063	33.21	3.92		19240.0			973.35	
2015	1549569	1339144	56.94	5.46		64642.9			0	
2016	1855823	1354508.78	40.38	5.57		45619.0			6850.36	
2017	1237435	1444033.66	53.27	5.57	3738.6	73345.0				
2018	1289326	1517156.54	59.21	5.57	3977.0	73436.0				
2019	1148352	1479788.42	53.56	5.57	14.0	73058.0				
2020	1142526	1459081.3	37.73	5.57	0.0	64548.7	452.2			
2021	1087559	1461228.18	31.84	5.57	12505.0	84527.9	579.8			
2022	986413	176494	45.59	5.57	14920.5	109873.5	91.5			

2.3.3.4 Emissions Trends Under IPPU

The emissions in this sector increased from 1,160.3 $GgCO_2eq$ in the base year (1990) to 1,744.26 $GgCO_2eq$ in the current year (2022). The increase in the IPPU sectoral emissions observed over the longer term are primarily due to growth in emissions associated with the manufacture of mineral products, product uses as substitutes for Ozone Depleting Substances, and other product manufacture and use as presented in Figure 2.26.

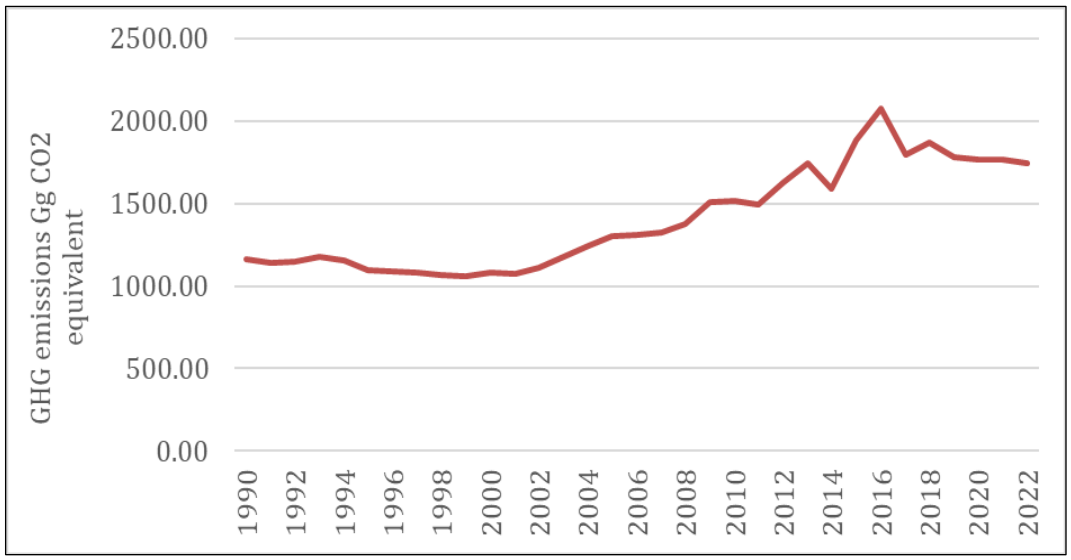


Figure 2-26: Emission Trends for IPPU

In 2022, the highest source of emissions in the IPPU sector was from the mineral industry at 93.79% with emissions generated from lime and cement production followed by Product Used as Substitutes for Ozone Depleting Substances at 3.9%, emissions from Metal Industry at 1.10%, emissions from Non-Energy Products from Fuels and Solvent Use with 1.08% and emissions from Other Product Manufacture and Use was almost negligible with 0.05. The details of quantities of emissions ($GgCO_2eq$) from IPPU by category are provided in Table 2.-15.

Table 2-15: Emission Trends for categories in the IPPU Sector($GgCO_2eq$)

Categories	2 - Industrial Processes and Product Use	2.A - Mineral Industry	2.B - Chemical Industry	2.C - Metal Industry	2.D - Non-Energy Products from Fuels and Solvent Use	2.E - Electronics Industry	2.F - Product Uses as Substitutes for Ozone Depleting Substances	2.G - Other Product Manufacture and Use	2.H - Other
1990	1161.30	1029.93	99.96	13.44	17.74	0.00	304.20	11.60	0.00
1991	1140.80	1030.45	83.11	8.90	17.75	0.00	0.59	0.00	0.00
1992	1151.27	1030.96	92.47	9.14	17.76	0.00	0.93	0.00	0.00
1993	1176.94	1031.48	119.86	6.54	17.77	0.00	1.28	0.01	0.00
1994	1153.34	1032.29	100.71	0.93	17.78	0.00	1.61	0.02	0.00
1995	1096.46	1032.52	43.33	0.87	17.79	0.00	1.94	0.02	0.00
1996	1087.95	1033.03	33.96	0.87	17.80	0.00	2.27	0.02	0.00
1997	1084.04	1033.55	29.17	0.87	17.80	0.00	2.61	0.02	0.00
1998	1065.13	1034.07	9.37	0.88	17.81	0.00	2.98	0.02	0.00
1999	1061.44	1034.59	4.76	0.88	17.82	0.00	3.37	0.02	0.00
2000	1081.58	1038.79	20.27	0.88	17.83	0.00	3.78	0.03	0.00
2001	1077.19	1049.88	4.36	0.88	17.84	0.00	4.21	0.03	0.00
2002	1111.90	1088.47	0.00	0.88	17.85	0.00	4.67	0.03	0.00
2003	1178.32	1149.75	3.82	0.88	17.86	0.00	5.98	0.03	0.00
2004	1242.53	1215.52	0.00	0.88	17.88	0.00	8.22	0.03	0.00
2005	1299.74	1268.68	0.00	0.88	17.88	0.00	12.08	0.23	0.00
2006	1308.65	1273.42	0.00	0.88	17.88	0.00	16.24	0.23	0.00

2007	1327.06	1288.25	0.00	0.88	17.89	0.00	19.80	0.23	0.00
2008	1375.24	1330.09	0.00	0.88	17.90	0.00	26.14	0.23	0.00
2009	1509.36	1462.55	0.00	0.88	17.91	0.00	27.80	0.23	0.00
2010	1515.31	1465.75	0.00	1.48	17.92	0.00	29.76	0.39	0.00
2011	1491.71	1435.08	0.00	3.90	17.93	0.00	34.31	0.51	0.00
2012	1628.31	1561.90	0.00	5.44	17.94	0.00	42.51	0.52	0.00
2013	1745.75	1669.13	0.00	7.23	17.94	0.00	50.93	0.52	0.00
2014	1589.60	1516.47	2.32	1.54	17.96	0.00	50.66	0.65	0.00
2015	1888.01	1810.17	0.00	5.17	17.96	0.00	54.19	0.52	0.00
2016	2073.78	1980.94	16.34	3.65	17.97	0.00	53.96	0.92	0.00
2017	1796.03	1712.30	0.00	8.48	17.98	0.00	56.35	0.92	0.00
2018	1873.40	1782.51	0.00	8.66	17.99	0.00	63.33	0.92	0.00
2019	1780.48	1687.26	0.00	5.85	18.00	0.00	68.44	0.92	0.00
2020	1767.05	1672.12	0.00	5.25	20.12	0.00	68.64	0.92	0.00
2021	1766.22	1644.91	0.00	15.63	33.93	0.00	70.83	0.92	0.00
2022	1744.26	1635.97	0.00	19.25	18.84	0.00	69.28	0.92	0.00

2.3.3.5 Emissions Trends by Gas

Provided in Figure 2.27 is the emissions trend by gas for IPPU for the period 1990 to 2022.

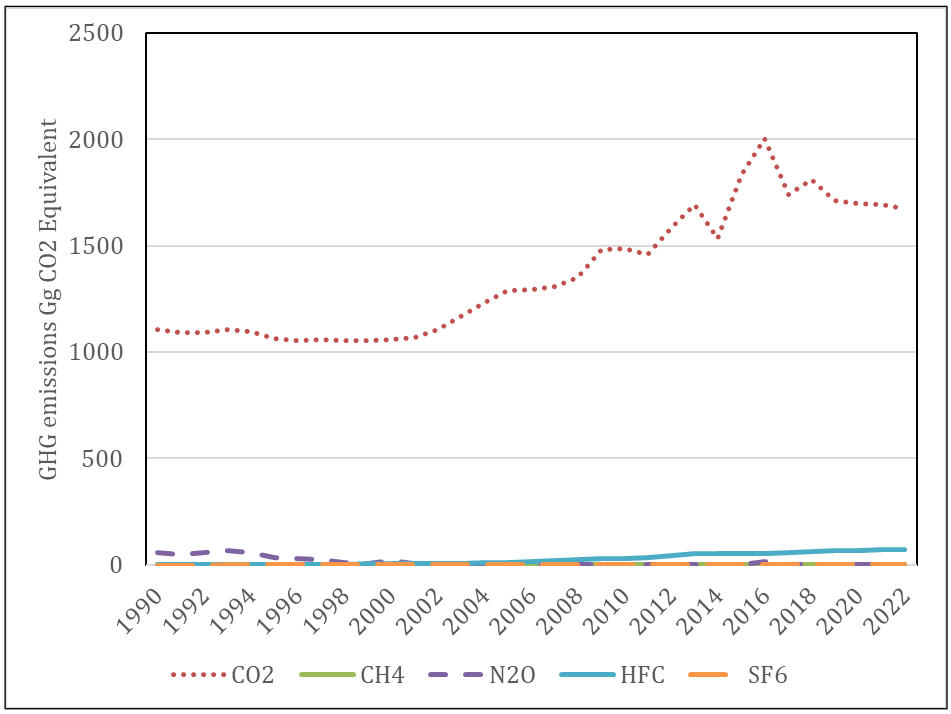


Figure 2-27: is the emissions trend by gas for IPPU for the period 1990 to 2022

In the year 2022, CO_2 was the highest emitted gas in the IPPU sector at 95.98% followed by HFCs at 3.97%. SF_6 was almost negligible with 0.05 as shown in Figure 2.28.

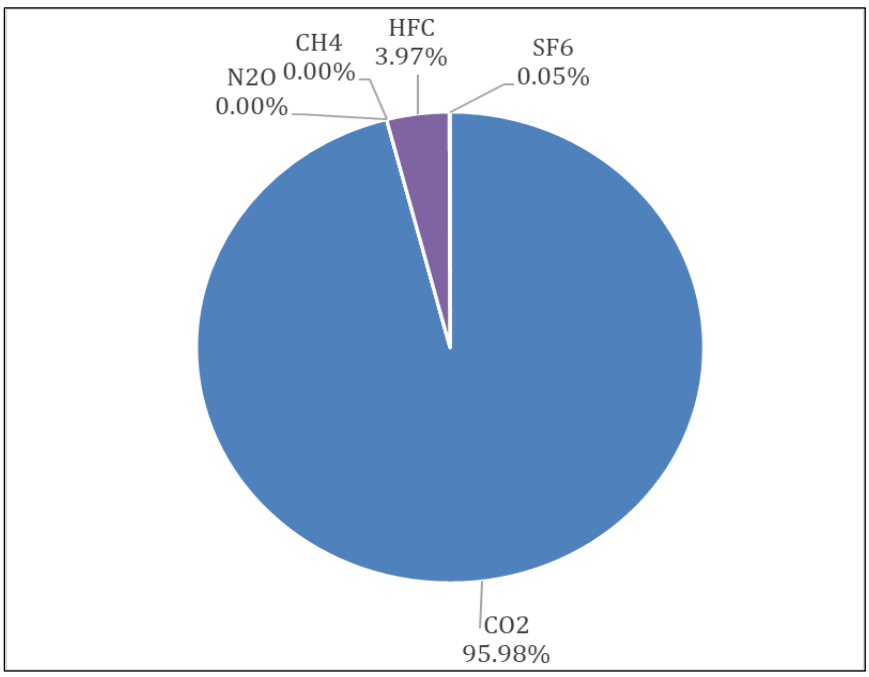


Figure 2-28: Emissions by gas in 2022 for the IPPU Sector

The main contribution of emissions within the IPPU sector was CO_2 emissions from cement and lime industries. Lubricant use, iron and steel production also contributed marginally to the CO_2 emissions. HFCs were mainly emitted from Refrigeration and Air Conditioning while SF_6 was from electrical equipment. Trends of precursor gases from the IPPU sector are provided in Table 2-16 and a summary report table of emissions from IPPU subcategories for 2022 are presented in Table 2.17

Table 2-16: Trend of Precursor Gases from the IPPU Sector

Gas (Gg)	Nox	NMVOC	CO	SO2	NH3
1990	0.698	0.001	0.019	0.009	N/E
1991	0.566	0.001	0.019	0.006	N/E
1992	0.607	0.001	0.019	0.006	N/E
1993	0.835	0.001	0.019	0.004	N/E
1994	0.715	0.001	0.019	0.001	N/E
1995	0.252	0.001	0.019	0.001	N/E
1996	0.163	0.001	0.019	0.001	N/E
1997	0.166	0.001	0.019	0.001	N/E
1998	0.041	0.001	0.019	0.001	N/E
1999	0.021	0.001	0.019	0.001	N/E
2000	0.086	0.001	0.019	0.001	N/E
2001	0.020	0.001	0.019	0.001	N/E
2002	0.001	0.001	0.019	0.001	N/E
2003	0.017	0.001	0.019	0.001	N/E
2004	0.001	0.001	0.019	0.001	N/E
2005	0.001	0.001	0.019	0.001	N/E
2006	0.001	0.001	0.019	0.001	N/E
2007	0.001	0.001	0.019	0.001	N/E
2008	0.001	0.001	0.019	0.001	N/E
2009	0.001	0.001	0.019	0.001	N/E
2010	0.002	0.001	0.032	0.001	N/E
2011	0.006	0.002	0.083	0.003	N/E
2012	0.009	0.003	0.116	0.004	N/E
2013	0.012	0.004	0.154	0.005	N/E
2014	0.012	0.001	0.033	0.001	N/E
2015	0.008	0.003	0.110	0.004	N/E
2016	0.074	0.002	0.078	0.003	N/E
2017	0.010	0.004	0.131	0.005	N/E
2018	0.010	0.004	0.132	0.005	N/E
2019	0.009	0.003	0.124	0.004	N/E
2020	0.008	0.003	0.110	0.004	N/E
2021	0.013	0.004	0.165	0.006	N/E
2022	0.016	0.006	0.212	0.008	N/E

Provided in Table 2-17 is a Summary report table for IPPU for 2022.

Table 2-17: Summary table for IPPU for 2022

Categories	(Gg)			CO2 Equivalents (Gg)					(Gg)				
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	NF_3	Other halogenated gases with CO_2 equivalent conversion factors (1)	Other halogenated gases without CO_2 equivalent conversion factors (2)	NOx	CO	NMVOCs	SO_2
2 - Industrial Processes and Product Use	1674.07	0.00	0.00	69.28	0.00	0.92							
2.A - Mineral Industry	1635.97	0.00	0.00										
2.A.1 - Cement production	512.93												
2.A.2 - Lime production	1123.04												
2.A.3 - Glass Production	NO												
2.A.4 - Other Process Uses of Carbonates	0.00												
2.A.4.a - Ceramics	NO												
2.A.4.b - Other Uses of Soda Ash	NO												
2.A.4.c - Non Metallurgical Magnesia Production	NO												
2.A.4.d - Other (please specify) (3)	NO												
2.A.5 - Other (please specify) (3)	NO	NO	NO										

2.B - Chemical Industry	NO NO	NO	NO	NO									
2.B.1 - Ammonia Production	NO												
2.B.2 - Nitric Acid Production			NO										
2.B.3 - Adipic Acid Production			NO										
2.B.4 - Caprolactam, Glyoxal and Glyoxylic Acid Production			NO										
2.B.5 - Carbide Production	NO	NO											
2.B.6 - Titanium Dioxide Production	NO												
2.B.7 - Soda Ash Production	NO												
2.B.8 - Petrochemical and Carbon Black Production	NO	NO											
2.B.8.a - Methanol	NO	NO											
2.B.8.b - Ethylene	NO	NO											
2.B.8.c - Ethylene Dichloride and Vinyl Chloride Monomer	NO	NO											
2.B.8.d - Ethylene Oxide	NO	NO											
2.B.8.e - Acrylonitrile	NO	NO											
2.B.8.f - Carbon Black	NO	NO											
2.B.8.x - Other petrochemical production	NO	NO											

2.B.9 - Fluorochemical Production				NO									
2.B.9.a - By-product emissions (4)				NO									
2.B.9.b - Fugitive Emissions (4)													
2.B.10 - Hydrogen Production	NO	NO	NO										
2.B.11 - Other (Please specify) (3)	NO	NO	NO										
2.C - Metal Industry	19.25	NO			0.00								
2.C.1 - Iron and Steel Production	19.23	NO											
2.C.2 - Ferroalloys Production	NO	NO											
2.C.3 - Aluminium production	NO				NO								
2.C.4 - Magnesium production (5)	NO												
2.C.5 - Lead Production	NO												
2.C.6 - Zinc Production	NO												
2.C.7 - Rare Earths Production	NO												
2.C.8 - Other (please specify) (3)	NO												
2.D - Non-Energy Products from Fuels and Solvent Use (6)	18.84	NO	NO										
2.D.1 - Lubricant Use	18.84												
2.D.2 - Paraffin Wax Use	NE												
2.D.3 - Solvent Use (7)													

2.D.4 - Other (please specify) (3), (8)	NO	NO	NO										
2.E - Electronics Industry			0.00		0.00	0.00							
2.E.1 - Integrated Circuit or Semiconductor (9)			NO										
2.E.2 - TFT Flat Panel Display (9)			NO										
2.E.3 - Photovoltaics (9)													
2.E.4 - Heat Transfer Fluid (10)													
2.E.5 - Other (please specify) (3)	NO	NO	NO		NO	NO							
2.F - Product Uses as Substitutes for Ozone Depleting Substances				69.28		NO							
2.F.1 - Refrigeration and Air Conditioning				69.28		NO							
2.F.1.a - Refrigeration and Stationary Air Conditioning				69.28		NO							
2.F.1.b - Mobile Air Conditioning													
2.F.2 - Foam Blowing Agents													
2.F.3 - Fire Protection													
2.F.4 - Aerosols													
2.F.5 - Solvents													
2.F.6 - Other Applications (please specify) (3)													
2.G - Other Product Manufacture and Use			0.00			0.92							

2.G.1 - Electrical Equipment						0.92							
2.G.1.a - Manufacture of Electrical Equipment													
2.G.1.b - Use of Electrical Equipment						0.92							
2.G.1.c - Disposal of Electrical Equipment													
2.G.2 - SF6 and PFCs from Other Product Uses						0.00							
2.G.2.a - Military Applications						NO							
2.G.2.b - Accelerators						NO							
2.G.2.c - Other (please specify) (3)						NO							
2.G.3 - N2O from Product Uses			0.00										
2.G.3.a - Medical Applications			NO										
2.G.3.b - Propellant for pressure and aerosol products			NO										
2.G.3.c - Other (Please specify) (3)			NO										
2.G.4 - Other (Please specify) (3)	NO	NO	NO										
2.H - Other	NO	NO	NO										
2.H.1 - Pulp and Paper Industry	NO	NO	NO										
2.H.2 - Food and Beverages Industry	NO	NO	NO										
2.H.3 - Other (please specify) (3)													

2.3.3.6 Emissions by IPPU Category

This section provides respective emissions, activity data and emission factors and methodologies for categories under IPPU.

Mineral Industry

The emissions source categories resulting from the consumption of carbonates from cement and lime production, including non-metallurgical magnesia were estimated. Emissions for the mineral industry increased from 1,029.93 $GgCO_2eq$. in the base year 1990 to 1,635.97 $GgCO_2eq$. in the current year 2022 as presented in Figure 2.29. The major sources of emissions are attributed to lime production at 68.6% followed by cement production at 31.3% with CO_2 being the only emitted gas from the mineral industry in 2022.

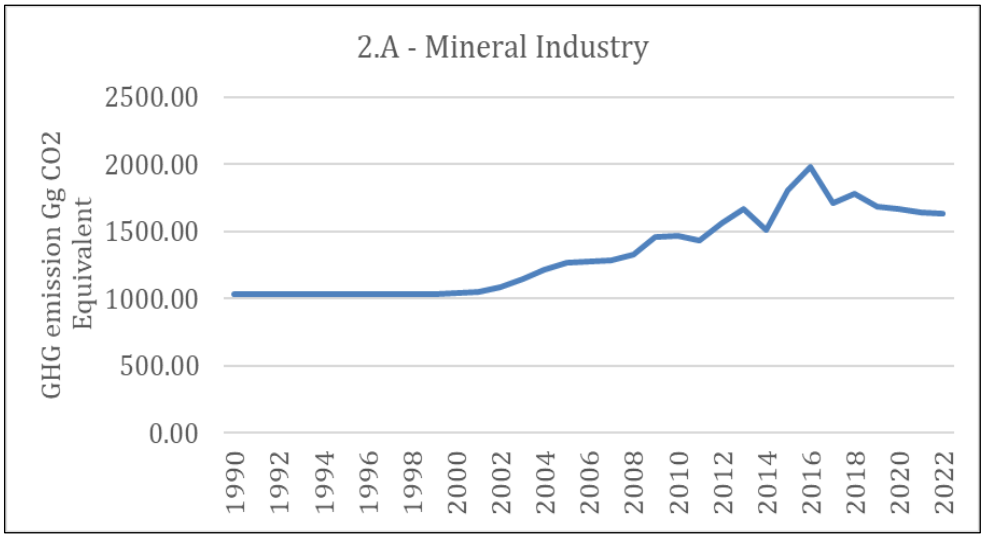


Figure 2-29: Trends of emissions for Mineral Industry Category

Chemical Industry

GHG emissions from the chemical industry arise from the production of various in-organic and organic chemicals. The chemical industries include: Ammonia production; nitric acid production; adipic acid production; caprolactam, glyoxal, and glyoxylic acid; production of carbide; titanium dioxide; and soda ash. While CO_2 and N_2O were reported for 1994, 2000, 2014 and 2016, no emissions occurred in this category for the years 2005 to 2013 and 2015 and 2020 due to discontinuity in the production of ammonia and nitric acid in Zambia. Figure 2.30 provides emissions from the chemical industry. Emissions reduced from 99.96 $GgCO_2eq$, in 1990 to zero in 2022.

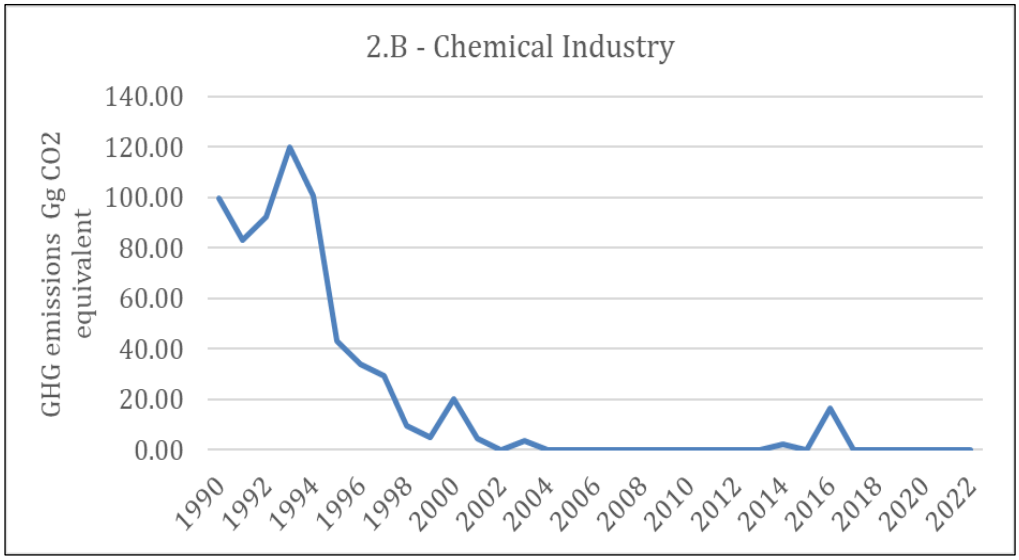


Figure 2-30: Emissions from Chemical industry

Metal Industry

Metal industry covers emissions from the production of iron and steel, metallurgical coke, ferroalloys, aluminium, magnesium, lead and zinc. In this subsector, lead and steel productions were the primary sources of emissions. However, there was no data for metal industry production for the years 2000 and 2005. In 1990 to 1994 production of lead and zinc contributed to the emissions however, the production subsequently ceased as a result of closure of the mine. Emissions declined from 1990 to 1994, and remained marginal up to 2010. After 2010, the emissions increased moderately until 2020 and thereafter recorded a sharp increase until 2022 as shown in Figure 2.31.

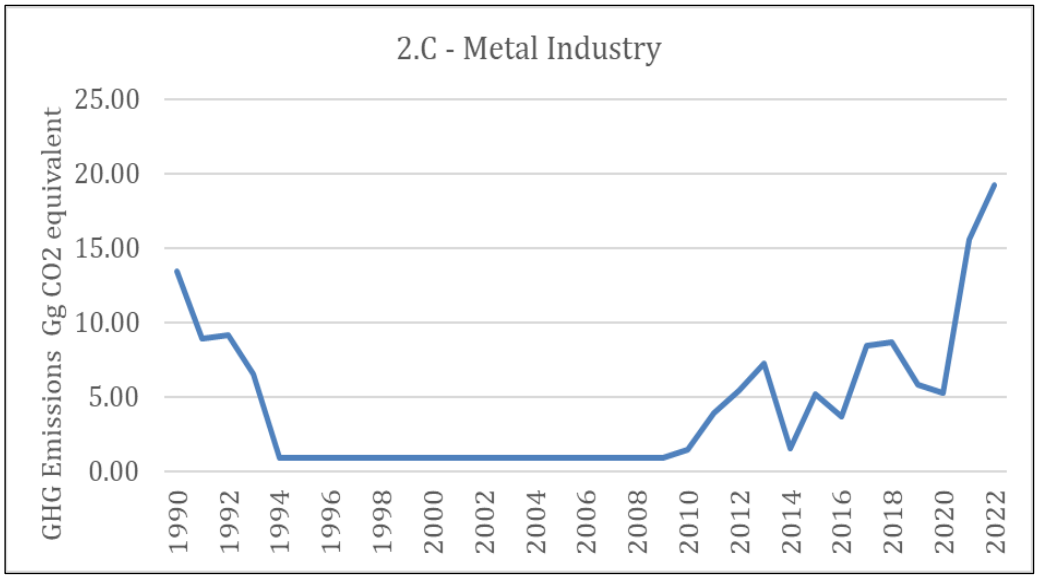


Figure 2-31: Emission from the Metal industry

In the period under review, the Metal Industry in Zambia was characterised by Iron and Steel production. The Iron and Steel production has been growing rapidly by demand from the construction and mining industries both in the domestic and regional markets. Many local and foreign investors had set up their manufacturing bases of steel products in Zambia and the factories utilise scrap metal as the primary raw material. Several steel makers began operations and have continued expanding their operations. This explains the sharp increase in iron and steel production between 2011 and 2014. However, as steel manufacturers expanded their production, it was getting harder for the companies to find steel scrap at reasonable prices. It became clear that steel scrap alone will not be able to sustain Zambian steel-making, hence the decline in production in 2015 and 2016 and then increased steadily through to 2022.

Non-Energy Products from Fuels and Solvent Use

This category presents the GHG emissions from the use of non-energy products (lubricants, waxes, greases, and solvents). In 2005, the emission from non-energy products from fuels and Solvent Use was 17.74 $GgCO_2eq$. and remained steady until 2020. Emissions increased sharply in 2021 and declined again in 2022 as presented in Figure 2.32. The emissions were estimated from use of lubricants.

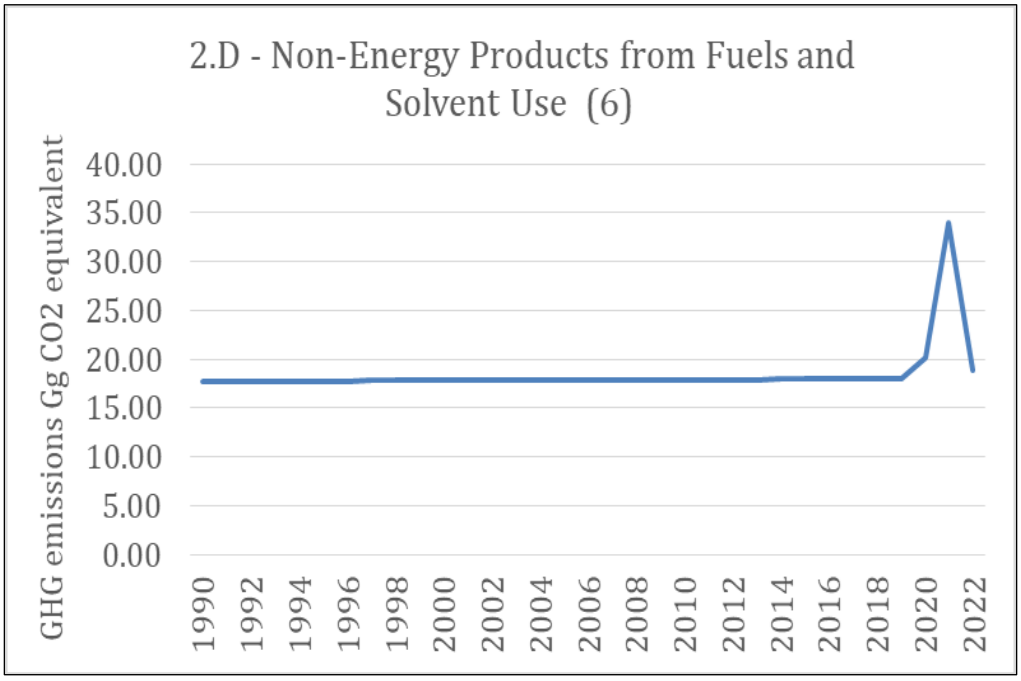


Figure 2-32: Emissions from the Non-Energy Products from Fuels and Solvent Use

Non-energy use of fuels and solvents includes lubricants, paraffin wax and solvents. Emissions from solvents and paraffin wax are not estimated due to a lack of activity data. Lubricants are divided into two types, namely, motor and industrial oils, and greases that differ in physical characteristics. Lubricants are mainly used in industrial and transport applications. This market is segmented into commercial and retail. The market continues to be plagued by unlicensed operators who continue to flood the market with imported lubricants[52].

[52]UNCTAD/DITC/CLP/2011/1

Electronics Industry

No activity occurred under this category in Zambia from 1990 to 2022 and hence, emissions estimates were not calculated

Products Used as Substitutes for Ozone Depleting Substances

Under this category Hydrofluorocarbons (HFCs) serving as alternatives to Ozone Depleting Substances (ODS) are used in refrigeration and air conditioning; fire suppression and explosion protection; aerosols; solvent cleaning; foam blowing; and other applications. Emissions in this category were mainly from refrigeration and air conditioning and the gas considered was HFC-134a (CH2FCF3). The emissions increased from 0.23 $GgCO_2eq$. in the base year 1990 to 69.28 $GgCO_2eq$. in the current year 2022 as shown in Figure 2.33. This significant increase is attributed to both growth in refrigeration and air conditioning.

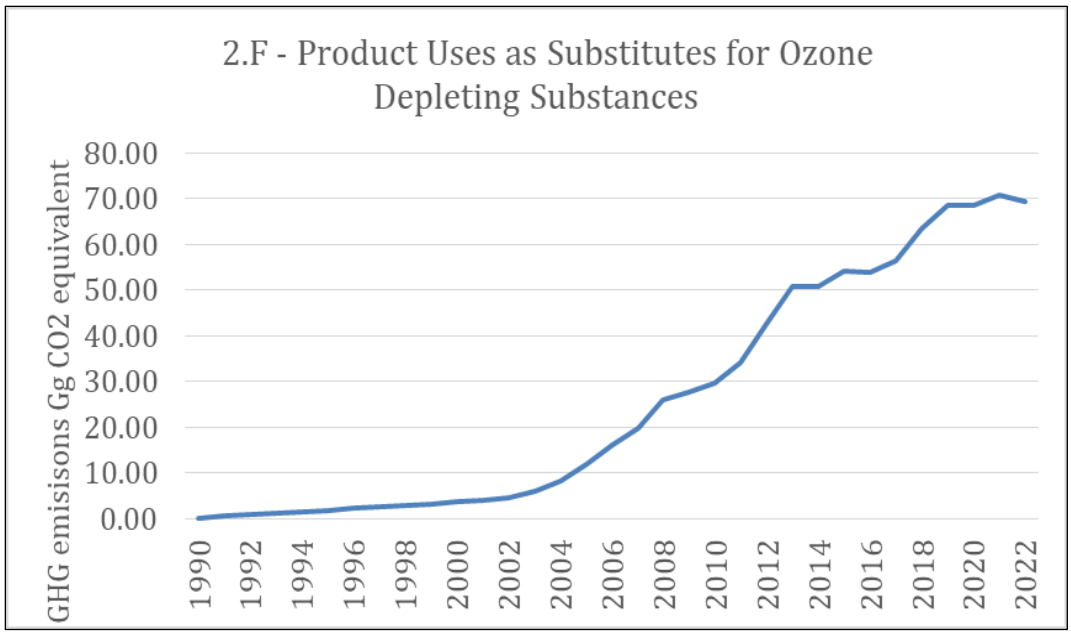


Figure 2-33: Emissions from Product Uses as Substitutes for Ozone Depleting Substances

Other Product Manufacture and Use

The sources of emissions under this category were SF_6 and PFCs from the manufacture and use of electrical equipment. N_2O emissions are generated from several products, but data was unavailable. Calculations of emissions were based on the use of electric equipment. Emissions increased from 0.00 $GgCO_2eq$. in 1990 to 0.92 $GgCO_2eq$. in 2022. Figure 2.34 shows the emissions generated from electrical equipment for the period 1990 to 2022.

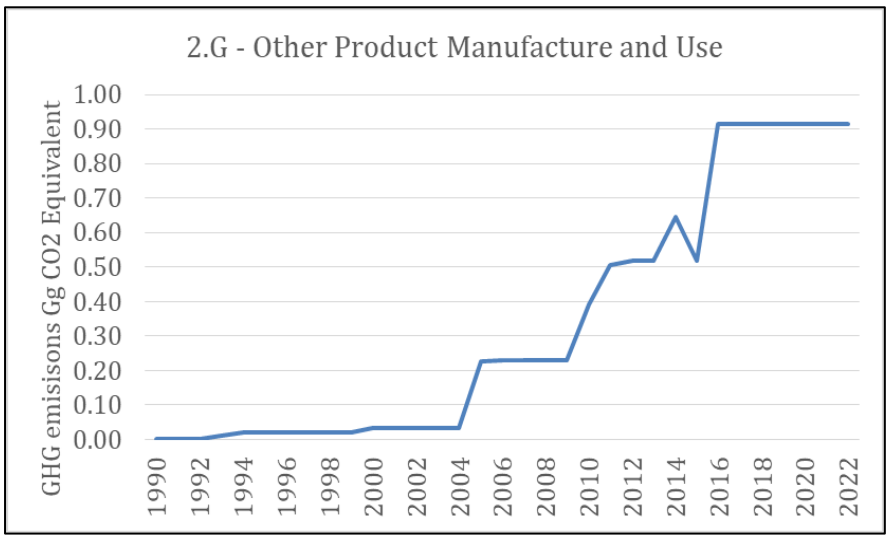


Figure 2-34:SF6 Emissions from use of Electric Equipment

2.3.3.7 Quality Assurance/Quality Control Measures

Activity data used in estimating GHG emissions from the IPPU was obtained from industries (Lubricants), ZamStats, Zambia Revenue Authority. Efforts were made to compare data from various sources and compile the most suitable data sets for use in emissions estimates. Efforts were made to check and verify the data from all sources to ensure good quality data was utilised in the inventory preparation from the IPPU sector.

2.3.3.8 IPPU Sector Uncertainties

The Uncertainty Analysis (UA) for the year 2022 for the IPPU sector was estimated using approach 1 and computed using the IPCC 2006 software and is provided in Annex I. Uncertainty arose from the quantity of cement and lime produced. Slight differences were observed between data from the Zambia Revenue Authority, ZamStats, and from manufacturers. As regards nitric acid and ammonia, production data was obtained from factory records with uncertainty of ±2%. Data on steel production was obtained from the ZRA and ZamStats databases whose uncertainty was about ±5%. Data on lubricants were obtained from the Ministry of Energy database. Uncertainty for data on SF_6 in electrical equipment was ±2% obtained from nameplate capacity from electricity utility companies.

2.3.3.9 Planned Improvements

The activity data for IPPU was derived from ZamStats and Zambia Revenue Authority (ZRA). Further, there is a need to incorporate GHG inventory parameters in the ZRA data capturing instruments. This will enable capturing of activity data accurately for refrigeration, fertilisers, petroleum products (lubricants), fire protection, solvents, aerosols and N2O for medical applications. Improvement in future inventories would require use of clinker production quantities as opposed to cement production figures. It is recommended that activity data be collected from all lime production plants in Zambia and obtain information of dolomitic lime.

Another improvement would be the development of country-specific emission factors and hydrated lime correction factors. Other activity data gaps in the IPPU Sector include the following:

- Limited activity data on records of fuel used as feedstock and of lubricant consumption.
- Inconsistent/insufficient activity data. It was observed that non-ferrous metals present an inconsistent fuel use (majorly coal) reporting from the current data sources. Industry facilities produce ferro-alloys through integrated unit operations; it is difficult for data sources like ZamStats to keep a measure of exact production statistics of ferro-alloys. For the Chemical Industry; activity data is insufficient from the current data sources. Other areas that need improvement in data collection are Textile and leather/ Paper and pulp, Food and Beverages: Wood and wood products. The activity data obtained from the ZRA and ZamStats for many of these sectors is not consistent across the years. There is therefore a need to
- Harmonise data from these two sources.
- Industry specific information lies mainly within the individual manufacturing units. An annual survey of manufacturing industries can be used as a prime source of information for the GHG estimations in the IPPU sector.

2.3.4 Agriculture Forestry and Other Land Use (AFOLU)

The Agriculture Forestry and Other Land Use (AFOLU) sector in Zambia contributes significantly to GHG emissions, primarily through activities like deforestation (from wood removals activities such as Timber harvesting, fuel-wood extraction, and disturbances (i.e. wildfires, pest outbreaks and land degradation), agricultural practices, and livestock management. Emission Reductions from Deforestation and Forest Degradation, Conservation, Enhancement of Carbon Stocks and Sustainable Forest Management (also known as REDD+) is a key outcome of the United Nations Framework Convention on Climate Change (UNFCCC) aimed to reduce emissions from tropical deforestation and degradation in developing countries.

2.3.4.1 Emissions Trend by Category in the AFOLU Sector

AFOLU consists of three categories namely Livestock, Land and Aggregate Sources and Non-CO2 emissions on land. Zambia recorded a progressive increase in emissions from AFOLU across the time series, during the period under review. Overall gross emissions from AFOLU increased by 115% from 93,636.2 $GgCO_2eq$ in the base year 1990 to 202,051.8 $GgCO_2eq$ in the current year 2022 as given in Figure 2.35 On the other hand, gross removals reduced

from 164745.1Gg CO2 in the base year 1990 to -160,443.0Gg CO2 in current year 2022, representing a reduction of 3% Figure. 2.35.

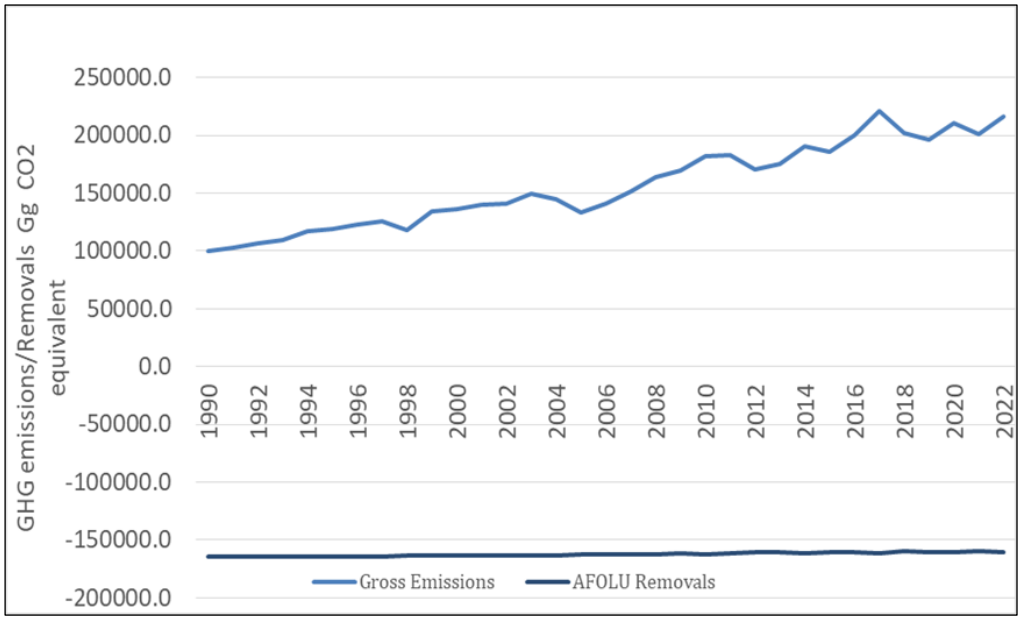


Figure 2-35: Trends of Emissions and Removals for AFOLU

Provided in Table 2-18 is the Trends of emissions and removals for AFOLU.

Table 2-18: Trends of Emissions and Removals for AFOLU($GgCO_2eq$)

	AFOLU Emissions	AFOLU Removals
1990	93636.19	-164745
1991	97855.75	-164778
1992	99987.53	-164679
1993	103284.3	-164665
1994	111924.7	-164652
1995	114609.9	-164621
1996	118853.9	-164716
1997	122109.8	-164721
1998	127357	-163737
1999	131204.1	-163511
2000	133699.6	-163477
2001	137847.7	-163346
2002	138702.3	-163222
2003	148243.2	-163077
2004	154401.8	-163931
2005	148942.4	-162841
2006	151059.1	-162727
2007	161559.3	-162910
2008	174795.5	-162328
2009	164823.7	-161498

2010	176915.4	-162185
2011	178053.2	-161887
2012	166890.9	-161045
2013	170840.1	-160901
2014	184796.9	-161452
2015	181181.1	-160609
2016	192416.8	-160414
2017	210849.2	-161171
2018	189895.8	-160177
2019	186340.8	-160882
2020	198994	-160737
2021	187778.6	-159743
2022	202051.8	-160443

In terms of AFOLU sub - categories, the trends show increasing growth of emissions from Livestock, Land, and Aggregate sources and non-CO2 emissions sources on land as presented in Figure 2.36.

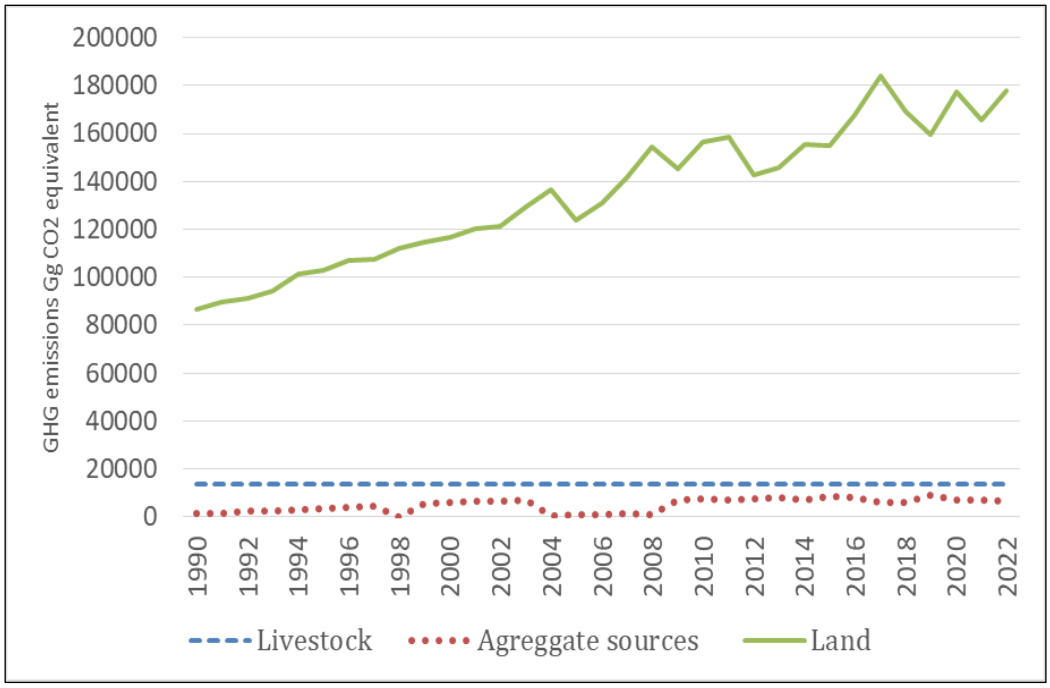


Figure 2-36: Emission trends and Contribution by Category from AFOLU sector

In the current reporting year, 2022, the highest GHG emissions contribution was from Land with 87.4% (176,604.9 $GgCO_2eq$) followed by Livestock at 6.7% (13,586.7 $GgCO_2eq$). The least was "Aggregate sources and non-CO2 emissions sources on Land" which contributed 6% (11,860.2 $GgCO_2eq$).

2.3.4.2 Emissions Trend by Gas for AFOLU Sector

The emissions by gas for the period 1990 to 2022 as shown in table 2.23 indicates that the most dominant gas across the timeline was CO_2, followed by CH_4 and N_2O. Emissions of CO_2 increased from 85,331.7 $GgCO_2eq$ in the base year 1990 to 176,725.7 $GgCO_2eq$ in the current year 2022. As regards CH_4, it indicated an increase from 6,915.7 $GgCO_2eq$ in the base year 1990 to 16,963.8 $GgCO_2eq$ in the current year 2022. In the case of N_2O, the emissions increased by 72.4% from 424.8 $GgCO_2eq$ in 1990 to 3,202.8 $GgCO_2eq$ in 2022 as shown in Table 2-19.

Table 2-19: Trend of Emissions by Gas for AFOLU ($GgCO_2eq$)

	CO2	CH4	N2O	Total Emissions	Removals
1990	85331.7	6915.7	424.8	92672.2	-164745.1
1991	88021.1	7777.0	583.5	96381.6	-164778.3
1992	89866.9	7901.3	916.6	98684.8	-164678.5
1993	92640.0	8109.6	916.6	101666.2	-164665.4
1994	99377.2	8473.6	1107.4	108958.3	-164652.3
1995	101440.7	8432.2	1269.6	111142.5	-164621.5
1996	105190.8	8230.3	1471.5	114892.6	-164716.0
1997	106107.2	9885.8	1657.3	117650.3	-164720.5
1998	110395.8	10231.0	1826.4	122453.2	-163737.4
1999	112664.8	11057.1	2018.0	125739.9	-163510.9
2000	114769.1	10679.0	2289.1	127737.2	-163476.7
2001	118378.9	10903.3	2337.0	131619.2	-163345.8
2002	119259.5	10517.5	2452.0	132229.1	-163222.3
2003	128173.9	10518.2	2666.2	141358.3	-163076.9
2004	134982.2	10322.4	2677.3	147981.9	-163930.5
2005	122851.0	13673.8	3361.0	139885.8	-162841.0
2006	130178.0	12412.4	2544.3	145134.7	-162726.9
2007	141275.8	11798.6	2620.6	155694.9	-162909.9
2008	153776.5	12689.4	2813.8	169279.7	-162327.8
2009	144308.7	12689.4	2384.2	159382.3	-161498.4
2010	155398.6	12803.0	2676.8	170878.3	-162184.5
2011	157280.6	11621.1	2701.1	171602.9	-161887.0
2012	141377.1	15472.5	2875.3	159724.9	-161045.4
2013	144170.3	16163.8	3020.2	163354.4	-160900.5
2014	154416.4	21526.1	2753.4	178695.9	-161451.7
2015	153293.5	16302.1	3912.7	173508.4	-160609.0
2016	166070.2	16103.2	3032.9	185206.3	-160414.2
2017	182639.1	20462.3	2498.2	205599.6	-161171.1
2018	167797.8	14536.8	2405.4	184740.0	-160176.9
2019	157993.9	10929.7	3224.8	172148.4	-160881.9
2020	175891.1	14025.1	2725.3	192641.5	-160737.2
2021	164442.9	14486.4	3072.4	182001.6	-159743.1
2022	176725.7	16963.8	3202.8	196892.3	-160443.0

The source for CO_2 was mainly from land use change conversion, wood removals (timber harvesting), fuel-wood removals, biomass burning and liming. N_2O and CH_4 emissions were mainly from manure management and enteric fermentation, respectively.

2.3.4.3 Precursor Gas Emissions Trend for AFOLU

Precursor gases that include; NOx, CO, NMVOC, SOx and NH_3 were estimated from Aggregate sources and non-CO_2 emissions sources on land and these include; biomass burning (in forestland, grassland and cropland), livestock (manure management) and crop farming (rice cultivation and fertiliser application). The estimations were based on EMEP/EEA air pollutant emission inventory guidebook 2023 [53].. Provided in Figure 2.37 are trends of precursor gases (Gg) in AFOLU for the period 1990 to 2022.

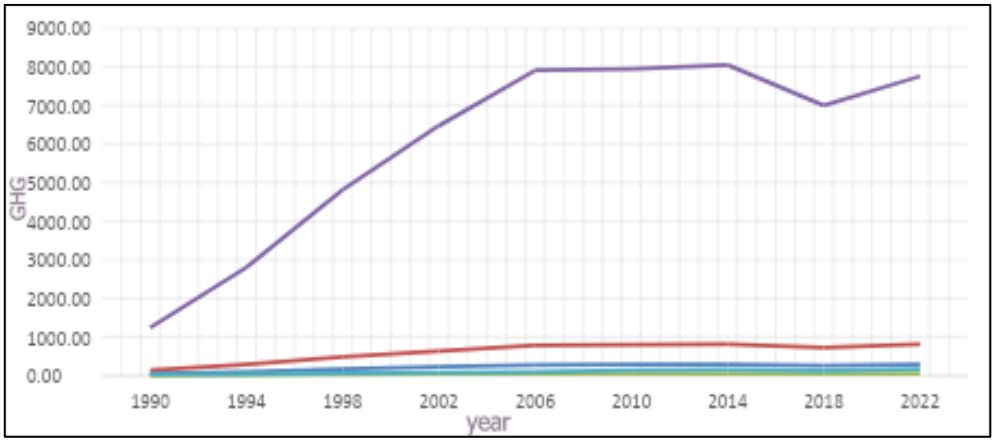


Figure 2-37: Precursor gases under AFOLU

Generally, the trend showed a steady increase in emission of all the precursor gases, with the highest share being for CO and followed by NMVOC. In the current reporting year (2022), CO emissions amounted to 7,756.55 Gg representing over 500% increase against CO emissions (1,244.50 Gg) in the base year, 1990. The main contributors to emission of CO were biomass burning and rice cultivation. Table 2.20 provides details of emissions of precursor gases from the assessed sub-categories in AFOLU for the current year, 2022.

Table 2-20: Precursor Gases from the Assessed Sub-categories in AFOLU for the Year 2022

Emissions (Gg)					
Precursor Gases	**NOx**	**NMVOC**	**SOX**	**CO**	**NH3**
3B1a Dairy cattle	0.16	3.77	N/A	N/A	0.93
3B1b Other cattle	0.97	39.78	N/A	N/A	8.94
3B2 Sheep	0.00	0.04	N/A	N/A	0.21
3B3 Swine	0.55	1.28	N/A	N/A	0.00
3B4a Buffalo	0.00	0.01	N/A	N/A	0.01
3B4d Goats	0.05	2.42	N/A	N/A	3.56
3B4e Horses	0.09	1.60	N/A	N/A	2.28
3B4f Mules and asses	0.00	0.00	N/A	N/A	0.02
Poultry	0.61	7.38	N/A	N/A	0.00

[53] EMEP/EEA air pollutant emission inventory guidebook 2023 | European Environment Agency's home page

Sub-total – Livestock	2.44	56.28	0.00	0.00	15.94
Forestry					
3.C.1.a - Burning in Forest Land	17.54	52.63	3.51	526.26	3.51
3.C.1.b - Burning in Cropland	0.01	0.00	0.00	0.43	0.02
3.C.1.c - Burning in Grassland	155.56	406.84	35.90	4463.29	35.90
Sub-total – Forestry	173.11	459.47	39.41	4989.98	39.42
3.C.3 - Urea Application	4.19				
3.C.7 - Rice cultivation	112.73	295.92	14.09	2766.57	112.73
Sub-total - Crop farming	112.73	295.92	14.09	2766.57	112.73
Total	**288.28**	**811.66**	**53.50**	**7756.55**	**168.09**

2.3.4.4 Livestock

2.3.4.4.1 Overview

The livestock sub-sector is key to agricultural development in Zambia and plays a pivotal role to job creation and economic diversification. However, the sub-sector also contributes significantly to greenhouse gas (GHG) emissions at present generating more than 25% (3.8 $GgCO_2eq$) of all emissions from food systems, particularly that of methane and N_2O from enteric fermentation and manure emitted from Livestock. The sub-sector is responsible for 82.5% of the 1,417,992 smallholder farmers, which means it sustains over 60% of the farming population[54]. The average typical livestock weight is 450 kg. The smallholder farmers face growing challenges that are associated with climate change and environmental degradation.

There are three livestock production systems practiced in Zambia, including the extensive, semi-intensive and intensive production systems. Under the extensive production system, animals meet all their nutritional requirements (ie feed and water) by scavenging around communal open grazing grasslands and rangeland This means livestock are left to graze in open and communally owned range-lands.

This is the most commonly type of management system practiced among smallholder farmers and is often characterised by poor range-land management largely due to uncontrolled grazing which usually leads to over-grazing and ultimately, soil degradation and often associated with high greenhouse gas emissions. In the semi-intensive production system, the grazing animals are usually provided with some supplementary feeds in addition to natural grazing in communal areas and natural range-lands. These animals tend to exhibit intermediate capacity for greenhouse gas emissions. In the intensive production system, farmers provide nearly all the feed to meet nutritional requirements for the animals. Suffice to say this only pertains to grazing animals including dairy cattle, other cattle and small ruminants that comprise of sheep and goats.

The source of CH_4 emissions from livestock is mostly through enteric fermentation and CH_4 and N_20 emission predominantly emanate from manure management. Other livestock species

[54] Livestock Survey Report, 2023

including pigs and poultry will mostly emit CH_4 and N_2O from manure , the amounts of which will depend on the type of manure management systems employed by farmers. Contributions from farmed ruminants as game animals including buffaloes is rather minimal at the moment.

A number of manure management systems exist. However, most smallholder farmers in Zambia do not apply recommended manure management practices, such as roofing of animal housing units, having a water-proof floor or covering of the manure during storage, which result in large nutrient losses during manure storage and eventually increasing on greenhouse gas emissions and reducing the quality of manure that is used as fertilizer in the field. In general, dairy cattle are kept under a confined system where they are kept in a small area, and this entails that the cow dung is cleaned, piled and composted for use in gardens and crop fields as organic fertilizer.

In the recent past, the Government with assistance from its cooperating partners has been promoting construction of bio-digesters using cow-dung manure for generation of power for domestic lighting and cooking. This is where farmers benefit from the gas produced from household bio-digesters for cooking. Some notable non-governmental organisations that are promoting the use of bio digesters are SNV and Musika.

2.3.4.4.2 Methodology and Emission Factors

(i) **Enteric Fermentation**

For Dairy Cattle and Other Cattle, Tier 2 methodology was used while Tier 1 was used for other livestock including Sheep, Goats, pigs and Chickens. IPCC (2006) Tier 2 methodologies were used for calculating emissions dairy and other cattle.

Emission factor for each animal category was determined using Equation 2.13 as provided for in the 2019 Refinement to the 2006 IPCC Guidelines for calculating National Greenhouse Gas Inventories.

EF= (GE*Ym/100*365)/55.65 Equation 2.13

Where:

EF	Emission factors, kg CH4 $head^{-1}$ $year^{-1}$
GE	Gross energy intake, MJ $head^{-1}$ day^{-1}
Ym	methane conversion factor, % of gross energy in feed converted to methane
55.65	Energy content of methane, MJ/kg CH4

Net Energy for Maintenance

Net energy for maintenance (NEm) is the net energy required for maintenance, which is the amount of energy needed to keep the animal in equilibrium where body energy is neither gained nor lost. It is determined from the Equation 2.14.

$$NE_m = CF_i * (Weight)^{0.75}$$ Equation 2.14

Where:

NE_m	net energy required by the animal for maintenance MJ day^{-1}
CF_i	a coefficient which varies for each animal category (Table 4.1),
$Weight$	live-weight of animal, kg

$$CF_{i(in\_cold)} = CF_i * 0.0048 * (20 - {}^oC)$$ Equation 2.15

Where:

$CF_{i(in\_cold)}$	coefficient which varies for each animal category MJ day^{-1} kg^{-1}
CF_i	a coefficient which varies for each animal category (Table 4.1),
${}^oC$	mean daily temperature in winter season

Table 2-21: Average Co-efficients for Calculating Net Energy for Maintenance

	Cf(in_cold)
Lactating Cows	0.386
Non-lactating cows	0.322
Bulls	0.37

Source: 2019 Refinement To The 2006 IPCC Guidelines For National Greenhouse Gas Inventories.

Results of Net energy required by the animal for maintenance for dairy cattle and other cattle is provided below (specify Table/reference). Net energy required by the animal for maintenance under dairy cattle for Adult cows, Adult bulls, Heifers, Growing males and Calves are provided in Table 2.21

Net Energy for Animal Activity

Net energy for activity: (NEa) is the net energy for activity, or the energy needed for animals to obtain their food, water and shelter. It is based on animal feeding situation rather than characteristics of the feed itself. Net energy for activity is determined using Equation 2.15.

$$NE_a = C_a * NE_m$$

Equation 2.15

NE_a	net energy for activity, MJ day $^{-1}$
C_a	a coefficient corresponding to animal's feeding situation (Table 2-22)

Table 2-22: Co-efficient Corresponding to Animal's Feeding Situation

Feed situation	C_a
Stall	0
Pasture	0.17
Grazing Large Areas	0.36

Source: 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

Net Energy for Growth

Net energy for growth: (NEg) is the net energy needed for growth (i.e., weight gain).

$$NE_g = 22.02 * \left(\frac{BW}{C*MW}\right)^{0.75} * WG^{1.097}$$ Equation 2.16

Where:

NE_g	net energy needed for growth, MJ day $^{-1}$
C	a coefficient (table 28) with a value of 0.8 for females, 1.0 for castrates, and 1.2 for bulls
BW	The average live body weight of the animals in the population (kg)
MW	The mature body weight of an adult animal individually, mature females, mature males and steers) in moderate body condition (kg)
WG	The average daily weight gain of the animals in the population (kg day^{-1})

Table 2-23: Co-efficient

Growth	Cg
Females	0.8
Castrates	1
Bulls	1.2

Results of Net energy for growth for dairy cattle and other cattle is provided below:

Net Energy for Lactation

Net energy for lactation: NE_l) is the net energy for lactation. For cattle and buffalo, the net energy for lactation is expressed as a function of the amount of milk produced and its fat content expressed as a percentage.

The methodology for determining Net Energy for Lactation is provided in equation 2.17.

$$NE_l = Milk * (1.47 + 0.40 * Fat)$$ Equation 2.17

Where:

NE_l	net energy for lactation, MJ day $^{-1}$
$Milk$	amount of milk produced kg of milk day^{-1}
Fat	fat content of milk, percent by weight

Net Energy for work

Net energy for work: (NEwork) is the amount of energy needed for work on each day per animal and is used to estimate the amount of energy required for draft power from cattle and buffalo and is estimated using the equation 2.18. Various authors have summarized the energy intake requirements for providing draft power (ref). The strenuousness of the work performed by the animal influences the energy requirements, and consequently a wide range of energy requirements have been estimated. The values by Bamualim and Kartiarso (year) showed that about 10 percent of a day's NEm requirements are required per hour for typical work by draft animals.

$$NE_{work} = 0.10 * NE_m * Hours$$

Equation 2.18

Where:

NE_{work}	net energy for work, MJ day $^{-1}$
NE_m	net energy for maintenance MJ day $^{-1}$
$Hours$	number of hours of work per day

Net Energy for Pregnancy

Net energy for pregnancy: (NEp) is the energy required to maintain pregnancy. For cattle and buffalo, the total energy requirement for pregnancy for a 281-day gestation period averaged over an entire year is calculated about 10 percent of NEm (Equation 2.19).

$$NE_p = c_{pregnancy} * NE_m$$

Equation 2.19

Where:

NE_p	net energy for pregnancy, MJ day $^{-1}$,
NE_m	net energy for maintenance MJ day $^{-1}$
$c_{pregnancy}$	Pregnancy coefficient (0.1)

Ratio of Net Energy for Maintenance

***Ratio of net energy available in diet for maintenance to digestible energy consumed (REM)*:** For cattle, buffalo, sheep and goats, the ratio of net energy available in a diet for maintenance to digestible energy (REM) is estimated using equation 2.20 (2019 Refinement to the 2006 IPCC Guidelines).

$$REM = [1.123 - (4.092 * 10^{-3} * DE) + (1.126 * 10^{-5} * (DE^2) - \left(\frac{25.4}{DE}\right)$$ Equation 2.20

Where:

REM	ratio of net energy available in a diet for maintenance to digestible energy
DE	digestibility of feed expressed as a fraction of gross energy (digestible energy/gross energy
REM	ratio of net energy available in a diet for maintenance to digestible energy

Ratio of Net Energy Available for Growth

***Ratio of net energy available for growth in a diet to digestible energy consumed (REG)*:** For cattle, buffalo, sheep and goats the ratio of net energy available for growth (including wool growth) in a diet to digestible energy consumed (REG) is estimated using (Equation 2.21)

$$REG = [1.164 - (5.16 * 10^{-3} * DE) + (1.308 * 10^{-5} * (DE^2) - \left(\frac{37.4}{DE}\right)$$ Equation 2.21

Where:

REG	ratio of net energy available for growth in a diet to digestible energy consumed
DE	digestibility of feed expressed as a fraction of gross energy (digestible energy/gross energy

Gross Energy Requirement

Gross energy (GE) requirement is derived based on the summed net energy requirements and the energy availability characteristics of the feed(s). Equation 2.22 represents good practice for calculating GE requirements for cattle, buffalo, sheep and goats using the results of the equations presented above.

$$GE = \frac{\left(\frac{NE_m + NE_a + NE_l + NE_{work} + NE_p}{REM}\right) * \left(\frac{NE_g + NE_{wool}}{REG}\right)}{DE}$$ Equation 2.22

Where:

GE	gross energy intake, MJ head^{-1} day^{-1}
NE_m	net energy required by the animal for maintenance MJ day^{-1}
NE_a	net energy for animal activity MJ day^{-1}
NE_l	net energy for lactation MJ day^{-1}
NE_{work}	net energy for work MJ day^{-1}
NE_p	net energy required for pregnancy MJ day^{-1}
NE_g	net energy needed for growth MJ day^{-1}
NE_{wool}	net energy required to produce a year of wool
REM	ratio of net energy available in a diet for maintenance to digestible energy
REG	ratio of net energy available for growth in a diet to digestible energy consumed
DE	digestibility of feed expressed as a fraction of gross energy (digestible energy/gross energy

Emission Factor for CH_4

Emission factor for methane is determined using Equation 2.23.

$$EF = \frac{GE*\left(\frac{Y_m}{100}\right)*365}{55.65}$$ Equation 2.23

Where:

EF	emission factor, kg CH_4 head^{-1} yr^{-1}
GE	gross energy intake, MJ head^{-1} day^{-1}
Y_m	methane conversion factor, percent of gross energy in feed converted to methane

(ii) **Manure Management**

Tier 2 was used for estimating emissions from dairy cattle and other cattle while Tier 1 was used for buffaloes, sheep, goats, pigs, broilers, layers, and indigenous chickens.

Provided in the equations is Tier 2 methodology use for dairy cattle and other cattle.

For dairy and other cattle, country-specific EFs for CH_4 from manure management in Zambia were used, including direct N_2O emission factors from cattle manure management. This tier 2-based approach involved measurement of country-specific volatile solids for manure as well as assessment of the impact of interactions between manure management systems and animal

categories in relation to CH_4 emissions during excretion, storage and treatment of manure. The volume of CH_4 emitted was driven primarily by the amount of manure produced and the portion of the manure that decomposed anaerobically. The EF for methane from manure was determined using equation 2.24.

$$EF = (VS_T * 365)[B_{o(T)} * 0.67 * \sum_{s,k} \frac{MCF_{s,k}}{100} * AWMS_{(T,s,k)}$$ Equation 2.24

Where:

EF	annual CH_4 emission factor for livestock category T, kg CH_4 head^{-1} yr^{-1}
$VS_{(T)}$	daily volatile solid excreted for livestock category T, kg dry matter head^{-1} day^{-1}
365	basis for calculating annual VS production, days yr^{-1}
$B_{o(T)}$	maximum methane producing capacity for manure produced by livestock category T, m^3 CH_4 kg^{-1} of VS excreted
0.67	conversion factor of m^3 CH_4 to kilograms CH_4
$MCF_{(s,k)}$	methane conversion factor for manure management system, S, by climate region, k
$AWMS_{(T,s,k)}$	fraction of livestock category manure handled using manure management system, s

Direct N_2O Emissions from Cattle Manure Management

The direct N_2O emissions from manure management was estimated as a product of the total amount of N excretion (from all cattle categories) in each type of manure management system and the associated EF, based on equation 2.25 of the IPCC 2006 guidelines.

$$N_2O_D = [\sum_S \left[\sum_{T,P} \left((N_{T,P} * Nex_{T,P}) * AWMS_{T,S,P}\right) + N_{cdg(s)}\right] * EF_S] * \frac{44}{28}$$ Equation 2.25

Where:

N_2O_D	direct N_2O emission from manure management, kg N_2O yr^{-1}
$N_{T,P}$	heads of cattle under category T in the country, for productivity system P, where applicable.
$Nex_{T,P}$	annual average N excretion per head of cattle category T in the country, for productivity system P, when applicable in kg N animal^{-1} yr^{-1}
$AWMS_{(T,S,P)}$	fraction of total annual nitrogen excretion for each livestock species/category T that is managed in manure management system S in the country
EF_S	emission factor for direct N_2O emissions from manure management system S in the country, kg N_2O -N/kg N in manure management system S
$\frac{44}{28}$	conversion of N_2O -N(mm) emissions to N_2O (mm) emissions

The amount of N excreted by each livestock species/category per year depends on the total N intake and total N retention of the animal each year. Equation 2.26 was used to determine the average amount of N excreted annually.

$$N_{ex,T} = N_{intake,T} * \left(1 - N_{retension_{frac}T}\right) * 365$$ Equation 2.26

Where:

$N_{ex,T}$	annual N excretion rates, kg N animal^{-1} yr^{-1}
$N_{intake,T}$	the daily N intake per head of animal of category T, kg N animal^{-1} day^{-1}.
$N_{retension,T}$	fraction of daily N intake that is retained by animal of category T.
365	number of days in a year.

The daily N intake rate was derived, using Equation 2.27.

$$N_{intake,T} = \frac{GE}{18.45} * \left(\frac{CP\%}{6.25}\right)$$ Equation 2.27

Where:

GE	Gross energy intake of the animal, MJ animal^{-1} day^{-1}.
$CP\%$	Percent crude protein in dry matter for growth stage.
6.25	Conversion from kg of dietary protein to kg of dietary N, kg feed protein (kg N)$^{-1}$.

The total N retained for cattle was derived, using Equation 2.28:

$$N_{retension,T} = \left[milk * \left(\frac{milk.PR\%}{6.38}\right)\right] + \left[\frac{WG * \left[268 - \left(\frac{7.03 * NE_g}{WG}\right)\right]}{1000}}{6.25}\right]$$ Equation 2.28

Where:

Milk	milk production, kg animal^{-1} day^{-1} (applicable to dairy cows only).
$milk.PR\%$	percentage protein in milk.
6.38	conversion from milk protein to milk N, kg Protein (kg N)$^{-1}$.
WG	weight gain, input for each livestock category, kg day^{-1}.
260 and 7.03	constants, g Protein kg^{-1} animal^{-1} and g Protein MJ^{-1} animal^{-1} respectively.
NE_g	net energy for growth, MJ day^{-1}.
6.25	conversion from kg of dietary protein to kg of dietary N, kg feed protein (kg N)$^{-1}$.

The estimation of EFs for direct N_2O emissions was based on the amount of nitrogen consumed (N-intake), the fraction of nitrogen retained (N-retention) and nitrogen excretion rate (Nex). The study estimated the EFs for direct N_2O emissions for various production systems of dairy and other cattle. The EFs for direct N_2O emissions for dairy cattle manure management are presented in Table 20 for intensive production system.

Indirect N_2O Emissions from Cattle Manure Management

To estimate N volatilization (in forms of NH3 and NOx) from manure management systems, the amount of nitrogen excreted (from all cattle categories) and managed in each manure management system is multiplied by a fraction of volatilized nitrogen based on Equation 2.29 of the IPCC 2006 guidelines.

$$N_{volatisation} = [\sum_S \left[\sum_{T,P} \left((N_{T,P} * Nex_{T,P}) * AWMS_{T,S,P}\right) + N_{cdg(s)}\right] * Frac_{GasMS}$$ Equation 2.29

Where:

$N_{volatilisation}$	amount of manure nitrogen that is lost due to volatilisation of NH3 and NOx, kg N_2O yr^{-1}
$N_{T,P}$	number of heads of cattle under category T in the country, for productivity system P, when applicable
$Nex_{T,P}$	annual average N excretion per head of cattle under category T in the country, for productivity system P, when applicable in kg N $animal^{-1}$ yr^{-1}
$AWMS_{(T,S,P)}$	fraction of total annual nitrogen excretion for each livestock species/category T that is managed in manure management system S in the country
$Frac_{GasMS}$	fraction of managed manure nitrogen for livestock category T that volatilises as NH3 and NOx in the manure management system S

The amount of N lost through leaching and runoff from manure management systems was determined as a product of the amount of nitrogen excreted (from all livestock categories) and managed in each manure management system by a fraction of nitrogen leached. Equation 2.30 was used to estimate the N leached from each manure management system.

$$N_{leaching} = [\sum_S \left[\sum_{T,P} \left((N_{T,P} * Nex_{T,P}) * AWMS_{T,S,P}\right) + N_{cdg(s)}\right] * Frac_{leachMS}$$ Equation 2.30

Where:

$N_{volatisation}$	amount of manure nitrogen that is lost due to volatilisation?? of NH3 and NOx, kg N_2O yr^{-1}
$N_{T,P}$	number of heads of cattle under category T in the country, for productivity system P, when applicable
$Nex_{T,P}$	annual average N excretion per head of cattle category T in the country, for productivity system P, when applicable in kg N $animal^{-1}$ yr^{-1}
$AWMS_{(T,S,P)}$	fraction of total annual nitrogen excretion for each livestock species/category T that is managed in manure management system S in the country
$Frac_{leachMS}$	fraction of managed manure nitrogen for livestock category T that is leached from manure management system S

Tier 1 is a simplified method that only requires livestock population data by animal species/category and climate region or temperature, in combination with IPCC 2006 default emission factors, to estimate emissions. Basic characterisation for Tier 1 was used involving use of animal population and default emission factors. A complete list of all livestock populations that have default emission factor values estimated (i.e., buffalo, sheep, goats, rabbits, and asses, swine, and poultry). Poultry populations were further sub-divided into layers, broilers, turkeys, ducks, and other poultry, suffice to note that the waste characteristics among these different populations varied quite significantly.

$$CH_4Emissions = \sum_T \frac{EF_T X N_T}{10^6}$$ Equation 2.31

Where:

Where: CH_4Emissions = CH_4 emissions from manure management, for a defined population, Gg CH4 yr^{-1}; $EF_{(T)}$ = emission factor for the defined livestock population, kg CH_4 $head^{-1}$ yr^{-1}(Table 2.21); $N_{(T)}$ = the number of heads of livestock species/category T in the country T = species/category of livestock..

Table 2-24: Emission Factors for Livestock Manure management

Category	Emission Factor (kg CH_4 / Head per year)
Dairy cattle	1.00
Non-Dairy Cattle	1.00
Buffalo	2.00
Sheep	0.15
Goats	0.17
Swine	1.00
Broilers	0.02
Layers	0.02
Indigenous	0.02
Others	0.02

2.3.4.4.3 Activity Data

Non-Dairy Cattle

There was a 10.65% decline in the total livestock emissions between 2000 and 2005. The reduction in emissions was as a result of declining cattle population in 2005 due to the Contagious Bovine Pluero-Pneumonia outbreak reported in Zambia that led to high cattle mortalities. Further, during disease control operations, all cattle that tested positive to the disease were slaughtered. Methane emissions from buffalo under captivity have been taken into consideration in the calculation of emissions for the years 2005 and 2010. Therefore, the

numbers of buffalo that were being held in captivity were relatively fewer, about 503 to 935 for 2005 and 2010, respectively.

There was an increase in non-dairy cattle population from 1,748,856 in 2011 to 2,109,231 in 2016, translated to an increase of 17% in population over a period of 5 years.

This was attributed to the Government's efforts in promoting livestock production in the country. Some of the notable specific interventions included improved pasture and range-land management programmes and stocking and restocking activities. Further, the Government promoted routine vaccinations against Contagious Bovine Pleuropneumonia (CBPP) and immunisation against East Coast Fever (ECF). These interventions reduced mortalities in cattle, which led to an increase in cattle population.

In 2011 the population of cattle dropped by 16% and this was attributed to data gaps because in the aforementioned year, there were no disease outbreaks that could have led to a reduction in the population. However, a 6% drop in population was observed from 2015 to 2016. This drop was attributed to the El nino effects which was experienced in the 2015/16 farming season. The El Nino induced drought reduced availability of grazing and browsing resources for the animals leading to reduced cattle population for smallholder households. The other most affected categories of cattle by El Niño were the pregnant ones most of which died from a condition known as dystocia due to lack of energy for muscle contraction at the time of giving birth. The impact of an El Niño-induced shock affected income and productivity of many farmers and was thus, classified as the most severe natural calamity in the last fifty years[55] .

The recent 2023 Livestock survey reported the beef cattle population of four million four hundred and sixty-nine thousand one hundred and twenty heads (4,469,120), the surge could be attributed to Government and private sector interventions in enhancing production and productivity in the sector. Farmers now have access to animal input supply from the Farmer Input Support Programme (FISP) and a boost in the availability of AI services.

Dairy Cattle

The population of dairy cattle increased from 874,268 in 2011 to 1,279,734 in 2012 due to an increase in the number of entities investing in the dairy value chain. Government and its cooperating partners also started constructing milk collection centres around the same period and has to date constructed seventy-nine (79) centres around the country. This led to a guaranteed market for raw milk marketing, hence making it attractive for dairy farmers to invest in raw milk production. A steady increase in dairy cattle was observed from 2012 to 2014 due to a steady increase in demand for dairy products by the market.

[55]ZVAC, 2016

The general increase in population from 2014 to 2015 was attributed to a number of interventions including, the Government and its cooperating partners having embarked on animal stocking and restocking activities through programmes such as Loan a cow promoted by ZANACO, Send a cow supported by a UK charity and, the pass on a gift scheme that was promoted by Heifer international. This meant selected communities were empowered with livestock in areas where livestock numbers reduced due to mortalities that were associated with outbreak of of livestock diseases.

Unfortunately, from 2015 to 2016, the dairy cattle population reduced by 44% from 1,995,677 to 1,320,609 heads of cattle. This was attributed to poor preparedness by recipients to receive livestock assets by most beneficiaries. The stocking and restocking were occurring in high numbers but within a season, most of the dairy animals died due to inadequate grazing resources during the dry season, coupled with poor dairy management capabilities by traditional small-scale farmers. Some of the exotic dairy breeds introduced in some areas could not acclimatize to harsh environmental conditions in the areas they were taken to.

The dairy cattle population was noted to stabilize at just fewer than one hundred and fifty thousand heads (150,000) from 2015 to 2021. There was however a surge to over two hundred thousand heads (200,000) noted in 2022. This could be as a result of renewed efforts by both the government and the private sector to import breeding dairy animals and semen from South Africa and other countries for distribution.

In the recent past, there has been an increase in attention to training communities in good animal husbandry practices which has led to an increase in livestock numbers. This is as a result of the creation of the Ministry of Fisheries and Livestock in 2015. This resulted in more attention being paid to good animal husbandry practices resulting in a a steady increase in livestock populations. Over the period under review, several disease outbreaks did occur more notably Foot and mouth Disease (FMD), which does not cause a lot of deaths (Mortality) but has high loss of Production (morbidity) as a result it did not depress the cattle numbers.

Small ruminants (Goats and Sheep)

Small ruminants equally recorded an increase in numbers rising from 1,855,366 in 2011 to 2,632,277 in 2016 which translated into a 30% increase in the population.

Goats

Goat population has generally been on the increase from 2011 to 2016 due to a number of interventions particularly stocking through the pass on the gift model. This pass on the gift model implemented by the government and its Cooperating Partners works by giving a certain number of goats to a beneficiary who in turn has to pass on the offspring to the next beneficiary. This model has led to an increase in goat numbers because measures are also being taken to provide intensive training to beneficiaries. This system has led to internal monitoring among farmers themselves, particularly the ones waiting to receive from the first beneficiary.

From 2015 to 2016, a reduction in population of 22% was observed and this was attributed to the high flock off-take due to the drought that was experienced in the 2015/16 season. Due to reduced income resulting from low crop yields, most farmers opted to sell their small livestock to generate income and cushion the shock against the drought. Indications are that households that were affected by the drought experienced a decrease in maize yield by around 20%, as well as a reduction in income up to 37%[56]. Practices that moderated the impact of the drought included livestock diversification, income diversification, and the adoption of agroforestry. Additionally, there has been an increase in demand for goat meat in the recent past and this has led to high numbers of goats being sold for consumption.

There was a surge in the goat population from 1,664,216 in 2015 to 3,503,099 in 2016 which was more or less maintained up to 2019, which was followed by another wave of population increase to above four million (4,000,000) from 2020 to 2022. All these changes point to the fact that goat production and marketing activities promoted by the government are seen as rewarding by the private sector.

Sheep

The population of sheep has generally been lower than that of goats for all the years under consideration. The country had less than one hundred thousand sheep from 1990 to 2005. Thereafter, the numbers increased to just below five hundred thousand between 2009 and 2015. Since then, the numbers declined to about two hundred and fifty thousand between 2020 and 2022. These changes could be due to increased interest in goat rearing at the expense of sheep. Sheep production in Zambia has been noted to be fraught with a number of challenges including requirements for better or high management skills compared to that for goat farming.

Poultry

Broilers

What has led to an increase in the population o broilers over the years has increased the number of hatcheries that entered the broiler market value chain. Some of the notable hatcheries that entered the Zambian market value chain in recent years include Ross breeders, Tiger chicks, Habdard, Zamchick. Government and cooperating partners have also been empowering vulnerable but viable farmers with climate resilient livestock packages. The broiler population in Zambia has in recent years been stabilized at slightly over twenty million birds per year from 2019 to 2022. The ecosystem for broiler production has been supportive of the growth achieved with the active participation even from small scale farmers.

[56] Ademola Braimoh, Alex Mwanakasale, Antony Chapoto, Rhoda Rubaiza, Brian Chisanga, Ngao Mubanga, Paul Samboko, Asa Giertz, and Grace Obuya, World Bank (2018), Increasing Agricultural Resilience through Better Risk Management in Zambia,

Layers

The population of commercial laying chickens has been on an upward swing since 2017 when it stood at 1,744,188 to 2022 with a population of 2,217,434. The egg sales have recorded an increase in demand for eggs for household consumption and other culinary activities.

Village chickens

Village chickens are the most prominent of the poultry species kept by the majority of producers. The population in 2017 was 12,303,332 which has since risen to above twenty million from 2018 to 2022. The increase could be attributed to the change in consumer preferences of the urban dwellers from fast foods to healthier meat products.

Pigs

A trend of increasing livestock population country wide from 2011 to 2013, attributed to increased market demand for pork products within the country was observed. There was a drop in the pig population in 2014 due to an outbreak of African Swine Fever which led to massive mortalities and slaughter of pigs. Lusaka and Southern Provinces were the most affected[54]. The pig population was steady at just over seven hundred thousand heads for the period 2009 to 2015. There was however a surge in numbers to above the one million (1,000,000) mark in 2016 which was sustained to 2022. Despite an outbreak of ASF in 2022, the management of the disease did not result in any reduction in the pig population but rather there was an increase to just below four million five hundred heads.

Buffaloes

The buffalo population has steadily been increasing from 769 in 2017 to just above 2000 in 2022. There is increasing interest in rearing buffaloes among game ranchers and there is good collaboration between ranchers and Department of National Parks and Wildlife.

Donkeys

The annual population of donkeys in the country was generally less than a thousand from 1990 up to 1996 when it started to increase rapidly by increasing to about four thousand heads between 2005 and 2007. Thereafter, there was a decline in the numbers falling to less than a thousand heads from 2008 to 2014. The population has since stabilized and was hovering around two thousand five hundred between 2019 and 2022. The undulating population could be as a result of inadequate population data capture.

Horses

The annual population of horses was generally less than three hundred and fifty heads between 1990 and 1998. It then rose to between eight hundred and nine hundred to about four thousand heads between 1999 and 2001. Thereafter, there was a decline in the donkey population to less than a two hundred heads between 2002 and 2004. The population suddenly rose to over four

hundred thousand heads from 2005 and have since stabilized at just over three hundred and seventy thousand heads since 2010. The population data would require further investigation which may relate to population data capture inadequacies.

Activity data on livestock population used for estimating enteric fermentation emissions is provided in Table 2-25.

Table 2-25: Livestock Population Trends in Zambia between 1990 and 2022.

Livestock	Dairy Cattle	Other Cattle	Sheep	Swine	Buffalo	Goats	Horses	Mules and Asses	Poultry
1990	130,030	2,481,087	52,814	240,859	0	68,284	104	290	3,967,807
1994	127,712	2,451,005	65,890	251,982	0	430,570	136	673	5,340,269
1998	102,900	2,644,276	84,284	317,929	0	722,072	299	1,110	14,907,819
2002	147,000	2,370,547	24,019	135,045	0	498,173	27	2,648	3,293,730
2006	142,778	2,658,897	117,928	398,634	0	1,762,459	541,030	4,346	49,734
2010	153,990	2,944,538	466,506	711,707	0	758,501	372,230	325	853
2014	151,278	3,923,354	492,658	736,919	0	1,483,073	372,598	1,089	4,078,529
2018	145,263	3,568,234	170,262	1,082,766	706	3,583,696	372,966	1,853	31,952,353
2022	210,287	4,469,120	260,560	1,160,843	2,097	4,455,860	373,334	2,617	29,036,391

2.3.4.4.4 GHG emission trend from Livestock

This section provides emissions related to enteric fermentation and manure management. Provided in Table 2-26 are trends of emissions for sub categories under livestock.

Table 2-26: Trends of Emissions for Sub-categories under Livestock ($GgCO_2eq$)

	3.A - Livestock	3.A.1 - Enteric Fermentation	3.A.2 - Manure Management (1)
1990	6197.5	5960.4	237.2
1991	6714.4	6475.6	238.8
1992	6545.2	6294.9	250.3
1993	6438.9	6188.3	250.6
1994	6505.3	6253.8	251.4
1995	6137.8	5877.0	260.8
1996	5623.3	5395.3	228.0
1997	6962.9	6680.4	282.5
1998	7065.0	6778.3	286.8
1999	7494.7	7198.5	296.1
2000	6815.7	6531.7	284.0
2001	6863.6	6574.5	289.1
2002	6305.5	6067.6	237.8
2003	6110.6	5871.3	239.3
2004	6086.0	5850.1	235.8
2005	7146.8	6866.1	280.7
2006	8127.0	7802.8	324.2
2007	7317.3	7021.6	295.7
2008	8770.4	8376.4	393.9
2009	8779.6	8376.4	403.2
2010	8629.7	8246.6	383.1
2011	7353.2	7035.7	317.5
2012	10706.3	10240.7	465.6
2013	11176.2	10688.3	487.9
2014	17456.3	16750.0	706.3
2015	11928.0	10687.8	1240.2
2016	11320.8	10861.6	459.2
2017	16943.0	16236.4	706.6
2018	11200.1	10720.5	479.6
2019	11000.2	10478.1	522.0
2020	9782.2	9317.9	464.3
2021	10593.2	10149.3	443.9
2022	13586.7	13021.6	565.0

Overall, emissions in this subcategory increased by 119.18% from 6,197.6 $GgCO_2eq$ in 1990 to 13,586.8 $GgCO_2eq$ in 2022 as illustrated in Figure 2.38. In 2022, approximately 95.8% of methane emissions were attributed to enteric fermentation and 4.2% to manure management.

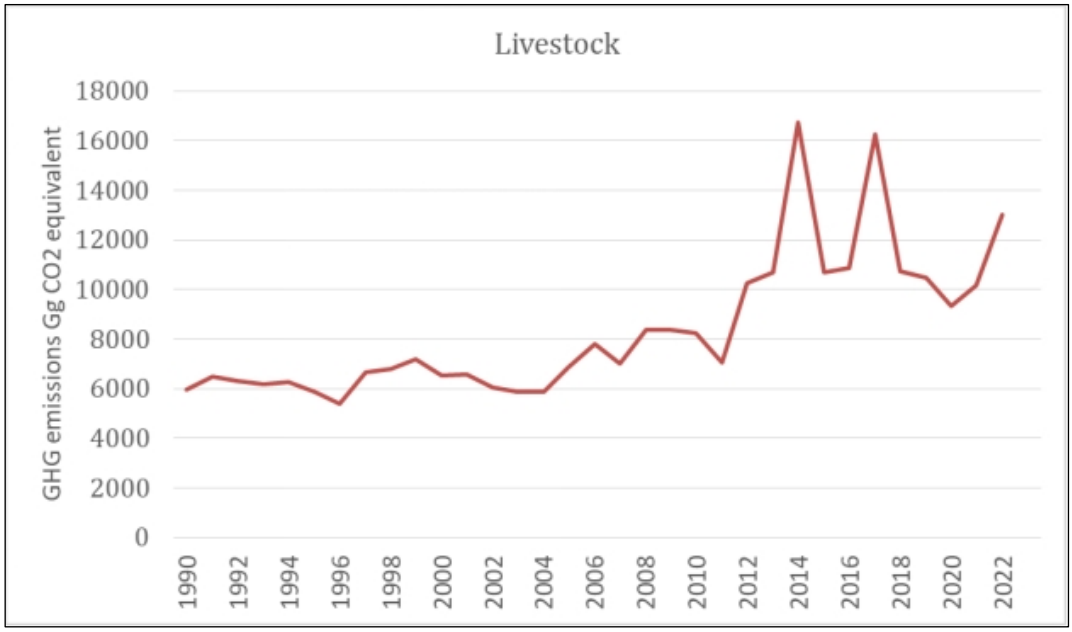


Figure 2-38: Emission Trends from Livestock

Enteric Fermentation

The quality of pasture determines the amount of emissions. This means that livestock fed on poor quality roughages will emit more methane than those fed on good quality roughages. Feeding of low-quality roughages is mostly associated with smallholder farmers. Government has taken steps in promoting production of improved pastures to over 80,000 households. This is done by providing improved pasture seeds to smallholder farmers who plant it in the rainy season then harvest towards the end of the rainy season and conserve the pastures in hay or silage form which they then feed to their grazing animals during the dry months when good quality pastures are not available.

Some of the notable programmes promoting improved production of pasture grasses and legumes are Enhanced Smallholder Livestock Investment Programme (E-SLIP), World Vision, Heifer international, GIZ and the Dairy Association of Zambia. The Government through E-SLIP has also embarked on a programme to improve the communal grazing areas (range-lands) where farmers take their animals for grazing. These communal grazing areas are overgrazed and depleted in terms of good quality pastures. The intervention from government is to promote 'over sowing' with hardy leguminous pasture species to improve feed quality and soil fertility. These interventions are expected to reduce emissions from enteric fermentation in the smallholder livestock farming operations. Other notable organisations promoting range-land improvement programmes are Solidaridad and Grassroots Trust. Emissions under enteric fermentation grew from 5,960.3 $GgCO_2eq$ in 1990 to 13,021.624 $GgCO_2eq$ in 2022 representing an increase of 118.4% as shown in Figure 2.39.

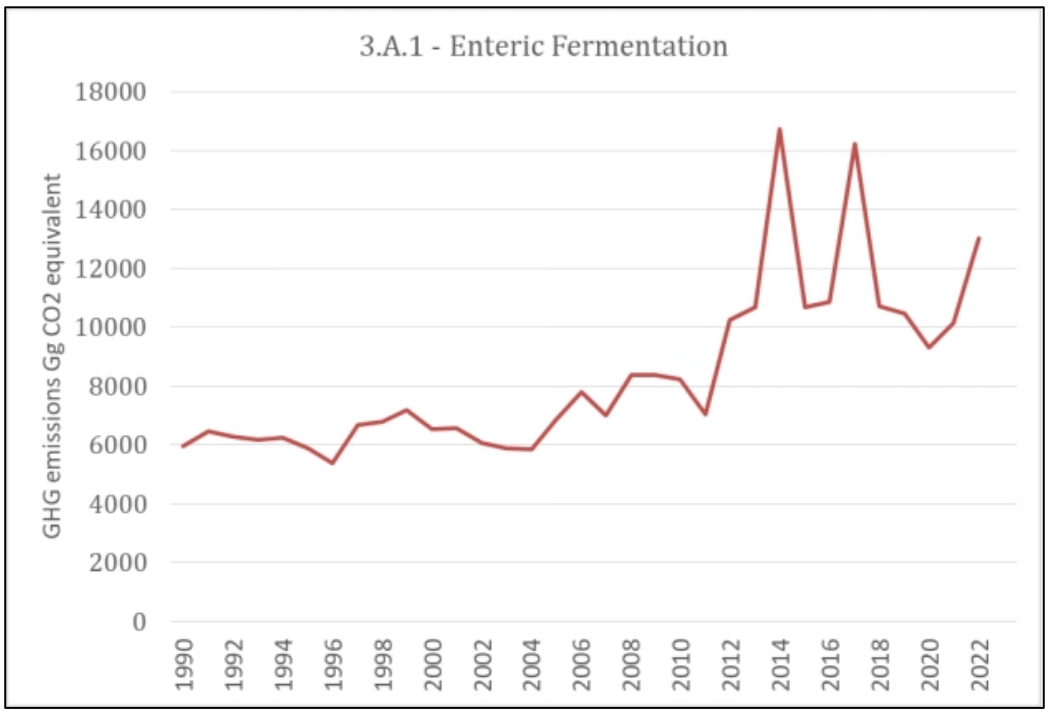


Figure 2-39: Trends in emissions for enteric fermentation

Manure Management (CH_4 and N_2O)

Manure management is the process in which livestock manure is collected, heaped, treated and stored. During the storage phase, methane is produced as a result of the decomposition of organic matter. N_2O emissions from manure management systems can also occur through a process of nitrification and denitrification. Nitrification is the biological oxidation of ammonia or ammonium to nitrite followed by the oxidation of the nitrite to nitrate. Indirect N2O emissions also occur from runoff and leaching, and the deposition of N volatilized from the manure management systems. Denitrification is a microbial facilitated process where nitrate is reduced and ultimately produces molecular nitrogen (N_2) through a series of intermediate gaseous nitrogen oxide products. The composition of livestock manure which is primarily a function of the animal species and diet, determines its methane producing potential. In the tropics cattle are mainly fed on roughage diet which will produce less biodegradable manure containing more complex organic substances such as hemi-cellulose, cellulose and lignin.

On the other hand, however, because of the lower digestibility of the natural pastures, cattle will take in a lot of this roughage to meet their nutrient requirements in the available space and time, and in turn, produce much more manure. The climatic parameters such as temperature and rainfall affect both the rate and total amount of methane production in manure. A warm and moist environment promotes methane production.

Most farmers in Zambia do not apply recommended manure management practices, such as roofing of animal housing units, having a water-proof floor or covering of manure during storage. This causes large nutrient losses during manure storage, thereby reducing the quality of the manure generated as a fertilizer. In general, Dairy cattle are kept under a confined system

where they are kept in a small area, and this entails the cow dung is cleaned and piled for use in gardens and field crops as organic fertilizer.

In Zambia, manure management also contributes significantly to GHG emissions under livestock subcategory. In this report, only methane produced from manure management has been calculated and the results presented. Compared to the base year 1990, emissions in the current year, 2022 increased by 138.2% as shown in Figure 2.40 from 237.2 $GgCO_2eq$ to 565.1 $GgCO_2eq$ respectively. Other cattle were the largest contributor of methane in the years under consideration.

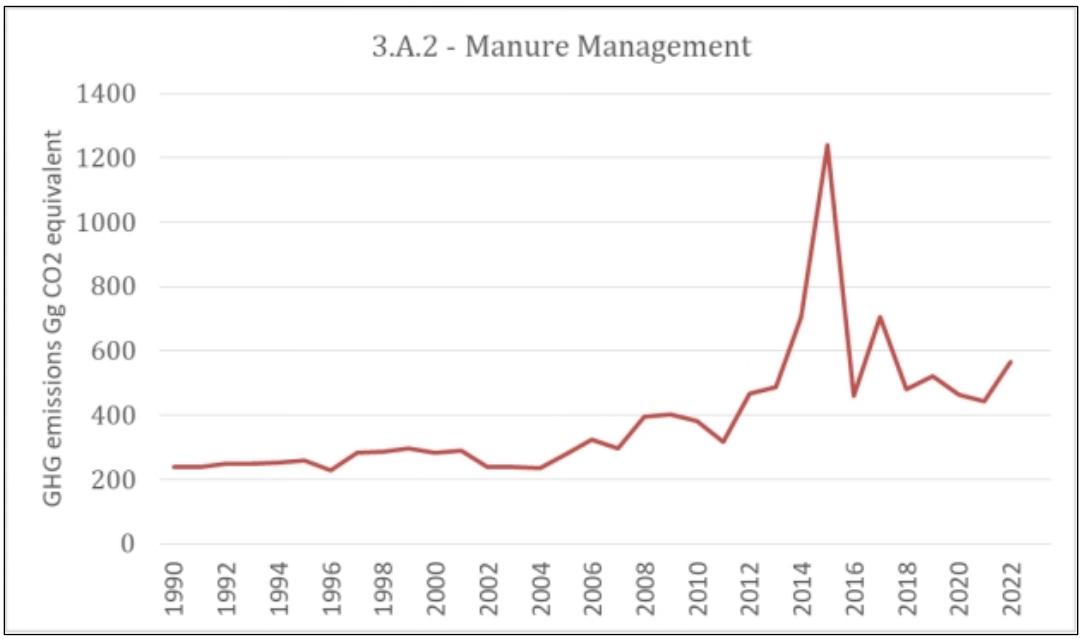


Figure 2-40: Trends of emissions under manure management

2.3.4.4.5 Quality Assurance/Quality Control Measures

Activity data used in estimating GHG emissions was obtained from ZamStats and Ministry of Fisheries and Livestock. Efforts were made to compare data from various sources and compile the most suitable data sets for use in emission estimates. Efforts were made to check and verify the data from all sources to ensure good quality data was utilised in the preparation of inventory from the AFOLU sector.

2.3.4.4.6 Sectoral Uncertainties

All the population data for dairy, other cattle, buffalo, sheep, goat, pigs and poultry were sourced from ZamStats whose uncertainty was 5%.

2.3.4.4.7 Planned Improvements

Data Gaps**:** There is a general lack of information on what quantities of methane is generated from the three production systems described above. Research areas**:** Determining emission factors for extensive, semi-intensive and intensive livestock system in Zambia

2.3.4.5 Land

2.3.4.5.1 Overview

Zambia has an estimated area of 45.94 million hectares of forest, representing approximately 61.01% of its total land, and is one of the forested countries in Southern Africa. The estimated annual rate of deforestation stands at 276,000 hectares. The major drivers of deforestation and forest degradation are agricultural expansion; settlement expansion; wood extraction; and uncontrolled fires. According to the Preliminary Study on the Drivers of Deforestation and Potential for REDD+ in Zambia under the UN-REDD Programme, the underlying causes have been elaborated as inadequate Policy and Legal Framework, Socio economic factors, Demography changes, inadequate Institutional arrangements and Environmental factors.

Under the current reporting period for the BTR (1990-2022), it has been noted that agricultural expansion has been evident in the opening up of farm blocks. During the period under review, Zambia launched several farm blocks, as part of its Farm Block Development Programme (FBDP), including the Nansanga Farm Block (Central Province), Luena Farm Block (Luapula Province), Mushindamo Farm Block (North-Western Province), Kalumwange Farm Block (Western Province), Luswishi Farm Block (Copperbelt Province), Manshya Farm Block (Muchinga Province), Musokotwane Farm Block (Southern Province) and Chikumbilo Farm Block (Eastern Province), among others.

For example, out-migrations from Southern Province into Lusaka and Copperbelt Provinces due to shortage of land and persistent droughts is causing areas such as Chongwe, Lufwanyama and Masaiti Districts to be opened up for new settlements and agriculture. The other cause of forest degradation is wood extraction for various purposes such as timber for domestic and export market; charcoal and fuelwood for domestic and commercial purposes.

Similarly, the areas for settlements increased due to growth in socio-economic activities, including declaration of new districts and mining activities both small and large scale in various parts of the country. This has been evidently noted in the North-western and Central provinces. It has been observed that North-western has been largely dominated by large scale mines and Central Province by small mines for copper and manganese production and refining respectively. The opening up of forest land for plantations has also been noted as significant such as the Pine Plantations in Kawambwa and Shiwangandu Districts located in Luapula and Muchinga Provinces respectively, by Zambia Forest Forestry Industrial Cooperation (ZAFFICO) Limited.

Disturbances such as wildfires, pest outbreaks and land degradation are among the causes of forest degradation. The effects of fire normally disturb even the regenerating saplings as well as the forest as a whole. The uncontrolled forest fires usually occur as a result of poor fire management schedules or plans. It has however been noted that most of the fires that have been occurring are as a result of traditional practices such as late burning regimes on traditional lands. Further, the effects of climate change such as dry spells or drought affected forest burning.

The 2006 IPCC Guidelines defines the six land-use categories which include: forest land, cropland, grassland, wetlands, settlements, and other land. Each land use category is divided into two subcategories: land that remains in the same use (e.g., Forest Land remaining Forest Land, or FL-FL) and land that has been converted from one land use to another (e.g., Forest Land converted to Cropland, or FL-CL). These subdivisions are used to estimate changes in carbon (C) stocks. The total CO_2 emissions or removals associated with each land-use category are calculated by summing the contributions from both subcategories.

Zambia's classification scheme for the National Land Cover Datasets (NLCD) is the main input dataset for AFOLU and was developed to provide baseline data for the land use, land-use change and forestry (LULUCF) for GHG monitoring. This resource has multiple applications, including reporting on the annualized deforestation rate for the country, updating the vegetation cover, protected forest areas, deriving and formulating land use plans amongst others. The classification scheme used was based on the IPCC as shown in Table 2-27.

Table 2-27: Land Cover Classification Scheme

	Land cover Categories	National land cover descriptions
1	Settlements	Land covered mainly by densely populated and organized or irregular settlement patterns surrounding cities, towns, chiefdoms and rural centres commonly referred to as urban and rural built-up areas.
2	Cropland	Land actively used to grow agriculture (annual and perennial) crops which may be irrigated or rain-feed for commercial, peasant and small-scale farms around urban and rural settlements
3	Grassland	Land that includes wooded rangeland that may be covered mainly by grasslands, plains, dambos, pans found along major river basins and water channels.
4	Forests	This is land covered both by natural and planted forest meeting the threshold of 10% canopy cover growing over a minimum area of 0.5 ha with trees growing above 5m height.
5	Wetlands	Land which is waterlogged, may be wooded such as marshland, perennial flooded plains and swampy areas (surface water bodies included).
6	Other land	Barren land covered by natural bare earth / soil such as sandy dunes, beach sand, rocky outcrops and may include old open quarry sites for mines and related infrastructure outside settlements.

Adapted from ILUA II, 2016

The GHGi for the forest subcategory of the AFOLU sector covers all CO_2 emissions and removals due to gains and losses in the relevant carbon pools of the predefined six land-use categories, as well as non-CO_2 emissions from biomass burning and disturbances associated with land-use conversions. GHG emissions estimates were based on comprehensive forestry statistical data presented in the 2016 Integrated Land Use Assessment (ILUA) Final Report. However, default emission factors were used to a limited extent.

All data relating to the land areas is streamlined and reported according to the six broader forest types of Zambia (in accordance with the methodology recommended by IPCC 2006). The largest vegetation type is the forest woodlands which comprises the Kalahari, Miombo, Mopane and Munga woodlands, of which the Miombo woodlands alone covers over 60% of all the forest types in Zambia. Other vegetation types used for reporting are: dry deciduous forests; dry evergreen forests; moist evergreen forests; the wooded grasslands and forest plantations (Table 2-28). The forest plantations consist of Broad-leaf Forest plantations (Eucalyptus) and Coniferous Forest plantation (Pine).

Table 2-28: Major Forest Types for Reporting

Major Vegetation and Other Land	Floristic Based Forest Types
Dry evergreen forest	*Parinari* forest and Copperbelt chipya
	Marquesia forest
	Lake basin chipya
	Cryptosepalum forest
	Kalahari sand forest
Dry deciduous forest	*Baikiaea* forest and deciduous thicket
	Itigi forest
Moist evergreen forest	Montane forest
	Swamp forest
	Riparian forest
Forest woodlands	Miombo woodland on plateau
	Miombo woodland on hills
	Kalahari woodland on sands
	Mopane woodland on clay
	Munga woodland on heavy soils
Forest plantations	Broad leaf forest plantation (Eucalyptus)
	Coniferous forest plantation (Pine)
Wooded grasslands (including pans and shrubs with some trees)	Termitary vegetation and bush groups
	Shrubs / thickets

2.3.4.5.2 Methodology and Emission Factors

The emissions and removals of CO2 for the AFOLU Sector, based on changes in ecosystem C stocks, are estimated using equations 2.32 to 2.37, for each land-use category (including both land remaining in a land-use category as well as land converted to another land use).

$$\Delta C_{AFOLU} = \Delta C_{FL} + \Delta C_{CL} + \Delta C_{GL} + \Delta C_{WL} + \Delta C_{SL} + \Delta C_{OL}$$ Equation 2.32

Where: ΔC = carbon stock change, FL = Forest Land, CL = Cropland, GL = Grassland, WL = Wetlands SL = Settlements, OL = Other Land

annual change in carbon stocks in biomass in land remaining in a particular land-use category (gain-loss method).

$$\Delta C_{CB} = \Delta C_{CG} - \Delta C_{CL}$$ Equation 2.33

Where: Δ_{CB} = annual change in carbon stocks in biomass for each land sub-category, considering the total area, tonnes C yr^{-1}, Δ_{CG} = annual increase in carbon stocks due to biomass growth for each land sub-category, considering the total area, tonnes C yr^{-1}, Δ_{CL} = annual decrease in carbon stocks due to biomass loss for each land sub-category, considering the total area, tonnes C yr^{-1}

$$\Delta_{CB} = \frac{(C_{t2} - C_{t1})}{t_2 - t_1}$$ Equation 2.34

Where: Δ_{CB} = annual change in carbon stocks in biomass in land remaining in the same category (e.g., Forest Land Remaining Forest Land), tonnes C yr^{-1} ; C_{t2} = total carbon in biomass for each land sub-category at time t_2 , tonnes C, C_{t1} = total carbon in biomass for each land sub-category at time t_1 , tonnes C; C = total carbon in biomass for time t_1 to t_2.

$$C = \sum_{i,j} \left(A_{ij} * V_{ij} * BCEF_{Sij} * (1 + R_{ij}) * CF_{ij}\right)$$ Equation 2.35

Where: A = area of land remaining in the same land-use category, ha (see note below) V = merchantable growing stock volume, m3 ha-1 , i = ecological zone i (i = 1 to n), j = climate domain j (j = 1 to m), R = ratio of below-ground biomass to above-ground biomass, tonne d.m. below-ground biomass (tonne d.m. above-ground biomass)$^{-1}$ CF = carbon fraction of dry matter, tonne C (tonne d.m.)$^{-1}$, BCEFS = biomass conversion and expansion factor for expansion of merchantable growing stock volume to above-ground biomass, tonnes above-ground biomass growth (m3 growing stock volume)$^{-1}$.

BCEFS = BEFS * D Equation 2.36

Where: Basic wood densities (D), Biomass expansion factor (BEFS)

Annual increase in biomass carbon stocks due to biomass increment in land remaining in the same land-use category is estimated using equation 2.37.

$$\Delta C_G = \sum_{i,j} \left(A_{ij} * G_{TOTAL\,ij} * CF_{ij}\right)$$ Equation 2.37

Where: ΔCG = annual increase in biomass carbon stocks due to biomass growth in land remaining in the same land-use category by vegetation type and climatic zone, tonnes C yr^{-1} , A = area of land remaining in the same land-use category, ha; G_{TOTAL}= mean annual biomass growth, tonnes d. m. ha^{-1} yr^{-1} ; i = ecological zone (i = 1 to n); j = climate domain (j = 1 to m); CF = carbon fraction of dry matter, tonne C (tonne d.m.)

Annual decrease in carbon stocks due to biomass losses in land remaining in the same land-use category is estimated using equation 2.38.

$$\Delta CL = Lwood - Removals + Lfuelwood + Ldisturbance$$ Equation 2.38

Where: ΔCL = annual decrease in carbon stocks due to biomass loss in land remaining in the same land-use category, tonnes C yr-1 ; Lwood-removals = annual carbon loss due to wood removals, tonnes C yr-1 ; Lfuelwood = annual biomass carbon loss due to fuelwood removals, tonnes C yr-1 ; Ldisturbance = annual biomass carbon losses due to disturbances, tonnes C yr-1.

Emission factors for the Land category are provided in Table 2-29.

Table 2-29: Forest Classification by Land Use Type Data

Land Type	Dry Evergreen Forest	Dry Deciduous Forests	Moist Evergreen Forest	Woodlands (Open Forests)	Other wooded land	Eucalyptus Plantations	Pinus Plantations
Whether natural forest?	Yes	Yes	Yes	Yes	Yes	No	No
Species	Other broadleaf	Other broadleaf	Other broadleaf	Other broadleaf	Other broadleaf	Eucalyptus	Pinus
Age class (year)	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified
CF (carbon Fraction) tonnes C/tonnes d.m.	0.47	0.47	0.47	0.47	0.47	0.47	0.47
R(Ratio of below ground to above ground)	0.42	0.42	0.42	0.42	0.42	0.2	0.2
BCEF (td.m./m3)	0.65	0.71	0.72	0.67	0.86	1.44	0.77
AGB (td.m./ha)	67.8	37.2	34.2	43.1	6.6	165	80
AGB Growth (td.m./ha/yr)	0.9	0.9	0.9	0.9	0.9	13	9
Reference C stock/EF	27.6	45.5	49.3	36.7	34.8	47	47
Litter	2.1	2.1	2.1	2.1	2.1	2.1	5.2

2.3.4.5.3 Activity Data

Generally, the trend in the carbon uptake in the natural forest indicates a decline for the period under review. This can be attributed to the continuous rise in the deforestation rate and forest degradation. As reflected in Figure 2.41, Zambia's natural forest suffered a steady decline, at an average rate of about 60,000 hectares per annum.

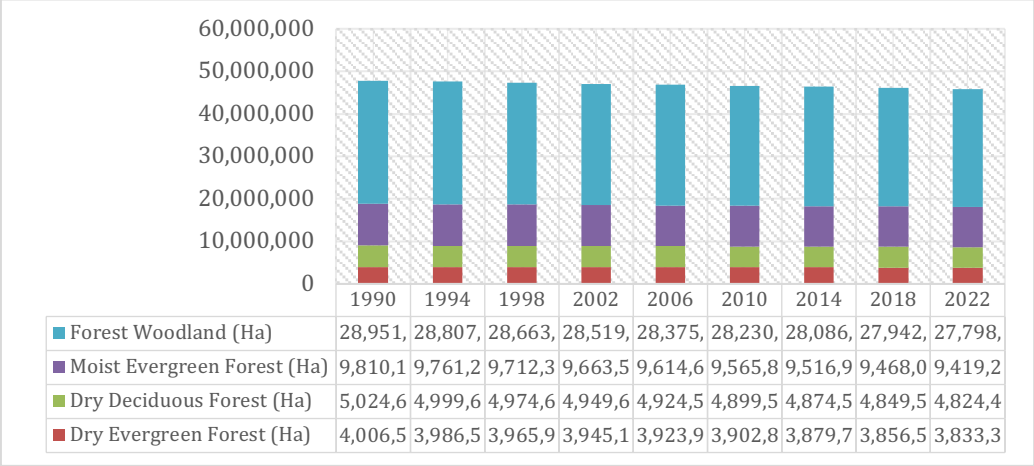


Figure 2-41: Decline of Zambia's Natural Forest

On the other hand, Zambia's land used for plantations (Pine and Eucalyptus) increased over the period under review. The increase was due to the establishment of new forest. Figure 2.42 indicates the trend of plantations over the period 1990 to 2022.

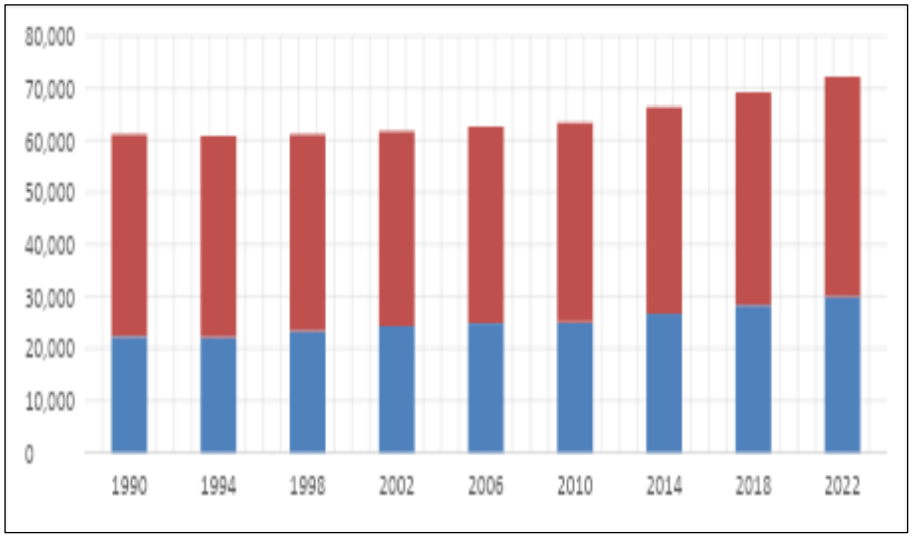


Figure 2.42: Trends in Carbon Uptake in Eucalyptus and Pine Plantations

Trends in the Land Area of Dry Evergreen Forests Sub-Category

Dry evergreen forests form part of the transitional zone between the Guineo Congolian rainforest and Zambia's dry woodlands. These forests cover less than 3–5% of the country's land area and are limited to the North-Western and Western provinces of Zambia[57]. The three main sub-types are distributed across different landscapes: *Cryptosepalum* forests on Kalahari sands, *Marquesia* forests in lake basins, and Parinari forests on the plateau[58]. These forest types typically feature a three-story structure with a canopy height of up to 27 meters and a dense shrub layer ranging between 1.5–6.0 meters. Occasionally, an understory measuring 0.3–1.3 meters high can also be found. The dominant species vary depending on the forest sub-type and include *Cryptosepalum exfoliatum*, *Guibourtia coleosperma*, *Marquesia acuminata*, *Marquesia macroura*, *Parinari excelsa*, *Syzygium guineense*, and *Anisophyllea pomifera*[59]. This woodland type is restricted to the wetter northern parts of the region, receiving mean annual rainfall of 800–1400 mm. Most of these forests occur at elevations of 1000–1500 meters. Disturbance to these woodland ecosystems often leads to variations of miombo woodland and Chipya forests.

The trend in the land area covered by dry evergreen forests has shown a steady decline over the years from 1990 to 2022, as illustrated in Figure 2.43.

[57] Siampale, 2008; Chidumayo, 2012a
[58] Kindt et al., 2011
[59] Fanshawe, 2010

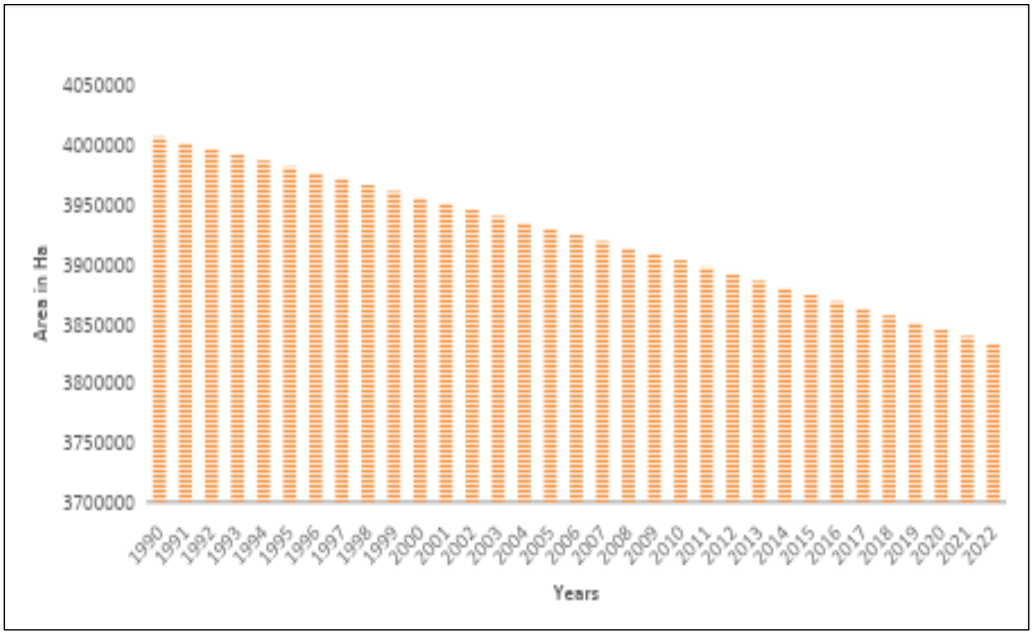


Figure 2.43: Trends of forest Areas under Dry Evergreen Forest

This decline in land cover is primarily attributed to land use change conversions for agriculture and settlements. Additionally, the eco - region is under threat from deforestation, forest degradation, unsustainable land use practices, and wild fires. Historically, these threats were driven by open-access exploitation and uncoordinated resource management policies in game management and protected areas. However, recent efforts have been made to improve the management of protected areas.

The Trend in Land Area for the Dry Deciduous Forest Sub - Category

The dry deciduous forests of Zambia are of two major types: the Baikiaea forest and the Itigi forest. The Baikiaea forest, restricted to the Kalahari sands in Western Zambia, is dominated by species such as *Baikiaea plurijuga* (commonly known as Zambezi teak) and *Pterocarpus antunesii*. These species play a crucial ecological role, contributing to both timber production and the support of local wildlife. On the other hand, the Itigi forest is ecologically related to Tanzania's famous Itigi thicket. It shares similarities in terms of its floristic composition, with dominant species from the genera *Baphia, Burthia*, and *Bussea*. The Itigi forest has a unique two-storey structure, with an open canopy made up of various deciduous and semi-deciduous tree species, contributing to its distinctive appearance.

Despite their ecological importance, these dry deciduous forests are experiencing a steady decline in coverage. The trend, observed over an extended time series 1990 to 2022 as provided in Figure 2.44, indicates a reduction in forest area due to increasing land use change conversions.

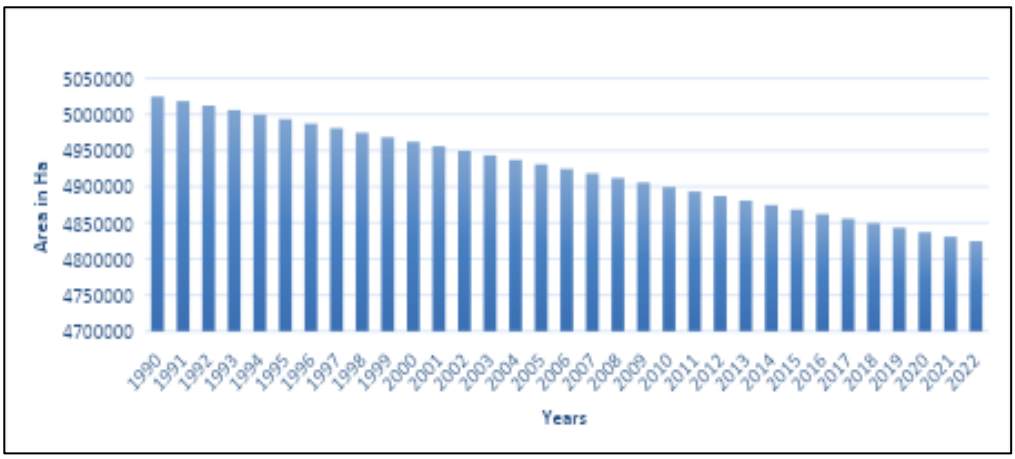


Figure 2.44: Trends of Forestland areas under Dry Deciduous Forest

The primary drivers of this deforestation include the expansion of agricultural activities, the development of human settlements, and other land-use changes. As a result, these forests are under threat, jeopardizing both their biodiversity and the ecosystem services they provide, such as carbon sequestration, soil stabilization, and support for local livelihoods.

The Trend in Land Area for the Moist Evergreen Forest Sub-Category

The Moist Evergreen Forest, a variable three-storeyed forest system divided into montane, swamp, and riparian types, has shown a consistent decline in area over time from 1990 to 2022. This trend is largely due to land use change conversion for agriculture and human settlements. The expansion of these activities encroaches on forested areas, reducing the forest cover and affecting the ecosystems within. The loss of such forests poses significant ecological concerns, as they are critical to biodiversity, water regulation, and carbon sequestration. Shown in Figure 2.45 is the decline in the Moist Evergreen Forest from 1990 to 2022.

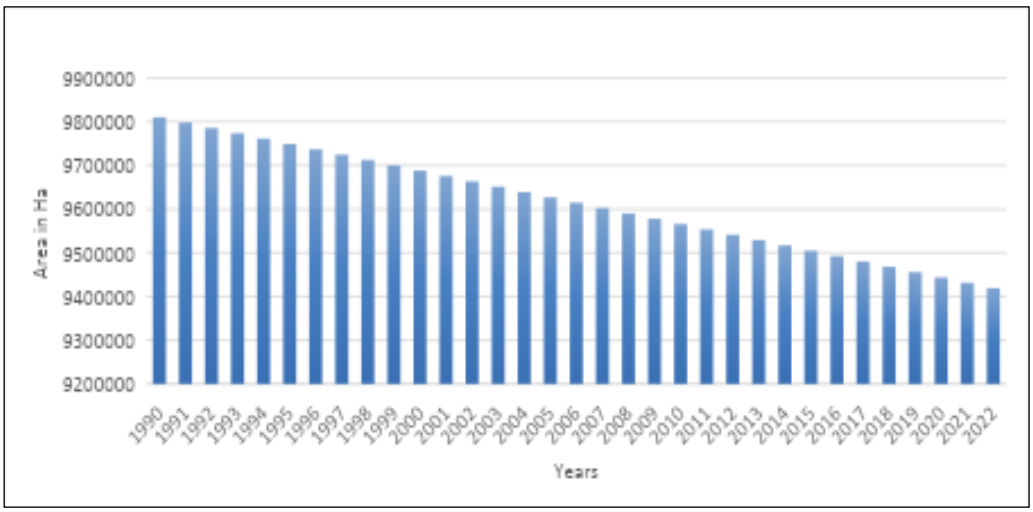


Figure 2.45: Trends of Forestland under Moist Evergreen Forest

The trend for the woodland (semi-evergreen) forest subcategory shows a consistent reduction in the land area over the entire time series as shown in Figure 2.46.

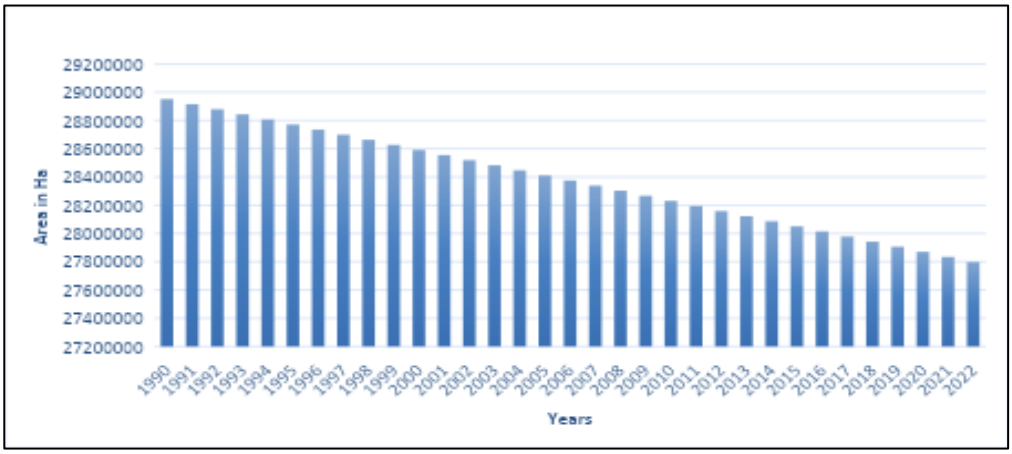


Figure 2.46: Trends of Forestland under Forest Woodland

This decline is primarily attributed to land use change conversions for agriculture and settlements, as well as the expansion of plantation estates led by the Zambia Forests and Forest Industries Corporation (ZAFFICO) who have been replanting forest plantation areas where removals have taken place and have also established new plantations in Luapula and Muchinga provinces. It is estimated that over 12,000 ha has been planted with exotic tree species in the country since 2011, of which 10% has been on additional acquired land[60]. This expansion has been driven by the increasing demand from the construction industry.

The Trend in Land Area for the Eucalyptus Plantations

The trend in Eucalyptus plantation land areas reflects a steady overall increase over the time series as provided in Figure 2.47.

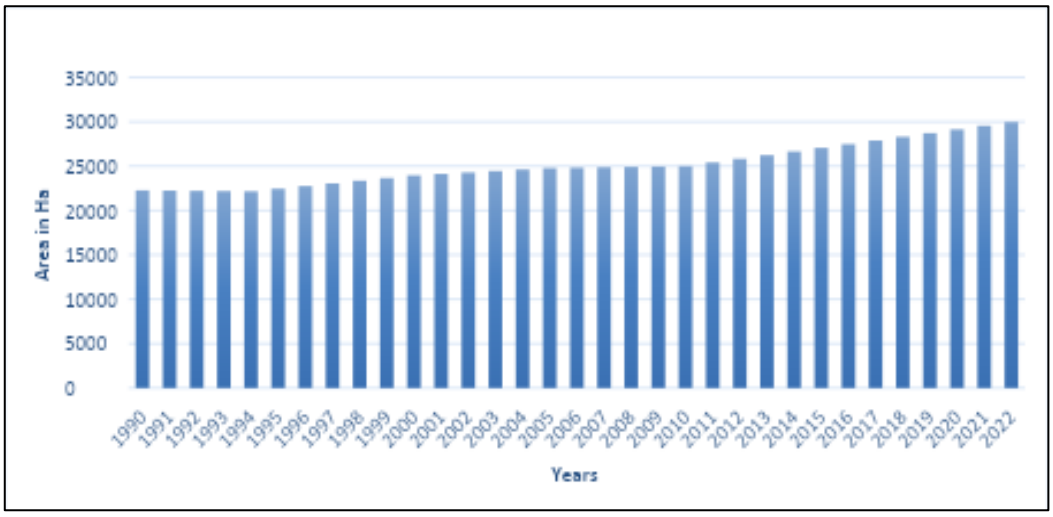


Figure 2.47: Trends of Forest areas under Eucalyptus

[60] ZAFFICO 2011, ZAFFICO 2014, Annual Reports, Lusaka, Zambia

The steady increase in Eucalyptus Plantation was primarily driven by the growing demand for timber in the construction industry. Key observations include:

- 1990 to 2006: The land area of Eucalyptus plantations showed a slight increase, likely due to the initial demand for timber and gradual expansion efforts.
- 2006 to 2010: There was a noticeable decline in plantation hectarage was observed. This is attributed to several factors such as market fluctuations, shifts in land use, and changes in policy affecting forestry operations.
- 2011 to 2022: A significant expansion in plantation hectarage occurred, primarily driven by an increased demand for timber, particularly in the construction sector. This boom may also be attributed to economic growth, urbanization, and infrastructure development during this period.

The Trend in Area for the Pine Plantations

The trend in Pine plantation as given in Figure 2.48 reflects a steady overall increase over the time series in land areas.

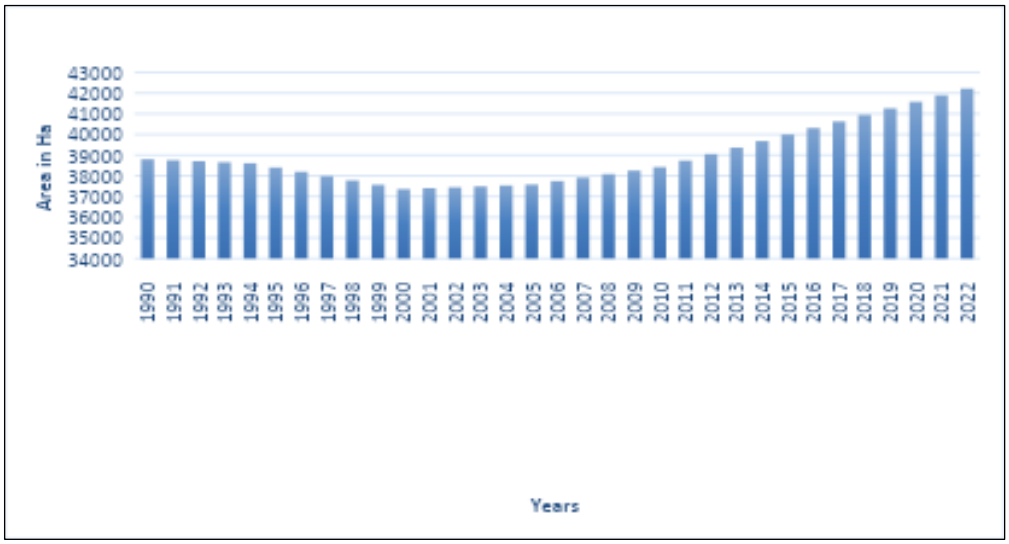


Figure 2.48: Trends of Forestland areas under Dry evergreen forest

This steady increase in pine plantations was primarily driven by the growing demand for timber in the construction industry and electricity pole production. Key observations include:

- **1992 to 2000**: During this period, the area of pine plantations showed a slight decrease. This could be attributed to reduced afforestation and reforestation activities for the areas as there was no replanting of the areas cut between 1985 and 2000[61].

[61]James T Mulenga, 2022: The state of industrial plantations in Zambia

- **2001 to 2022**: There was a gradual increase in the area of the forest plantations. This is attributed to increased demand for timber, particularly in the construction sector. This boom may also be attributed to economic growth, urbanization, and infrastructure development during this period.

Wood removals (Timber harvesting)

The trend in wood removals (timber harvesting) illustrates that the highest removals occurred in woodland (semi-evergreen) and pine plantations, while the least was observed in dry deciduous forests, moist evergreen forests, and eucalyptus plantations. Forest woodland, a major forest sub - category, comprises of Miombo, Kalahari, Mopane, and Munga woodlands[62] as shown in Figure 2.49.

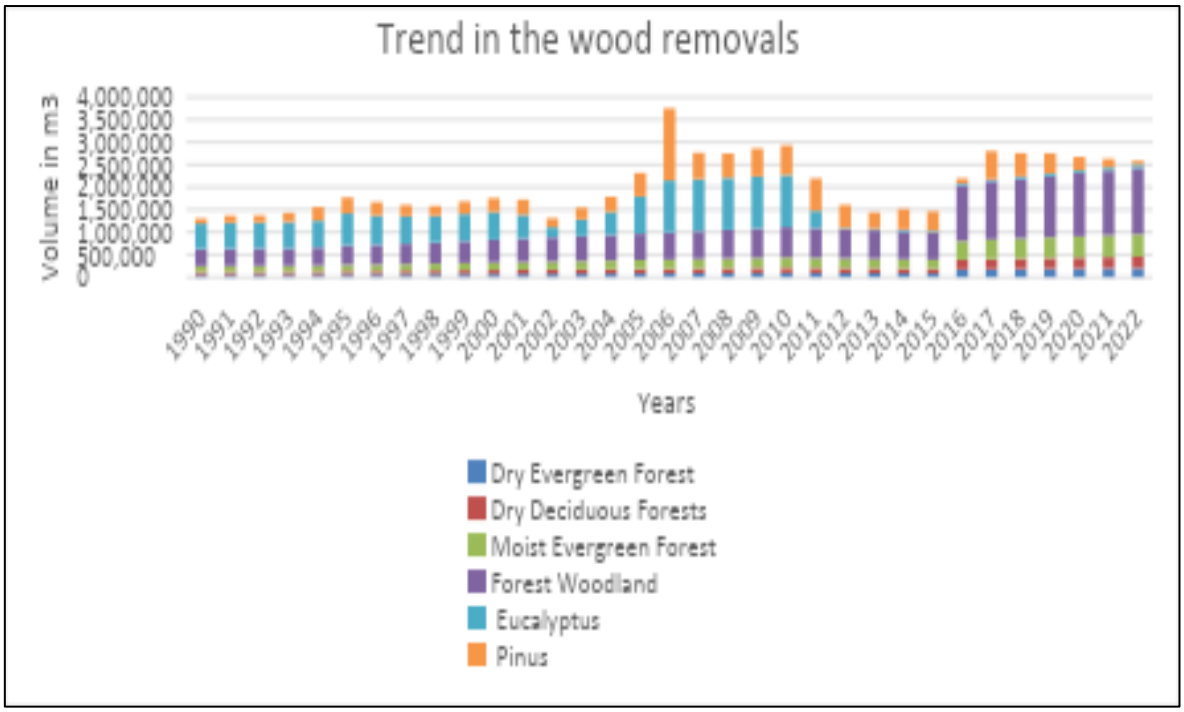


Figure 2.49: Trends in Wood removal for Commercial Timber Harvesting

Additionally, there was a marked increase in the harvesting of commercial species such as *Pterocarpus Chrysothrix* (Mukula), *Guibourtia Coleosperma* (Rosewood), and *Pterocarpus Angolensis* (Mukwa) among other high-value tree species. This surge, particularly between 201 and 2022, was driven by growing demand for timber in both domestic and export markets.

[62]Shakacite et al., 2016: ILUA II, p. 20

Trends in Fuel Wood Removals

Fuel-wood removals exhibited a steady upward trend from 1990 to 2010, followed by a decline between 2010 and 2015 as presented in Figure 2.50.

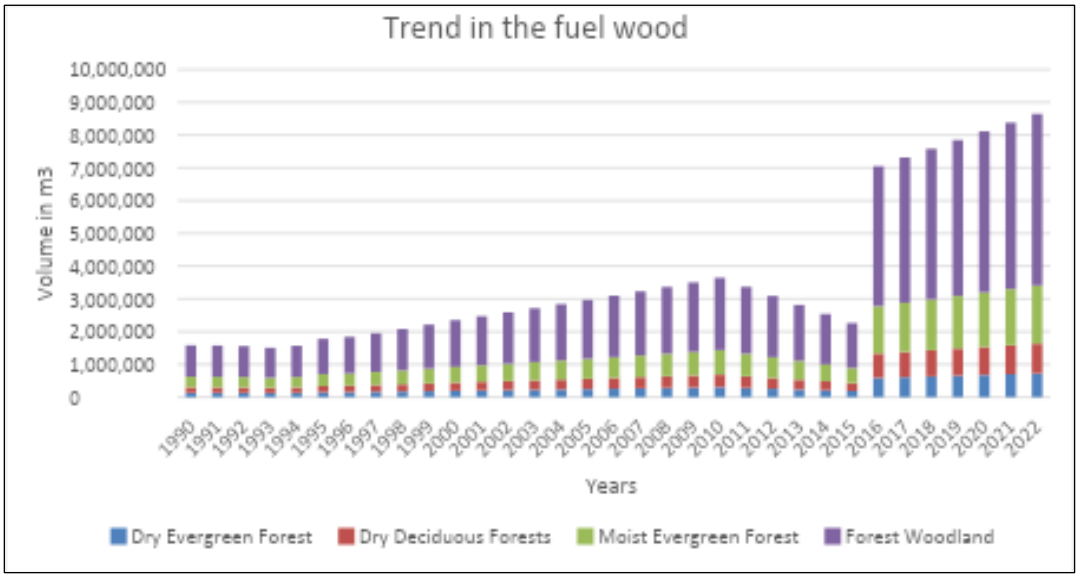


Figure 2.50: Trends in Fuelwood Removals for Firewood

However, there was a significant surge from 2016 to 2022, driven primarily by increases in electricity tariffs. This prompted heightened demand for charcoal, particularly in urban and peri-urban areas. Notable spikes in fuel-wood removals were observed in 2015 and 2022, largely attributed to rising electricity costs and load management policies implemented by the electricity utility company during 2015 to 2016. These factors led many households to adopt charcoal as a more accessible energy source, further increasing fuel-wood removals. Among forest sub-categories, forest woodlands recorded the highest levels of removals, while dry deciduous and moist evergreen forests experienced the least. Overall, the data analysis reveals a growing trend in fuel-wood removals across most forest sub-categories.

Trends in the Wood Removal for Charcoal

Wood removals associated with charcoal production have shown a moderate upward trend from 1990 to 2010, followed by a steady increase from 2010 to 2014, and a sharp rise from 2015 to 2022 (Figure 2.51).

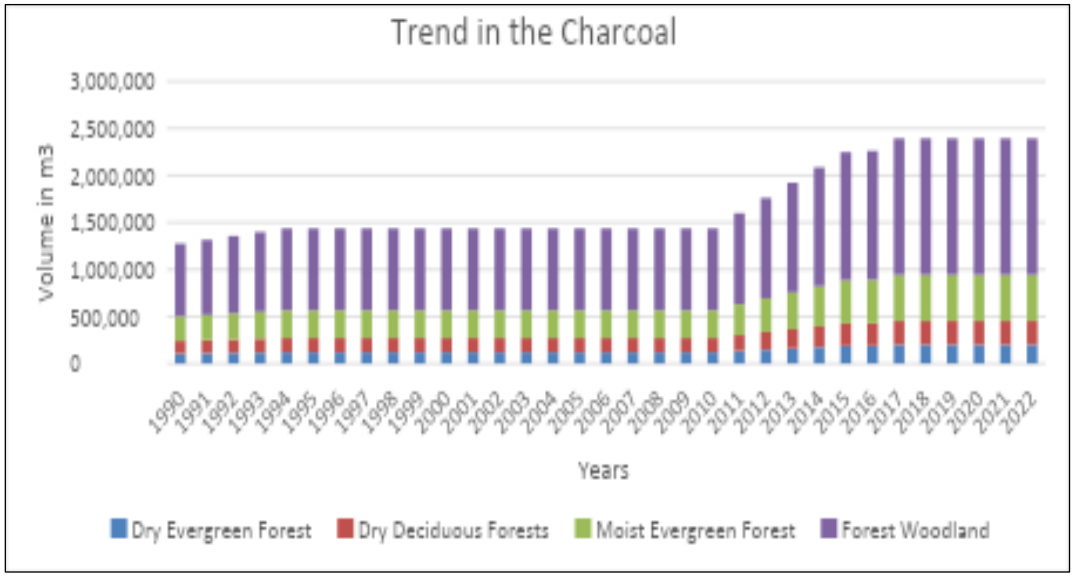


Figure 2.51: Trends in Wood Removal for Charcoal

This surge is largely attributed to increases in electricity tariffs, which have driven heightened demand for charcoal in urban and peri-urban areas. Significant spikes in wood removals were recorded in 2015 and 2022, primarily due to rising electricity costs and load management policies implemented by the electricity utility company during this period. These factors prompted many households to rely on charcoal as a more accessible energy source, further escalating fuelwood removals.

Among forest sub-categories, forest woodlands experienced the highest levels of removals, whereas dry deciduous and moist evergreen forests recorded the least. Overall, the data analysis shows a consistent increase in wood removals for charcoal across most forest sub-categories.

Disturbance (Wild-fires, pest out-breaks and natural land degradation)

Disturbances mostly attributed to wild fires in forest and grassland areas are primarily associated with late burning, often conducted for purposes such as land preparation, while early burning is typically classified as a management practice to mitigate fire risks. These burning activities are categorized into three regimes: early-season fires (April–June), mid-season fires (July–August), and late-season fires (September–November). During the period under review (1990–2022), disturbances included areas within forest and grassland ecosystems. The general trend in forest disturbances revealed fluctuations, with the highest levels observed in 2017 and the lowest in 1990 as presented in Figure 2.52.

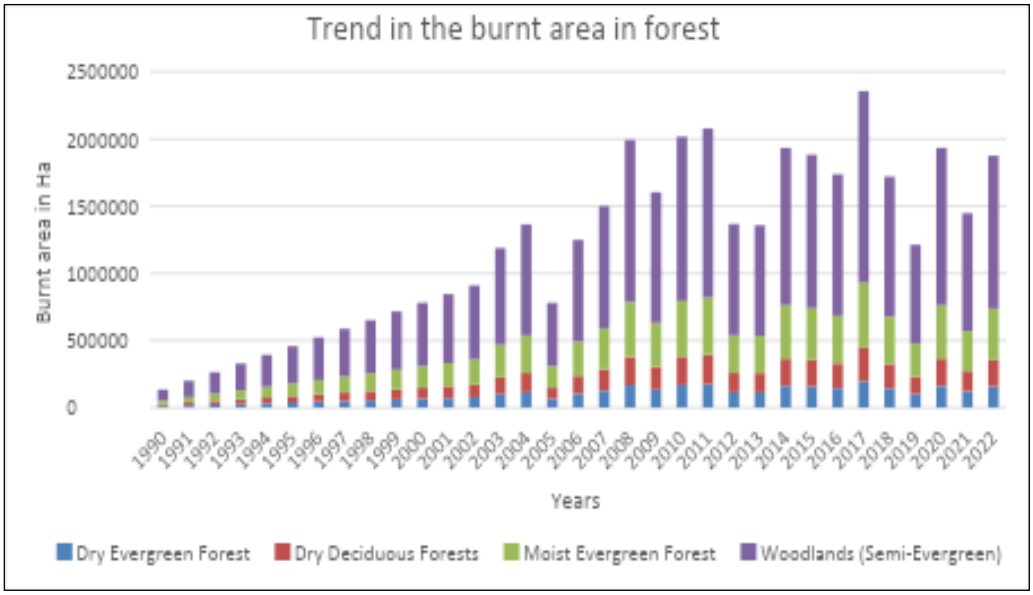


Figure 2.52: Trends in the disturbances (Wildfires, Pest outbreaks and Natural land degradation)

Regards the forest sub-categories, semi-evergreen forest woodlands exhibited the largest burnt areas, followed by moist evergreen forests. Conversely, dry deciduous and dry evergreen forests recorded the smallest burnt areas, suggesting they were less impacted by fires compared to other forest types.

Regarding burnt biomass, semi-evergreen forest woodlands displayed the highest levels, followed by moist evergreen and dry deciduous forests. Dry evergreen forests consistently showed the lowest levels of burnt biomass throughout the analysis period. The spike in disturbances and burnt biomass in 2017 was likely driven by the prolonged dry spell experienced in the 2017/2018 season. Additionally, El Niño-induced droughts during the 2015/2016 season may have increased biomass vulnerability, contributing to higher levels of burnt biomass during these years.

Activity data used to estimate emissions under Land category are provided in Tables 2.30 to 2.39.

Table 2.30: Land Cover/Class Land Areas (ha)

	Forest	Cropland	Grassland	Wetlands	Settlements	Other lands
1990	47863257	5199425	19561589	1906825	494721.4	235581.6
1991	47803669	5238920	19576140	1907518	499571.6	235581.6
1992	47744081	5278414	19590691	1908211	504421.8	235581.6
1993	47684492	5317909	19605241	1908904	509272	235581.6
1994	47624904	5357403	19619792	1909597	514122.3	235581.6
1995	47565316	5396898	19634343	1910290	518972.5	235581.6
1996	47505727	5436392	19648893	1910983	523822.7	235581.6
1997	47446139	5475887	19663444	1911676	528672.9	235581.6
1998	47386551	5515382	19677994	1912368	533523.1	235581.6
1999	47326962	5554876	19692545	1913061	538373.3	235581.6
2000	47267374	5594371	19707096	1913754	543223.5	235581.6
2001	47207786	5633865	19721646	1914447	548073.7	235581.6
2002	47148198	5673360	19736197	1915140	552923.9	235581.6
2003	47088609	5712854	19750748	1915833	557774.1	235581.6
2004	47029021	5752349	19765298	1916526	562624.4	235581.6
2005	46969433	5791844	19779849	1917219	567474.6	235581.6
2006	46909844	5831338	19794400	1917912	572324.8	235581.6
2007	46850256	5870833	19808950	1918604	577175	235581.6
2008	46790668	5910327	19823501	1919297	582025.2	235581.6
2009	46731080	5949822	19838051	1919990	586875.4	235581.6
2010	46671491	5989316	19852602	1920683	591725.6	235581.6
2011	46611903	6028811	19867153	1921376	596575.8	235581.6
2012	46552315	6068305	19881703	1922069	601426	235581.6
2013	46492726	6107800	19896254	1922762	606276.2	235581.6
2014	46433138	6147295	19910805	1923455	611126.5	235581.6
2015	46373550	6186789	19925355	1924148	615976.7	235581.6
2016	46313962	6226284	19939906	1924840	620826.9	235581.6
2017	46254373	6265778	19954456	1925533	625677.1	235581.6
2018	46194785	6305273	19969007	1926226	630527.3	235581.6
2019	46135197	6344767	19983558	1926919	635377.5	235581.6
2020	46075608	6384262	19998108	1927612	640227.7	235581.6
2021	46016020	6423757	20012659	1928305	645077.9	235581.6
2022	45956432	6463251	20027210	1928998	649928.1	235581.6

Table 2.31: Area covered by Forest Type (ha)

Sub-category	Dry Evergreen Forest	Dry Deciduous Forests	Moist Evergreen Forest	Forest Woodland	Eucalyptus	Pinus
1990	4006539	5024696	9810121	28951822	22270.84	38800.91
1991	4001550	5018440	9797906	28915771	22243.11	38752.59
1992	3996561	5012183	9785690	28879720	22215.38	38704.28
1993	3991572	5005926	9773475	28843669	22187.64	38655.96
1994	3986583	4999669	9761259	28807618	22159.91	38607.65
1995	3981428	4993412	9749043	28771567	22457.74	38400.33
1996	3976272	4987156	9736827	28735515	22756.54	38192.55
1997	3971117	4980899	9724612	28699464	23056.32	37984.28
1998	3965960	4974642	9712396	28663413	23357.09	37775.52
1999	3960803	4968385	9700180	28627361	23658.85	37566.29
2000	3955646	4962128	9687965	28591310	23961.63	37356.55
2001	3950375	4955872	9675749	28555260	24123.46	37399.46
2002	3945102	4949615	9663534	28519210	24286.59	37442.98
2003	3939827	4943358	9651319	28483160	24451.02	37487.11
2004	3934550	4937102	9639103	28447110	24616.78	37531.86
2005	3929271	4930845	9626888	28411060	24783.88	37577.24
2006	3923995	4924588	9614672	28375009	24826.65	37745.42
2007	3918720	4918331	9602457	28338958	24869.49	37913.81
2008	3913443	4912075	9590241	28302907	24912.4	38082.43
2009	3908167	4905818	9578025	28266855	24955.39	38251.27
2010	3902890	4899561	9565810	28230804	24998.46	38420.33
2011	3897098	4893304	9553594	28194754	25410.3	38734.49
2012	3891306	4887048	9541379	28158703	25822.6	39049.02
2013	3885513	4880791	9529163	28122652	26235.35	39363.92
2014	3879719	4874534	9516948	28086602	26648.57	39679.2
2015	3873924	4868277	9504732	28050551	27062.25	39994.87
2016	3868129	4862021	9492517	28014501	27476.39	40310.91
2017	3862332	4855764	9480301	27978450	27891.01	40627.34
2018	3856535	4849507	9468086	27942399	28306.09	40944.15
2019	3850737	4843251	9455870	27906349	28721.65	41261.36
2020	3844938	4836994	9443655	27870298	29137.69	41578.95
2021	3839138	4830737	9431439	27834247	29554.21	41896.93
2022	3833337	4824480	9419224	27798197	29971.21	42215.31

Table 2.32: Area affected by Disturbances (ha)

YEAR OF ASSESSMENT	Indigenous forest	Dry Evergreen Forest	Dry Deciduous Forests	Moist Evergreen Forest	Woodlands (Semi-Evergreen)
1990	Area (ha)	11287	14152	27630	81541
1991	Area (ha)	16698.42	20942.08	40886.75	120664.8
1992	Area (ha)	22109.83	27732.17	54143.5	159788.5
1993	Area (ha)	27521.25	34522.25	67400.25	198912.3
1994	Area (ha)	32932.67	41312.33	80657	238036
1995	Area (ha)	38344.08	48102.42	93913.75	277159.8
1996	Area (ha)	43755.5	54892.5	107170.5	316283.5
1997	Area (ha)	49166.92	61682.58	120427.3	355407.3
1998	Area (ha)	54578.33	68472.67	133684	394531
1999	Area (ha)	59989.75	75262.75	146940.8	433654.8
2000	Area (ha)	65401.17	82052.83	160197.5	472778.5
2001	Area (ha)	70812.58	88842.92	173454.3	511902.3
2002	Area (ha)	76224	95633	186711	551026
2003	Area (ha)	99550	124907	243867	719704
2004	Area (ha)	114337	143471	280110	826667
2005	Area (ha)	65368	82030	160153	472648
2006	Area (ha)	104625	131304	256354	756558
2007	Area (ha)	125720	157790	308065	909168
2008	Area (ha)	166944	209545	409111	1207377
2009	Area (ha)	134335	168627	329225	971614
2010	Area (ha)	168946	212089	414078	1222035
2011	Area (ha)	174024	218509	426613	1259029
2012	Area (ha)	114472	143764	280681	828352
2013	Area (ha)	113639	142748	278699	822501
2014	Area (ha)	161837	203335	396987	1171594
2015	Area (ha)	157571	198016	386602	1140948
2016	Area (ha)	145318	182657	356615	1052450
2017	Area (ha)	197085	247777	483756	1427669
2018	Area (ha)	143824	180855	353098	1042069
2019	Area (ha)	101366	127492	248914	734599
2020	Area (ha)	161659	203370	397055	1171797
2021	Area (ha)	120972	152218	297188	877066
2022	Area (ha)	156718	197239	385086	1136473

Table 2.33: Wood removals by Forest Classification (m3/yr)

Sub-category	Dry Evergreen Forest	Dry Deciduous Forests	Moist Evergreen Forest	Forest Woodland	Eucalyptus	Pinus
1990	52594.77	65960.36	128779.8	380057.3	563000	113000
1991	53220.8	66745.48	130312.6	384581.1	573000	160000
1992	53651.4	67285.51	131367	387692.7	573000	160000
1993	53437.94	67017.81	130844.3	386150.2	587000	205000
1994	55308.31	69363.48	135423.9	399665.7	597000	300000
1995	59225.65	74279.4	145021.7	427990.8	709000	356000
1996	60290.6	75618.21	147635.5	435704.9	650000	300000
1997	62349.04	78203.26	152682.6	450599.8	611000	250000
1998	64683.3	81134.52	158405.5	467489.4	592000	219000
1999	67164.55	84250.43	164488.9	485442.9	604000	278000
2000	69700.78	87435.59	170707.6	503795.6	615000	310000
2001	71866.98	90159.42	176025.5	519490	528000	339000
2002	74088.02	92952.53	181478.7	535583.6	227000	199000
2003	76345.52	95791.83	187022.2	551943.4	371000	262000
2004	78657.83	98700.42	192700.8	568702.4	512000	335000
2005	81006.57	101655.2	198469.7	585727.6	827000	522000
2006	83373.42	104633.1	204283.7	602885.9	1155000	1601000
2007	85795.1	107680.3	210232.9	620443.4	1155000	585000
2008	88271.6	110796.7	216317.4	638400.1	1155000	543000
2009	90802.89	113982.5	222537.2	656756	1155000	620000
2010	93407.35	117260.5	228937.3	675644.1	1155000	658000
2011	91287.19	114622.7	223787.2	660445.2	385595	718513
2012	89167.78	111984.8	218637	645245.8	29500	510500
2013	87049.1	109346.8	213486.6	630045.9	36000	364000
2014	84931.17	106708.7	208336.1	614845.6	46000	455000
2015	82813.99	104070.6	203185.4	599644.7	37973	434906
2016	170969.3	214898.8	419564.3	1238226	38603	110831
2017	178261.9	224112.7	437553.3	1291316	45322	624224
2018	183110.1	230256.9	449549.1	1326718	52041	515889
2019	187956.2	236401.3	461545.3	1362122	58760	448621
2020	192800.3	242545.9	473542	1397526	65479	299219
2021	197642.3	248690.8	485539.1	1432933	72198	190884
2022	202482.3	254835.9	497536.8	1468340	78917	82549

Table 2.34: Estimated Consumption of Woodfuel ('000 Tonnes')

Year	Firewood	Wood for charcoal production	Total
1994	4,634.91	2,566.59	**7,201.50**
1995	4,729.50	2,618.97	**7,348.47**
1996	4,826.02	2,728.09	**7,554.12**
1997	4,924.51	2,841.77	**7,766.28**
1998	5,025.01	2,960.17	**7,985.19**
1999	5,127.57	3,083.51	**8,211.08**
2000	5,232.21	3,211.99	**8,444.20**
2001	5,338.99	3,277.54	**8,616.53**
2002	5,447.95	3,414.11	**8,862.06**
2003	5,559.13	3,556.36	**9,115.49**
2004	5,672.58	3,704.54	**9,377.13**
2005	5,788.35	3,858.90	**9,647.25**
2006	5,904.12	4,013.26	**9,917.37**
2007	6,022.20	4,173.79	**10,195.99**
2008	6,142.64	4,340.74	**10,483.38**
2009	6,265.50	4,514.37	**10,779.86**
2010	6,390.81	4,694.94	**11,085.75**
2011	6,518.62	4,882.74	**11,401.36**
2012	6,648.99	5,078.05	**11,727.04**
2013	6,781.97	5,281.17	**12,063.15**
2014	6,917.61	5,492.42	**12,410.03**
2015	7,055.97	5,712.11	**12,768.08**
2016	7,385.94	5,426.01	12,811.95

NB. 0.618 cubic meter of wood volume is equivalent to one tonne of wood.

Table 2.35: Cropland Converted to Forestland

	Dry Evergreen Forest	Dry Deciduous Forests	Moist Evergreen Forest	Forest Woodland	Eucalyptus	Pinus
1990	754.1	945.8	1846.5	5449.6	4.2	7.3
1991	754.1	945.8	1846.5	5449.6	4.2	7.3
1992	754.1	945.8	1846.5	5449.6	4.2	7.3
1993	754.1	945.8	1846.5	5449.6	4.2	7.3
1994	754.1	945.8	1846.5	5449.6	4.2	7.3
1995	754.1	945.8	1846.5	5449.6	4.3	7.3
1996	754.1	945.8	1846.5	5449.6	4.3	7.2
1997	754.0	945.8	1846.5	5449.6	4.4	7.2
1998	754.0	945.8	1846.5	5449.6	4.4	7.2
1999	754.1	945.8	1846.5	5449.6	4.2	7.3
2000	754.1	945.8	1846.5	5449.6	4.2	7.3
2001	754.1	945.8	1846.5	5449.6	4.2	7.3
2002	754.1	945.8	1846.5	5449.6	4.2	7.3
2003	754.1	945.8	1846.5	5449.6	4.2	7.3
2004	754.1	945.8	1846.5	5449.6	4.2	7.3
2005	754.1	945.8	1846.5	5449.6	4.2	7.3
2006	754.1	945.8	1846.5	5449.6	4.2	7.3
2007	754.1	945.8	1846.5	5449.6	4.2	7.3
2008	754.1	945.8	1846.5	5449.6	4.2	7.3
2009	754.1	945.8	1846.5	5449.6	4.2	7.3
2010	754.1	945.8	1846.5	5449.6	4.2	7.3
2011	754.1	945.8	1846.5	5449.6	4.2	7.3
2012	754.1	945.8	1846.5	5449.6	4.2	7.3
2013	754.1	945.8	1846.5	5449.6	4.2	7.3
2014	754.1	945.8	1846.5	5449.6	4.2	7.3
2015	754.1	945.8	1846.5	5449.6	4.2	7.3
2016	754.1	945.8	1846.5	5449.6	4.2	7.3
2017	754.1	945.8	1846.5	5449.6	4.2	7.3
2018	754.1	945.8	1846.5	5449.6	4.2	7.3
2019	754.1	945.8	1846.5	5449.6	4.2	7.3
2020	754.1	945.8	1846.5	5449.6	4.2	7.3
2021	754.1	945.8	1846.5	5449.6	4.2	7.3
2022	754.1	945.8	1846.5	5449.6	4.2	7.3

Table 2.36: Forest Land Converted to Cropland

	Dry Evergreen Forest	Dry Deciduous Forests	Moist Evergreen Forest	Forest Woodland	Eucalyptus	Pinus
1990	4234.8	5311.0	10369.1	30601.4	23.5	41.0
1991	4234.8	5311.0	10369.1	30601.4	23.5	41.0
1992	4234.8	5311.0	10369.1	30601.4	23.5	41.0
1993	4234.8	5311.0	10369.1	30601.4	23.5	41.0
1994	4234.8	5311.0	10369.1	30601.4	23.5	41.0
1995	4234.6	5311.0	10369.1	30601.4	23.9	40.8
1996	4234.8	5311.0	10369.1	30601.4	23.5	41.0
1997	4234.8	5311.0	10369.1	30601.4	23.5	41.0
1998	4234.8	5311.0	10369.1	30601.4	23.5	41.0
1999	4234.8	5311.0	10369.1	30601.4	23.5	41.0
2000	4234.8	5311.0	10369.1	30601.4	23.5	41.0
2001	4234.8	5311.0	10369.1	30601.4	23.5	41.0
2002	4234.8	5311.0	10369.1	30601.4	23.5	41.0
2003	4234.8	5311.0	10369.1	30601.4	23.5	41.0
2004	4234.8	5311.0	10369.1	30601.4	23.5	41.0
2005	4234.8	5311.0	10369.1	30601.4	23.5	41.0
2006	4234.8	5311.0	10369.1	30601.4	23.5	41.0
2007	4234.8	5311.0	10369.1	30601.4	23.5	41.0
2008	4234.8	5311.0	10369.1	30601.4	23.5	41.0
2009	4234.8	5311.0	10369.1	30601.4	23.5	41.0
2010	4234.8	5311.0	10369.1	30601.4	23.5	41.0
2011	4234.8	5311.0	10369.1	30601.4	23.5	41.0
2012	4234.8	5311.0	10369.1	30601.4	23.5	41.0
2013	4234.8	5311.0	10369.1	30601.4	23.5	41.0
2014	4234.8	5311.0	10369.1	30601.4	23.5	41.0
2015	4234.8	5311.0	10369.1	30601.4	23.5	41.0
2016	4234.8	5311.0	10369.1	30601.4	23.5	41.0
2017	4234.8	5311.0	10369.1	30601.4	23.5	41.0
2018	4234.8	5311.0	10369.1	30601.4	23.5	41.0
2019	4234.8	5311.0	10369.1	30601.4	23.5	41.0
2020	4234.8	5311.0	10369.1	30601.4	23.5	41.0
2021	4234.8	5311.0	10369.1	30601.4	23.5	41.0
2022	4234.8	5311.0	10369.1	30601.4	23.5	41.0

Table 2-37: Forestland Converted to Settlement

Year	Dry Evergreen Forest	Dry Deciduous Forests	Moist Evergreen Forest	Forest Woodland	Eucalyptus	Pinus
1990	1218.2	1527.8	2982.9	8803.1	6.8	11.8
1991	1218.2	1527.8	2982.9	8803.1	6.8	11.8
1992	1218.2	1527.8	2982.9	8803.1	6.8	11.8
1993	1218.2	1527.8	2982.9	8803.1	6.8	11.8
1994	1218.2	1527.8	2982.9	8803.1	6.8	11.8
1995	1218.2	1527.8	2982.9	8803.1	6.9	11.7
1996	1218.1	1527.8	2982.9	8803.1	7.0	11.7
1997	1218.1	1527.8	2982.9	8803.1	7.1	11.7
1998	1218.0	1527.8	2982.9	8803.1	7.2	11.6
1999	1218.0	1527.8	2982.9	8803.1	7.3	11.6
2000	1217.9	1527.8	2982.9	8803.1	7.4	11.5
2001	1217.8	1527.8	2982.9	8803.1	7.4	11.5
2002	1217.7	1527.8	2982.9	8803.1	7.5	11.6
2003	1217.8	1527.8	2982.9	8803.1	7.4	11.5
2004	1217.8	1527.8	2982.9	8803.1	7.4	11.5
2005	1217.8	1527.8	2982.9	8803.1	7.4	11.5
2006	1217.8	1527.8	2982.9	8803.1	7.4	11.5
2007	1217.8	1527.8	2982.9	8803.1	7.4	11.5
2008	1217.8	1527.8	2982.9	8803.1	7.4	11.5
2009	1217.8	1527.8	2982.9	8803.1	7.4	11.5
2010	1217.8	1527.8	2982.9	8803.1	7.4	11.5
2011	1217.8	1527.8	2982.9	8803.1	7.4	11.5
2012	1217.8	1527.8	2982.9	8803.1	7.4	11.5
2013	1217.8	1527.8	2982.9	8803.1	7.4	11.5
2014	1217.8	1527.8	2982.9	8803.1	7.4	11.5
2015	1217.8	1527.8	2982.9	8803.1	7.4	11.5
2016	1217.8	1527.8	2982.9	8803.1	7.4	11.5
2017	1217.8	1527.8	2982.9	8803.1	7.4	11.5
2018	1217.8	1527.8	2982.9	8803.1	7.4	11.5
2019	1217.8	1527.8	2982.9	8803.1	7.4	11.5
2020	1217.8	1527.8	2982.9	8803.1	7.4	11.5
2021	1217.8	1527.8	2982.9	8803.1	7.4	11.5
2022	1217.8	1527.8	2982.9	8803.1	7.4	11.5

Table 2-38: Land Use Change Matrix Conversions

Year	Grassland converted to Cropland (Ha)	Cropland converted to Grassland (Ha)	Settlement converted to Grassland (Ha)	Grassland converted to Wetland (Ha)	Cropland converted to Settlement (Ha)	Grassland converted to Settlement (Ha)
1990	4157	4850	693	693	1386	693
1991	4157	4850	693	693	1386	693
1992	4157	4850	693	693	1386	693
1993	4157	4850	693	693	1386	693
1994	4157	4850	693	693	1386	693
1995	4157	4850	693	693	1386	693
1996	4157	4850	693	693	1386	693
1997	4157	4850	693	693	1386	693
1998	4157	4850	693	693	1386	693
1999	4157	4850	693	693	1386	693
2000	4157	4850	693	693	1386	693
2001	4157	4850	693	693	1386	693
2002	4157	4850	693	693	1386	693
2003	4157	4850	693	693	1386	693
2004	4157	4850	693	693	1386	693
2005	4157	4850	693	693	1386	693
2006	4157	4850	693	693	1386	693
2007	4157	4850	693	693	1386	693
2008	4157	4850	693	693	1386	693
2009	4157	4850	693	693	1386	693
2010	4157	4850	693	693	1386	693
2011	4157	4850	693	693	1386	693
2012	4157	4850	693	693	1386	693
2013	4157	4850	693	693	1386	693
2014	4157	4850	693	693	1386	693
2015	4157	4850	693	693	1386	693
2016	4157	4850	693	693	1386	693
2017	4157	4850	693	693	1386	693
2018	4157	4850	693	693	1386	693
2019	4157	4850	693	693	1386	693
2020	4157	4850	693	693	1386	693
2021	4157	4850	693	693	1386	693
2022	4157	4850	693	693	1386	693

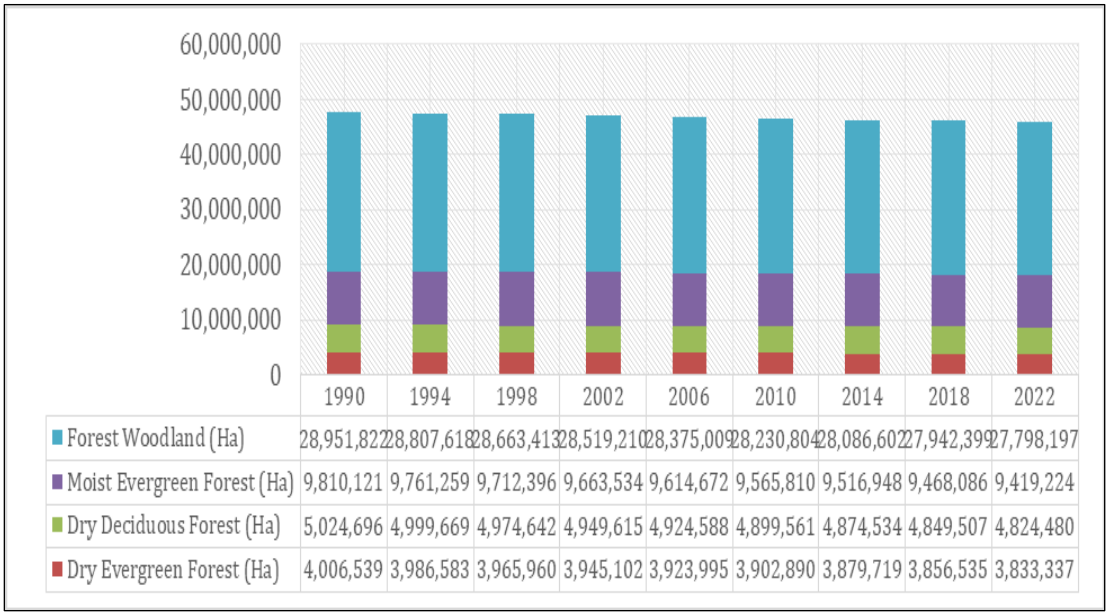
Activity data requirements under this section under aggregate Sources and Non-CO2 Emissions on Land are provided in Tables 2-39

Table 2-39: Area Burnt in Forest land (ha)

Year of Assessment	Dry Evergreen Forest	Dry Deciduous Forests	Moist Evergreen Forest	Woodlands (Semi-Evergreen)
1990	2813.518349	3528.500934	6888.978007	20330.89
1991	5627.036698	7057.001868	13777.95601	40661.77
1992	8440.555046	10585.5028	20666.93402	60992.66
1993	11254.0734	14114.00374	27555.91203	81323.55
1994	14067.59174	17642.50467	34444.89004	101654.4
1995	16880.46566	21171.07956	41334.01242	121985.7
1996	19693.12061	24699.67957	48223.18387	142317.2
1997	22505.5548	28228.30491	55112.40477	162648.8
1998	25317.76637	31756.9558	62001.67555	182980.6
1999	28129.75349	35285.63245	68890.99662	203312.5
2000	30941.51427	38814.33507	75780.36839	223644.5
2001	32345.82011	40578.86707	79225.40705	233811.6
2002	33749.92045	42343.42264	82670.49175	243978.8
2003	32528.12498	40813.51371	79683.52669	235163.6
2004	30545.66453	38328.91999	74832.65324	220847.6
2005	70798.94978	88845.65053	173460.5556	511920.2
2006	34481.71555	43274.32406	84487.96593	249342.5
2007	35696.78004	44802.54244	87471.63036	258148
2008	42208.91138	52979.77063	103436.6949	305264.4
2009	29735.16349	37325.76148	72874.10563	215067.5
2010	29432.87841	36949.07956	72138.67901	212897.1
2011	33484.3073	42043.82118	82085.5555	242252.5
2012	41308.25447	51878.57283	101286.7373	298919.4
2013	43762.02407	54971.70866	107325.7168	316741.7
2014	28885.83437	36292.57282	70856.92783	209114.3
2015	47432.68209	59607.63283	116376.8069	343453.5
2016	41666.16829	52372.03608	102250.1656	301762.7
2017	22963.83045	28870.36538	56365.95144	166348.3
2018	15507.88547	19500.82303	38073.03544	112361.9
2019	58056.59168	73020.47534	142563.7852	420737
2020	32902.08083	41391.35137	80811.68606	238493
2021	26984.21655	33953.88984	66290.92785	195639.1
2022	14658.02489	18447.98853	36017.50146	106295.6

2.3.4.5.4 Emissions Trends for Land Category

Managed Forest Land is partitioned into two sub categories namely; Forest Land Remaining Forest Land and Land Converted to Forest Land. The relevant carbon pools and non-CO_2 gases for which methods include; biomass (above-ground and below-ground biomass), dead organic matter (dead wood and litter), soil organic matter. Non-CO_2 gases include CH_4, CO, N_2O and NO_X. Forest land-use classification was undertaken according to geographic detail while considering ecosystem types, biomass densities, fractions of cleared biomass which are burnt, climate, ecology or species, forest types, land-use or forestry practices, fuel-wood and wood removals. Emissions from forestland increased from 85,299.6 $GgCO_2eq$ in the base year, 1990 to 176,604.91 $GgCO_2eq$ as given in Figure 2.53 and 2.54.



	1990	1994	1998	2002	2006	2010	2014	2018	2022
Forest Woodland (Ha)	28,951,822	28,807,618	28,663,413	28,519,210	28,375,009	28,230,804	28,086,602	27,942,399	27,798,197
Moist Evergreen Forest (Ha)	9,810,121	9,761,259	9,712,396	9,663,534	9,614,672	9,565,810	9,516,948	9,468,086	9,419,224
Dry Deciduous Forest (Ha)	5,024,696	4,999,669	4,974,642	4,949,615	4,924,588	4,899,561	4,874,534	4,849,507	4,824,480
Dry Evergreen Forest (Ha)	4,006,539	3,986,583	3,965,960	3,945,102	3,923,995	3,902,890	3,879,719	3,856,535	3,833,337

Figure 2.53: Trends of Emissions from Forestland Sub-categories under Land

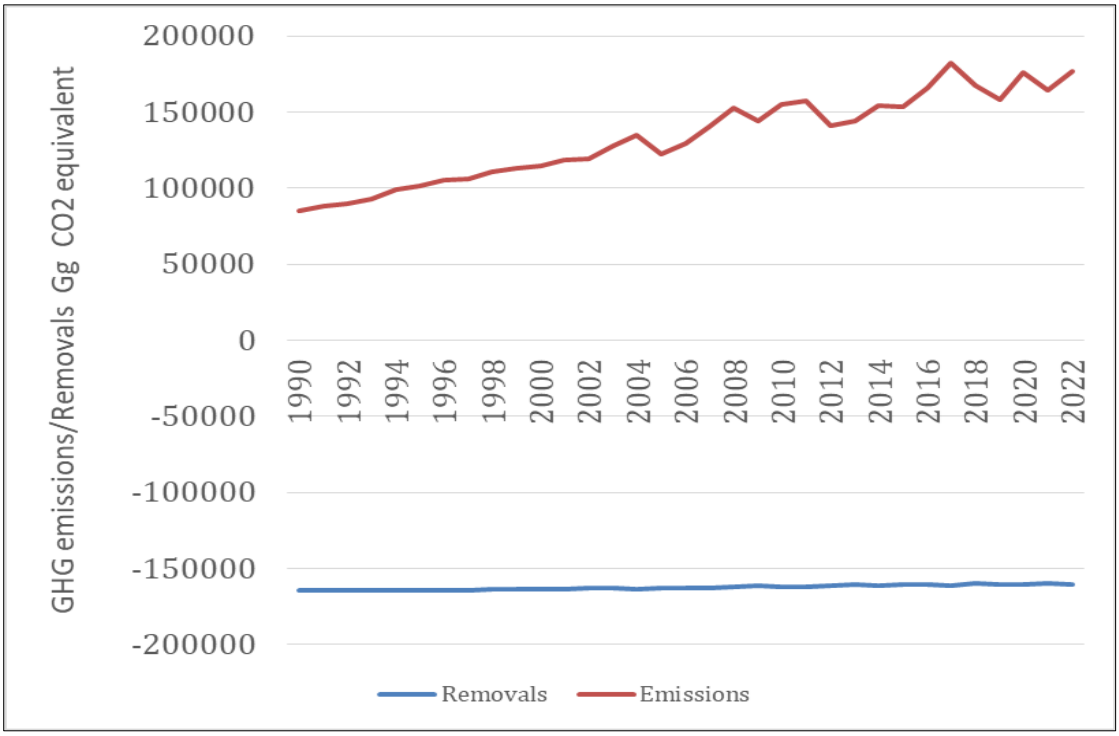


Figure 2.54: Trends of Emissions from Forestland

In Zambia, land use change (LUC) contributes significantly to the country's total GHG emissions. During the period from 1990 to 2022 national statistics show a significant reduction in the forest land category, primarily due to the conversion of forest land to other land uses. This reduction highlights the impact of expanding agricultural activities and urban development over time. Correspondingly, there has been an increase in other land-use

categories such as cropland, settlements, grasslands, and wetlands. The land use changes highlight the influence of economic and developmental pressures on land use dynamics.

The total GHG emission removals reduced from -84,996.2 $GgCO_2eq$ in the base year 1990 to -11,942.9 $GgCO_2eq$ in the current year 2022, representing a reduction of 86% (Figure 2.55)..

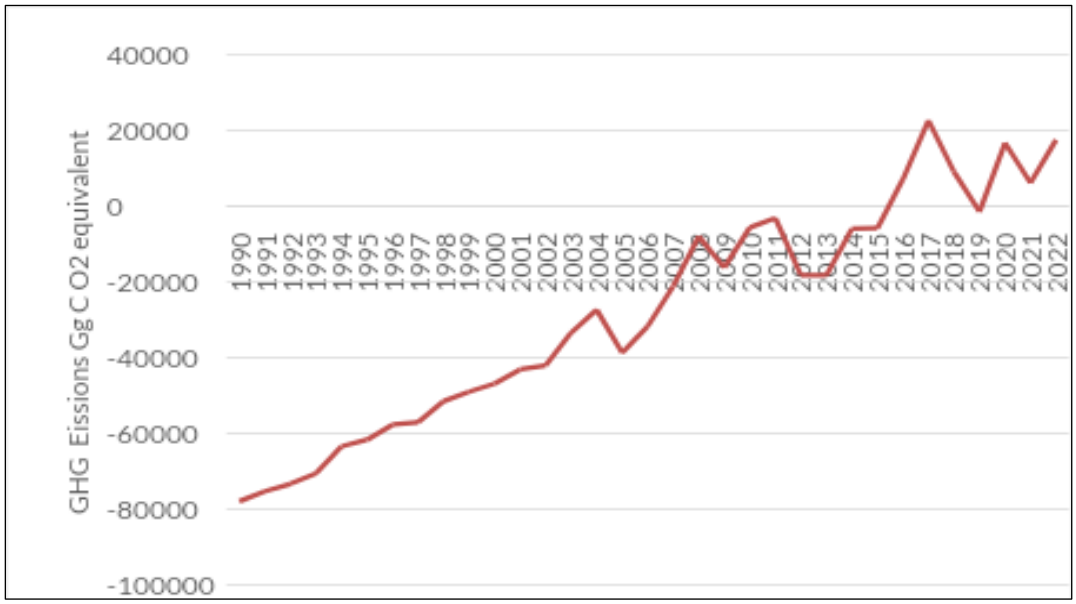


Figure 2.55: Emission Removals from Forestland Remaining Forestland and Land converted to Forestland Category

The emission removals or sink in land category was from annual increase in biomass carbon stock estimated from mean annual increment in tonnes of dry matter per hectare per year

Cropland includes arable and tillable land, rice fields, and agroforestry systems where the vegetation structure falls below the thresholds used for the Forest Land category, and is not expected to exceed those thresholds at a later time. Cropland includes all annual and perennial crops as well as temporal fallow land (i.e., land set at rest for one or several years before being cultivated again). Cropland is partitioned into two sub categories namely, Cropland Remaining Cropland (CC) and Land Converted to Cropland (LC) because of the difference in carbon dynamics. Land-use conversions to Cropland from Forest Land, Grassland and Wetlands usually result in a net loss of carbon from biomass and soils as well as N_2O to the atmosphere. The main drivers of cropland expansion in Zambia are;

- Commodity prices and market demand. Commodity prices and market demand are the key drivers of crop expansion in Zambia. Maize, the country's most widely cultivated crop, illustrates this dynamic well. Each the government through the Food Reserve Agency (FRA) sets a purchase price per 50 kg bag of maize, which it buys primarily from small scale farmers. In parallel, private buyers, especially Agro-processing companies, also participate in the market by purchasing maize and other crops.

  These price signals play a crucial role in shaping farmers' planting decisions. When a crop fetches high prices in one market season, farmers are often motivated to increase the areas planted with that crop in the following season. This is particularly true for staples such as maize and soybeans, which enjoy steady market demand both for human

consumption and as livestock feed. The combination of strong commodity prices and sus prices and sustained demand creates a strong incentive for cropland expansion.

- Policies and regulatory support. The Zambian Government, through the Ministry of Agriculture (GRZ, 2004) and Zambia Development Agency (ZDA, 2011), supported the commercial development and expansion of the agriculture sector through farm block development during the period under review. The expansion of the agriculture sector is contained in the policy and strategic documents such as Vision 2030 (GRZ, 2013), the Sixth National Development Plan (GRZ, 2011), Revised Sixth National Development Plan (GRZ, 2014) and The First National Agricultural Policy of 2004 - 2015 (GRZ, 2004).

- Internal migration. The frequent occurrence of droughts in the southern parts of Zambia, particularly in Southern Province, has resulted in the migration of farming households to provinces that experience favourable rains for farming. The farming households migrated to North Western, Copperbelt and Central provinces where new land has been opened for farming.

Emissions from cropland grew from 3,214.6 $GgCO_2eq$ in the base year 1990 to 7,453.5 $GgCO_2eq$ in the current year 2022 (Figure 2.56).

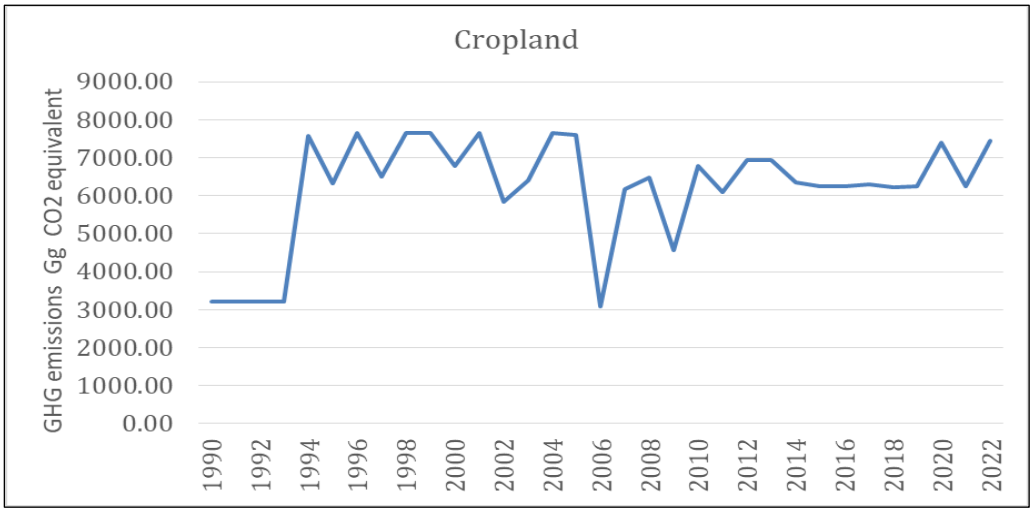


Figure 2.56: Emissions from Cropland

Settlements, Grasslands, and Wetlands

This section provides estimates of carbon stock changes and greenhouse gas emissions and removals associated with changes in biomass, dead organic matter (DOM), and soil carbon on lands classified as settlements. Settlements including all developed land i.e., residential, transportation, commercial, and production (commercial, manufacturing) infrastructure of any size. Emissions from Settlements increased sharply from 1990 to 2009 and thereafter remained steady until 2022 as shown in Figure 2.57.

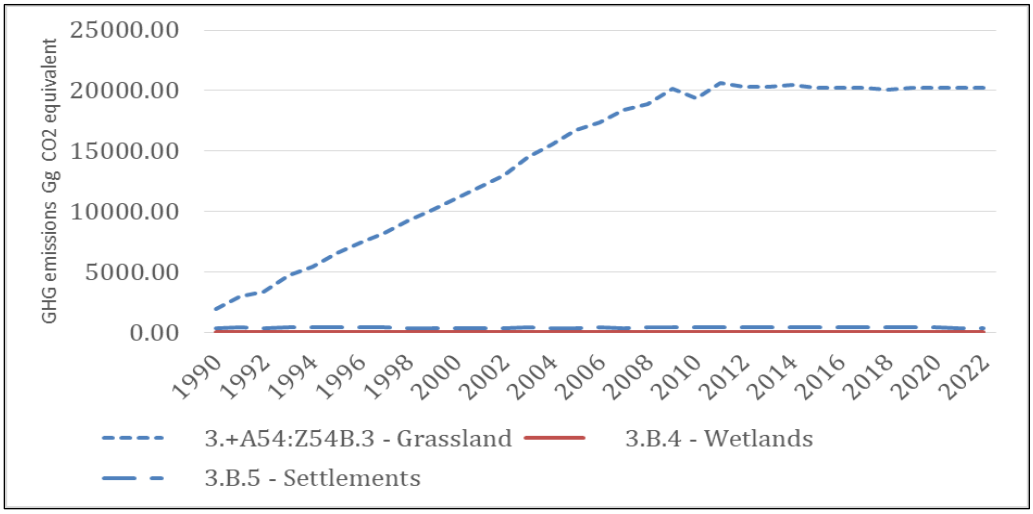


Figure 2.57: Tends of Emissions from Settlements, grasslands and Wetlands

Generally, emissions from Grassland, wetlands and settlements increased by from 1,932.5 $GgCO_2eq$, 41.6 $GgCO_2eq$, 362.02 $GgCO_2eq$ in 1990 to 20,247.7, $GgCO_2eq$, 41.6 $GgCO_2eq$, and 362.0 $GgCO_2eq$ in 2022, respectively.

2.3.4.5.5 Quality Assurance/Quality Control Measures

Activity data used in estimating GHG emissions from the AFOLU was obtained from Forest Department (ILUA II data set), ZamStats, and Zambia Revenue Authority (ZRA). Efforts were made to compare data from various sources and compile the most suitable data sets for use in emissions estimates. Efforts were made to check and verify the data from all sources to ensure good quality data was utilised in the inventory preparation from the AFOLU sector.

2.3.4.5.6 Sectoral Uncertainties

The Uncertainty Analysis (UA) was estimated using approach 1 and computed using the IPCC 2006 software and is provided in Annex I Data for estimating emissions in the Land category was obtained from the ILUA data and), ZamStats with uncertainty of ±5%.

2.3.4.6.7 Planned Improvements

Gaps on activity data and emission factor are elaborated as follows:

Data Gaps

There is a lack of emission factors by vegetation class.

Improvements

i. There is a need to institute a two-year data collection for activity data using improved methods. This can be addressed through the newly calculated emission factors for the vegetation classes for the 2020 forest reference emission level.
ii. There is need for the stratification of the vegetation types in the category forest woodland and other wooded land.

Propose emission factor and activity data research areas/projects for inventory improvement projects

i. There is need for validation of the emission factors newly calculated from ILUA II data.
ii. Mapping of Peatland areas in collaboration with relevant sectors such as Agriculture Research.
iii. Capacity building in fire data processing and estimation from Modis and, any other recommended data sources.
iv. Obtain accurate growth rate estimates for all categories for future GHG updates.
v. Enhance capacity in carrying out sample-based estimates for land use changes.
vi. Establish a dedicated GHG unit within the department.
vii. Enhance the sector's capacity in data collection, analysis, and utilization of IPCC software for improved greenhouse gas inventory reporting.
viii. Integrate GHG data collection into the department's daily operations and reporting processes to ensure consistent data availability for national reporting.

2.3.4.6 Aggregate Sources and Non-CO_2 emission on Land

2.3.4.6.1 Overview

Aggregate sources and non-CO_2 emissions on land were considered according to source subcategories as outlined in the IPCC 2006 guidelines, namely; Emissions from Biomass burning, Liming, Urea application, Direct N_2O emissions from managed soils, Indirect N_2O emissions from managed soils, Indirect N_2O emissions from manure management, Rice cultivation and Other as given in Figure 2.58.

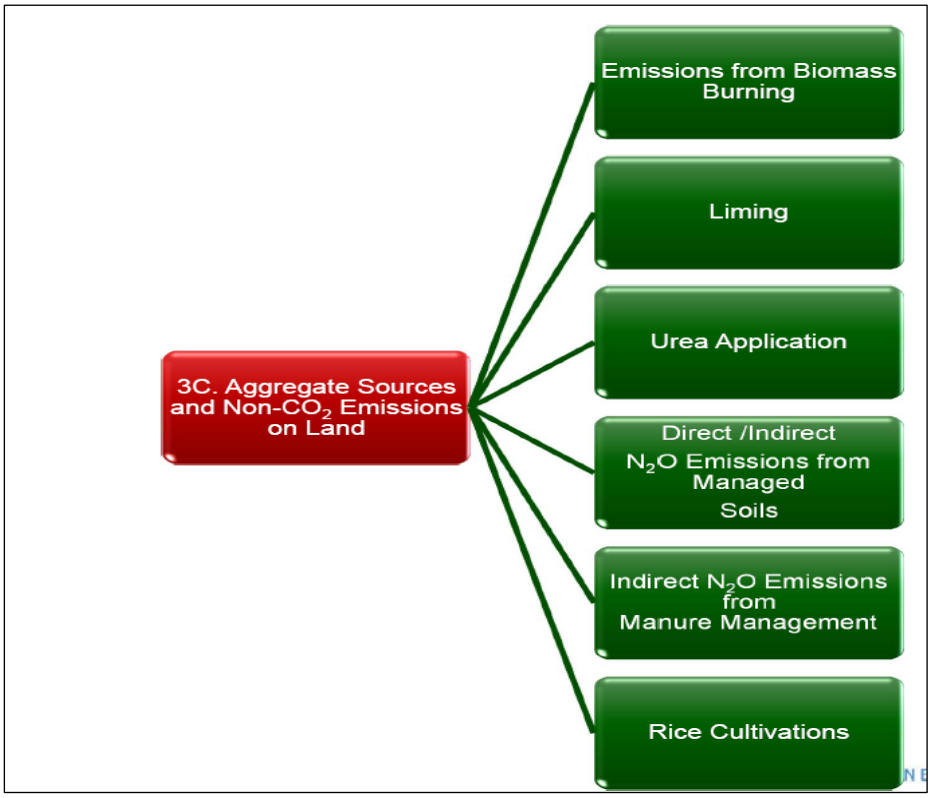


Figure 2.58: Aggregate Sources and non- CO_2 emission on Land

2.3.4.6.2 Methodology and Emission Factors

Tier 1 method was used in estimating emissions in (i) direct N_2O emissions from managed soils are estimated, (ii) N_2O emissions from atmospheric deposition of N volatilised from managed soil are estimated and (iii) CO_2 Emissions from additions of carbonate limes to soils. Tier 1 emission factors were used in the estimates.

2.3.4.6.3 Activity Data

Biomass burning in forest land

Biomass burning in forestland under aggregate sources primarily includes areas affected by early-season fires, often employed as a management practice to reduce fuel loads. These fires are classified into three burning regimes based on timing: early-season fires (April–June), mid-season fires (July–August), and late-season fires (September–November). For the period under

review, fires included under aggregate sources in forestland primarily occurred between January and July.

The general trend of biomass burnt in forestland from 1990 to 2022 exhibited fluctuations, with the highest levels recorded in 2005 and the lowest in 1990 (Figure 2.59).

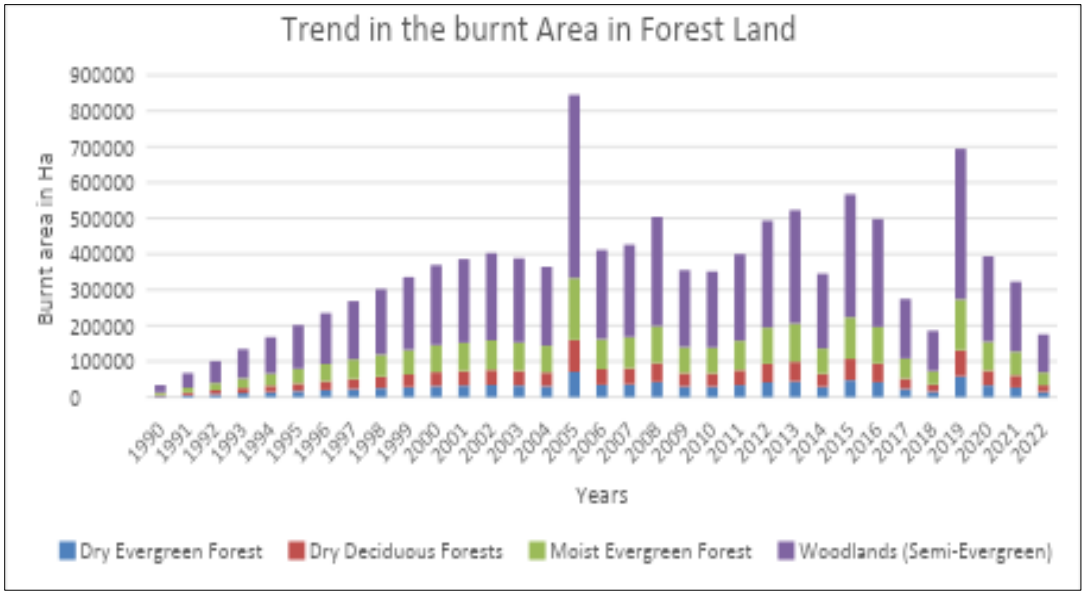


Figure 2.59: Trends in Burnt Area in Forest land

In terms of forest subcategories, woodlands (semi-evergreen) accounted for the largest burnt areas, followed by moist evergreen forests. Conversely, dry deciduous and dry evergreen forests experienced the smallest burnt areas, suggesting they were less affected by fires compared to other forest types.

Regarding burnt biomass, semi-evergreen woodlands showed the highest levels, followed by moist evergreen and dry deciduous forests. Dry evergreen forests consistently recorded the lowest burnt biomass throughout the analysis period (1990–2022). The year 2005 marked a significant spike in burnt biomass, likely due to the prolonged dry spell Zambia experienced during the 2004/2005 season[63]. Similarly, El Niño-induced droughts in the 2017/2018 season may have left substantial biomass susceptible to fire disturbances, further contributing to increased burnt biomass during these years.

Biomass burning in Grassland

The analysis of fire trends in grasslands, indicate that largest burnt area was recorded in 2005, while the smallest or minimum extent was observed in 1990 (Figure 2.60).

[63] Lekprichakul, M. 2008. Impact of 2004/2005 Drought on Zambia's Agricultural Production: Preliminary Results.

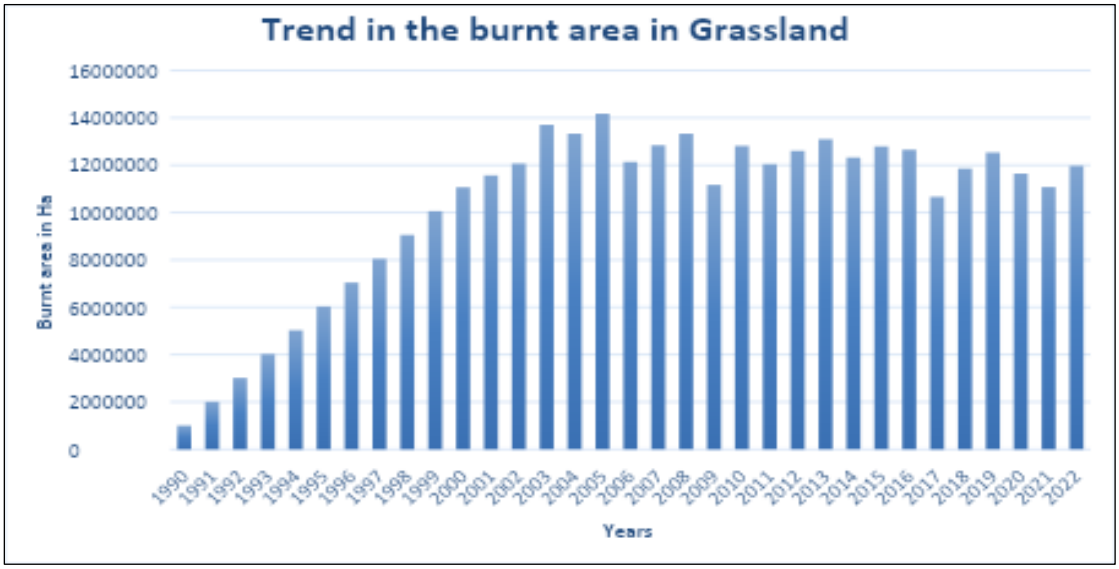


Figure 2.60: Trends in Burnt Areas in Grasslands

The overall trend variations in the burnt area across the time series may reflect or is influenced by interannual climate variability and associated changes in fire occurrences and land management practices.

Biomass Burning in All Other Land

In grassland, the largest burnt area during the fire trend analysis was observed in 2005 while the lowest was recorded in 1990 (Figure 2.61).

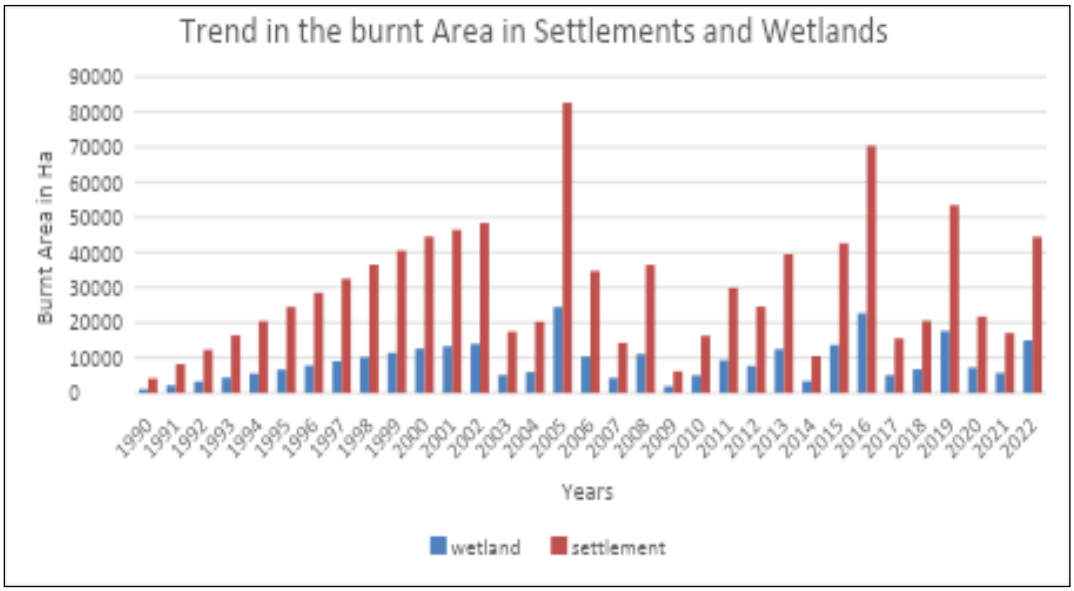


Figure 2.61: Trends in burnt Area in Other land

It was however worth noting the areas burnt under for biomass burning in all other lands were quite moderate from the MODIS fire data set that was used.

Liming

Liming is used to reduce soil acidity and improve plant growth in managed systems, particularly agricultural lands and managed forests. Adding carbonates to soils in the form of lime (e.g., calcic limestone ($CaCO_3$), or dolomite ($CaMg(CO_3)_2$) leads to CO_2 emissions as the carbonate limes dissolve and release bicarbonate (2HCO3), which evolves into CO2 and water (H_2O). Lime consumption in Zambia for agriculture purposes is mostly by large -scale farmers. Large scale farmers, particularly in high rainfall areas of the country, where crop commercial farming is concentrated, use dolomitic or calcitic lime to increase the pH of acidic soils. Dolomitic and calcitic lime are both available on the Zambian market. In this report the lime consumed has therefore been taken to be dolomitic, based on the assumption that farmers would prefer it over calcitic because it contains large amounts of magnesium which are an important mineral for plant health.

Lime usage has been periodic over time. From 2000 to 2011, limestone ($CaCO_3$) calcite was applied in Regions I and II, while from 2011 to 2015, dolomite ($CaMgCO_3$) was used in Regions II and III. The use of lime and its recommendations were driven by promotional programs, including those rolled out by the Programme Against Malnutrition (PAM) and the activities of the Ministry of Agriculture

Urea Application

Adding urea to soils during fertilisation leads to the release of CO_2 that was fixed in the industrial production process. Urea ($CO(NH_2)_2$) is converted into ammonium (NH_4^+), hydroxyl ion (OH-), and bicarbonate (HCO_3-), in the presence of water and releases enzymes. Similar to the soil reaction following addition of lime, bicarbonate that is formed evolves into CO_2 and water. Consumption of urea presents the total quantity of urea used in the crop sector, showing an increasing trend, especially after the year 2000. Before 2000, urea usage was relatively low, but it has significantly risen since then, with the cultivated hectarage having quadrupled by the year 2000. Maize production accounts for the highest urea usage compared to other crops or agricultural enterprises.

Direct N_2O Emissions from Managed Soils

In most soils, an increase in available Nitrogen (N) enhances nitrification and denitrification rates which then increase the production of N_2O. Increases in available N can occur through human-induced N additions or change of land-use and/or management practices that mineralise soil organic Direct N_2O emissions from managed soils occur from sources which include; synthetic N fertilisers, N in crop residues and drainage/management of organic soils. In most soils, an increase in available N enhances nitrification and denitrification rates which then increase the production of N_2O. Increases in available N can occur through human-induced N additions or change of land-use and/or management practices that mineralise soil organic N. The following N sources are included in the methodology for estimating direct N_2O emissions from managed soils:

a) synthetic N fertilisers (FSN);
b) Organic N applied as fertiliser (e.g., animal manure, compost, sewage sludge, rendering waste) (FON);
c) Urine and dung N deposited on pasture, range and paddock by grazing animals (FPRP);
d) N in crop residues (above-ground and below-ground), including from N-fixing crops 2 and from forages during pasture renewal (FCR);
e) N mineralisation associated with loss of soil organic matter resulting from change of land use or management of mineral soils (FSOM); and
f) Drainage/management of organic soils (i.e., Histosols) 4 (FOS).

The largest source of nitrogen emissions comes from agricultural crop cultivation residues, followed by organic fertilizers, with livestock being the third largest emitter of nitrous oxide. The proportion of nitrogen emissions from crop cultivation residues compared to urine and dung consistently ranges between 50% and 80%, indicating a steady variation between these two sources.

Indirect N_2O Emissions from Managed Soils

Indirect emissions of N_2O from managed land take place through two indirect pathways; (a) the volatilisation of N as NH_3 and oxides of N (NOx), and the deposition of these gases and their products NH_4^+ and NO_3- onto soils and the surface of lakes and other waters; (b) The leaching and runoff from land of N from synthetic and organic fertiliser additions, crop residues, mineralisation of N associated with loss of soil C in mineral and drained/managed organic soils through land-use change or management practices, and urine and dung deposition from grazing animals. Methane (CH_4) is generated during wetland rice growing from the decomposition of plant residues and other organic carbon material in the soil. This generation occurs through microbial action under anaerobic environments following flooding of the rice crop.

Indirect N_2O Emissions from Manure Management

The leaching and runoff from land of N from urine and dung deposition from grazing animals contributes to nitrogen losses to water bodies, leading to nutrient enrichment, water pollution, and associated greenhouse gas emissions such as nitrous oxide (N_2O). Methane (CH_4) is generated during wetland rice growing from the decomposition of plant residues and other organic carbon material in the soil. Emissions from this sub category were not estimated due to lack of activity data.

Rice Cultivation

Methane (CH_4) is generated during wetland rice growing from the decomposition of plant residues and other organic carbon material in the soil. This generation occurs through microbial action under anaerobic environments following flooding of the rice crop

The area under rice production increased steadily from about 33,000 ha in 2011 to 43,000 ha 2015 before dropping sharply to 25,500 ha in 2016. This can be attributed to the Ministry of Agriculture's Crop Diversification Programme which has recognized rice as one of the

strategic commodities that contributes to food security, and with potential to significantly increase incomes and employment among rural producers[64]..

Government's decision to include rice as one of the nine crops supported by the Farmer Input Support Programme (FISP) has also contributed to the upswing of areas under rice cultivation. According to the Second National Rice Development Strategy[65]. rice growing has been promoted vigorously across the ten provinces of Zambia. However, the decline in production of rice in the 2015/16 farming period could be attributed to the drought that occurred during the season. Area expected to be harvested under rice dropped slightly from 27,000 ha in 2011 to 26,000 ha in 2012.

The succeeding years of 2013 and 2014 shows an increase in the harvested area, exceeding 30,000 ha. This is in view of the fact that rice has become an important staple food in Zambia in the recent past with a steady increase in demand and growing importance as evidenced by its current status as a strategic food crop[41]. Production areas of rice are largely concentrated in Northern, Muchinga, Western, Eastern and Luapula Provinces. This is in view of the abundance of water which creates favourable conditions for rice cultivation especially in the dambos and wetlands. The promotion of rice growing in upland areas has been emphasized in recent years due to the introduction of up-land rice varieties.

Maize Production 1990 to 2022

A staggered analysis of the four-year trends from 1990 to 2022 for Zambia's maize cultivation indicated progressive expansion of areas under the cropland category. From 1990 to 1994 this dropped by 11% from the initial 763,000 Ha to 679,000, thereafter, this increased by 14.9% from 1995 to 1999. From 2000 to 2004, maize cultivation saw a steady increase of 12.3%. This was followed by a significant expansion in the area planted between 2005 and 2009, rising by 34.8% to exceed one million hectares. Growth continued, with the area increasing by 14.2% from 2010 to 2015, then by 4.2% from 2015 to 2019. The most recent period, 2020 to 2022, saw a 16% surge, bringing the total maize cultivation area to a record 1.9 million hectares. This expansion reflects enhanced support to smallholder farmers through targeted programs such as the Farmer Input Support Programme (FISP).

Notably, the largest area expansions occurred in 2005–2009 (34.8%) and 2020–2022 (16.0%), aligning with production increases during the same periods. Maize production soared by 117.8% in 2005–2009 and by 42.7% in 2000–2004. However, between 2015 and 2019, production dropped by 23.4%, primarily due to prolonged droughts.

Looking further back, maize production declined from 1.1 million metric tons (MT) in 1990 to 1 million MT in 1994, reaching a low of 737,000 MT in 1995. By 1999, production had recovered slightly to 800,000 MT and increased to 850,000 MT in 2000. A notable rise followed, reaching 1.2 million MT in the early 2000s. Though it dipped to 866,000 MT in 2005, production surged to 1.8 million MT by 2009. It then rose further to 2.6 million MT in the early 2010s, peaking at 3 million MT. However, it fell again to 2.6 million MT and then to 2 million MT between 2015 and 2019 a period marked by severe droughts. These declines persisted through 2020–2022. In summary, while maize cultivation area has generally trended upward with major expansions in 2005 to 2009 and 2020 to 2022. The production has experienced both substantial growth and significant setbacks, often influenced by climatic conditions.

[64] FAO 1997: Estimating Biomass and Biomass Change of Tropical Forests
[65](GRZ, 2011). GRZ. 2011. National Urban Water Supply and Sanitation (2011-2030): MLGH.

The Wheat Production Expansions 1990 to 2022

Wheat started off in 1990 around 11,000ha with slight improvement by 0.3% at the end of 1994. This went on to a steady rise by 27.1% within the 1995 to 1999 period, which rose by 37.2% in the years 2000 to 2004, when it reached its peak change of 53.6% in the 2005 to 2009 period. Thereafter there was a slight drop by 4.2% in the 2010 to 2014 phase. Thereafter, this dropped by 36.7% within the 2015 to 2019 period by 40.9% rise to the highest peak in the 2020 to 2023 cultivated cropland areas. This started off around 53,000 MT which has increased over the production to the highest 277,000MT.

The production increase is a steady one, but checked on a staggered approach, rose by 13.7% within the 1990 to 1994 phase. This dramatically increased in the 1995/1999 by 82.1 %, and continued to grow in the 2000/2004 period and progressively into the 2005/2009 period by 42.8%. The increased production reached its highest in 2010/2015 period by 17.7 %. This, then dropped by 24.4% in the 2015/2019 era. Definitely influenced by the droughts, while the last period increased by 44.8%. All these rises have evidenced increasing production capacity and potential for wheat production in Zambia. The area planted with wheat has generally increased over the years, with significant growth periods in 2005-2009 (53.6%) and 2020-2023 (40.9%). Wheat production has shown substantial increases, particularly in 1995-1999 (82.1%) and 2020-2023 (44.8%).

Cultivated Area Soybean

In Zambia, soybean cultivation and production have shown a generally upward trend over the past three decades, with notable fluctuations driven by climatic conditions and shifts in policy support. From 1990 to 1994, the area under soybean cultivation ranged between 25,000 and 29,000 hectares, accounting for 14.7% of the total. This area sharply declined in the 1995–1999 period, dropping 45.9% from 21,000 hectares to approximately 11,000 hectares.

A remarkable recovery occurred from 2000 to 2004, with the area expanding from 2,500 hectares to 33,000 hectares, representing an exceptional 1,220% increase. However, this growth plateaued in 2005–2009, with a slight decrease of 0.8%, as the area declined marginally from 65,000 to 64,000 hectares. The growth trend resumed in the 2010 to 2014 period, when cultivated area rose from 62,000 to 116,000 hectares, a 86.9% increase. This was followed by another significant increase from 129,000 hectares to 235,000 hectares between 2015 and 2019, marking an 81.6% growth.

The most dramatic expansion occurred in 2020–2022, when the cultivated area jumped from 229,000 to 700,000 hectares, representing a 205.7% increase the largest recorded during the entire period. These trends illustrate the long-term expansion of soybean cropland, driven by increased demand and supportive agricultural policies. Soybean production mirrored these shifts in cultivated area, though with more dramatic changes in certain periods.

During 1990–1994, production remained modest at 24,000 to 26,000 metric tons (MT). Slight improvement was noted in 1995–1999, with production increasing to 21,000–26,000 MT, a modest 6.4% rise. A breakthrough occurred in 2000–2004, when production soared from 1,800 MT to 54,000 MT, marking an extraordinary 2,873.5% increase. This rapid growth continued through 2005–2009, maintaining the upward momentum.

The 2010–2014 periods saw production grow from 111,000 MT to approximately 214,000 MT, representing a 91.4% increase. From 2015 to 2019, production rose from 226,000 MT to 281,000 MT, followed by another significant increase in 2020–2023, where output jumped from 296,000 MT to 760,000 MT, a 155.9% increase. Both the area under cultivation and total soybean production in Zambia has shown substantial long-term growth, with key surges during 2000–2004 and 2020–2023. These periods align with broader agricultural development initiatives and growing market demand for soybeans. The data from ZamStats (1990–2022) underscores a positive trajectory for Zambia's soybean sector, despite intermittent setbacks. Continued investment in farmer support programs and climate-resilient practices is likely to sustain this upward trend.

Activity Data

Provided in Tables 2-40 to 2-42 is the actual activity data used.

Table 2-40: Biomass Burning in Grassland, Wetland and Settlement (ha)

	Grassland	Wetland	Settlement	Other Land
1990	1,006,078	1,067	4,114	508
1991	2,012,157	2,151	8,215	1,015
1992	3,018,235	3,252	12,301	1,519
1993	4,024,313	4,368	16,372	2,021
1994	5,030,392	5,500	20,430	2,520
1995	6,036,470	6,649	24,474	3,018
1996	7,042,549	7,813	28,504	3,514
1997	8,048,627	8,994	32,521	4,008
1998	9,054,705	10,190	36,523	4,499
1999	10,060,784	11,401	40,513	4,989
2000	11,066,862	12,628	44,488	5,476
2001	11,569,901	13,293	46,432	5,714
2002	12,072,940	13,965	48,369	5,950
2003	13,700,654	5,082	17,457	2,147
2004	13,331,570	5,957	20,292	2,494
2005	14,175,866	24,445	82,589	10,148
2006	12,143,370	10,357	34,708	4,263
2007	12,840,796	4,287	14,249	1,750
2008	13,334,747	11,061	36,474	4,477
2009	11,169,142	1,883	6,162	756
2010	12,813,835	5,011	16,264	1,995
2011	12,038,402	9,288	29,912	3,668
2012	12,602,396	7,693	24,584	3,013
2013	13,090,938	12,461	39,518	4,842
2014	12,329,994	3,329	10,478	1,283
2015	12,787,024	13,648	42,632	5,220
2016	12,647,990	22,693	70,358	8,611
2017	10,665,853	5,051	15,544	1,902
2018	11,860,128	6,723	20,538	2,512
2019	12,541,025	17,617	53,428	6,532
2020	11,647,079	7,231	21,771	2,661
2021	11,077,182	5,699	17,035	2,081
2022	11,965,912	14,970	44,431	5,426

Table 2-41: Quantities of Crop Production in t/year

Crop	1994	2000	2005	2010
Maize	1020749.4	850466	866187	2795483
Maize (for seed)				37,550
Wheat	60944.4	66544.6	136833	172256
Rice	16589.9	6358.2	13337.5	51655.9
Sorghum	35067.51	8167.7	18,714	27732.1
Millet	62643.51	42743	29,583	47996.9
Sunflower	9820.9	6393.2	8,112	26420.4
Soya beans	24629.76	1839.1	89,660	111888
Groundnuts	34732.08	23446.9	74,218	164602
Mixed Beans	23179.59	1850.5	23,098	65265.2
Cowpeas		35210.7	1,249	2721.8
Bambara nuts	512.9		1,237	
Irish Potatoes			14,035	22940.5
Cassava	183,742.40	968521	-	
Sweet Potatoes		9841.4	66,926	252867
Cotton			155,213	72482.3
Virginia Tobacco		3066	23,211	22073.9
Burley Tobacco		7610	13,094	9808.6

Table 2-42: Quantities of Compound D and Urea Fertilizer used in t/year

Year	Fertiliser (t)				N- Total
	Compound- D	N- Content	Urea	N- Content	
1994					
2000	32,095.70	4,012.00	30040.8	13818.8	17,830.70
2005	25,060.00	3,132.50	25060	11527.6	14,660.10
2010	121,861.20	15,232.60	114665.6	52746.2	67,978.80

2.3.4.6.4 Trends of Emissions under Aggregate Sources

The emissions from aggregate Sources and Non-CO_2 emissions on land varied while increasing from 2,139.0 $GgCO_2eq$ in the base year 1990 to 11,860.2 $GgCO_2eq$ in current year 2022 as presented in Figure 2.62.

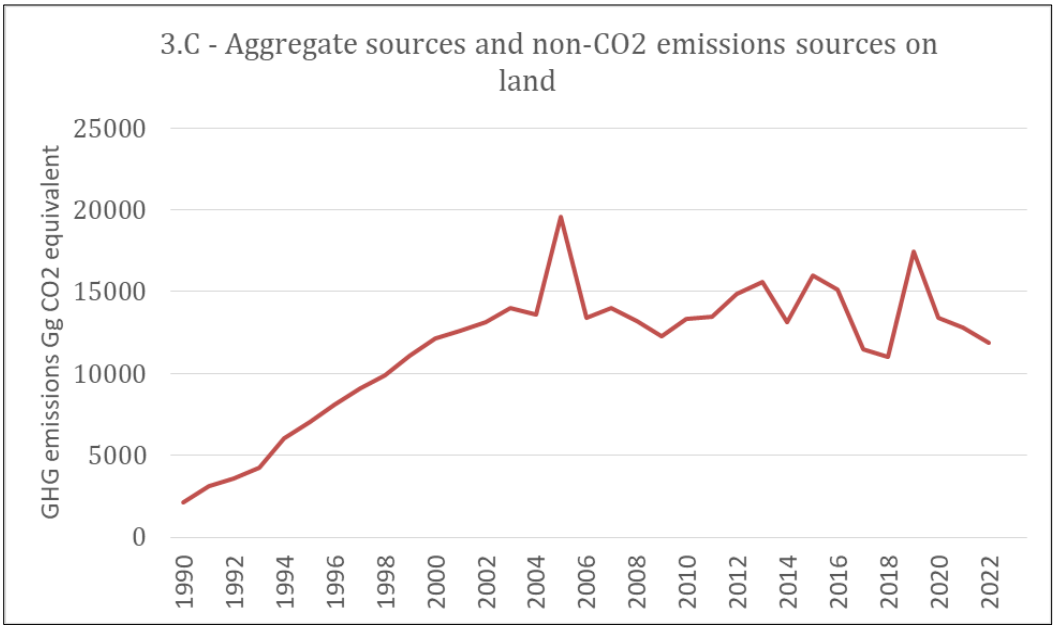


Figure 2.62: Emission trends for the Aggregate Sources and non-CO2 emission sources

In 2022, emissions from biomass burning were the highest contributor to emissions for Aggregate sources and non-CO2 emissions sources on land with 80%. This was followed by emissions from Direct N_2O emissions from managed soils were at 15%. Emissions from Indirect N2O Emissions from managed soils were 2% and the least was emissions from rice cultivation at 3% as given in Figure 2.63.

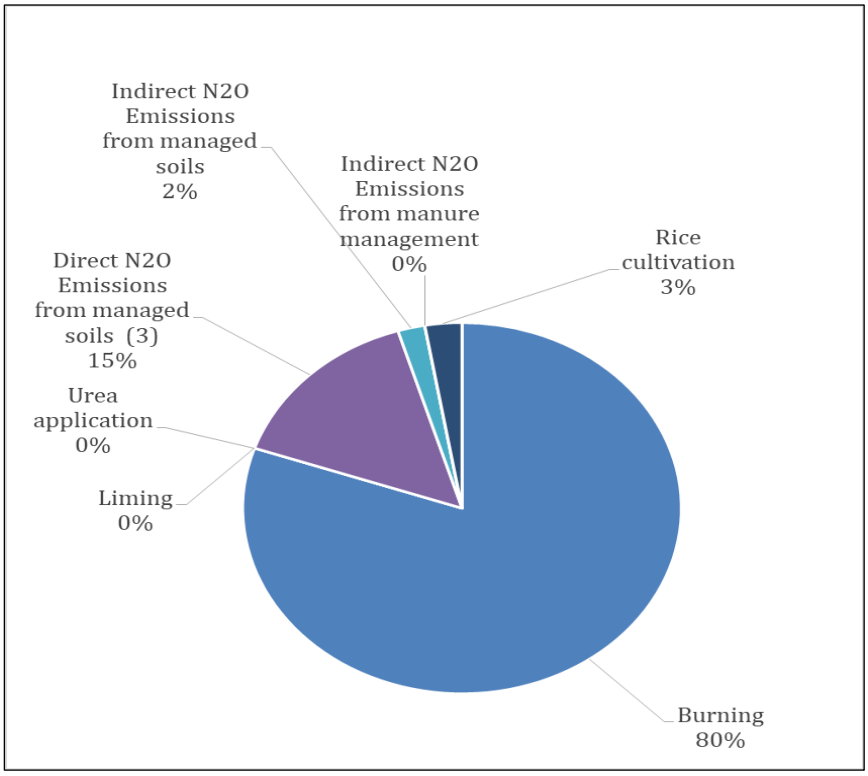


Figure 2.63: Percentage contributions to Aggregate Sources and non- CO2 Emissions on Land

By gas, CH_4 was the highest contributor to emissions under Aggregate sources on land with 51% followed by N_2O at 47%. The least was CO_2 at 2% given in Figure 2.64.

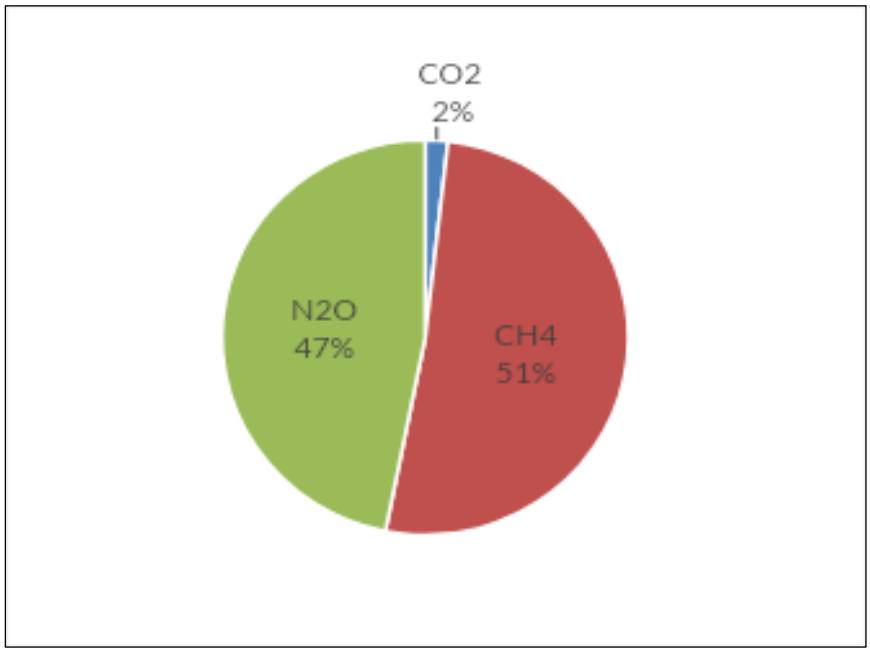


Figure 2.64: Gas percentage contributions to Aggregate Sources and non-CO2 emissions on Land

Results for emissions of greenhouse gases for subcategories on aggregate sources from 1990 to 2022 are provided in the subsequent sections.

Emissions from Biomass burning

Uncontrolled (wildfires) and managed (prescribed) fires can have a major impact on the non-CO_2 greenhouse gas emissions from forests. Biomass burning occurs in forest land, crop land, grassland and in all other land. In Forest Land Remaining Forest Land, emissions of CO2 from biomass burning also are accounted for because they are generally not synchronous with rates of CO_2 uptake.

This is especially important after stand replacing wildfire, and during cycles of shifting cultivation in tropical regions. Biomass is defined as the total amount of aboveground living organic matter in trees expressed as oven-dry tons per unit area[66].. Generally, forest biomass that burns in a forest includes trees (bark, leaves), saplings, dead wood, grass and litter.

Where the type of forest changes (e.g., conversion of natural forests to plantation forests), there may be net emissions of CO_2 from biomass burning during the initial years, in particular if significant woody biomass is burnt during the conversion. Over time, however, the impacts are not as great as those that result from Forest Land Converted to Cropland or Grassland.

Every year, during the dry season, forest fires occur in most parts of Zambia. All burning in the early season (April to July) was classified as cultural management practice, while late burning (August to November) was classified as forest disturbance due to the damage caused

[66] FAO 1997: Estimating Biomass and Biomass Change of Tropical Forests

on the plant stocks as a result of the dry fuel loads. The uncontrolled (wildfires) and managed (prescribed) fires contribute to greenhouse gas emissions to the atmosphere. The non-CO2 gases that are emitted are Methane (CH_4), Nitrous Oxide (N_2O), Nitrogen oxides (NOx) and Carbon monoxide (CO).

In Zambia fires occur annually on croplands after harvest particularly on fields of small farmers. The burning of residual crop material releases CH_4, N_2O, CO and NOx into the atmosphere. These gases are formed from carbon and nitrogen in the plant material during the combustion process. The burning of biomass in grasslands releases CH_4, N_2O, CO and NOx into the atmosphere in the same way that these gases are produced from burning of crop residues. The emissions from biomass burning varied across the timeline while increasing from 996.2 $GgCO_2eq$ in base year 1990 to 5,280.21 $GgCO_2eq$ in current year 2022 (Figure 2.65).

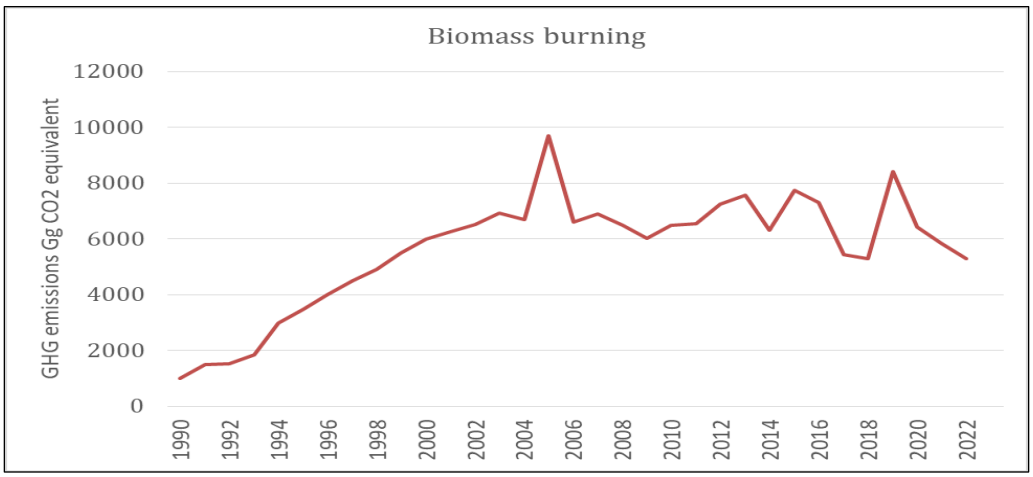


Figure 2.65: Emissions from Biomass Burning

Liming

The emissions from Liming have been varying from 1990 to 2022 with a peak occurring in 2007. The emissions in 1990 were 1.2 $GgCO_2eq$ and it grew steadily until 2003 after which it grew sharply to 1,020.5 $GgCO_2eq$ followed by a sharp decline until 2011. The emissions varied after that with 2022 recording 8.2 $GgCO_2eq$ as given in Figure 2.66.

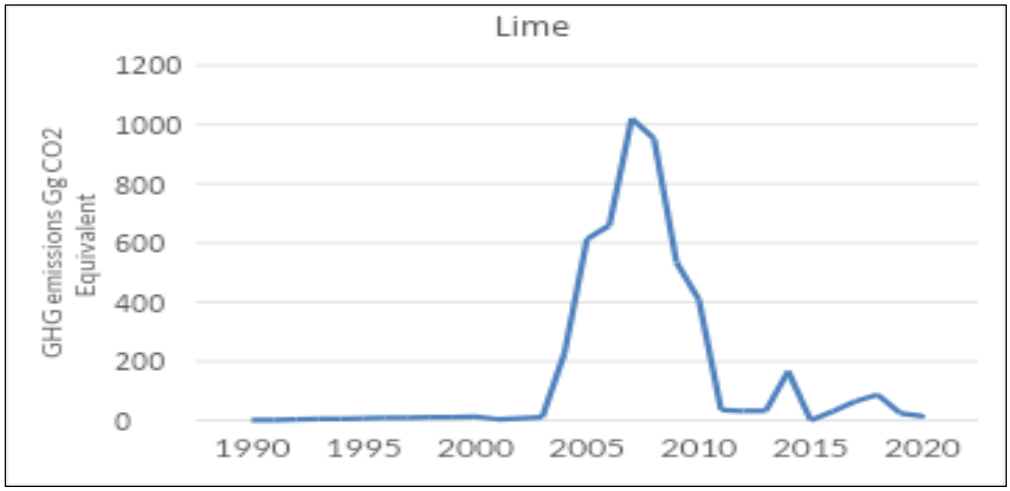


Figure 2.66: Emissions from Liming

Urea Application

The emissions from Urea application have been varying from 1990 to 2022. The lowest emissions were estimated in 1990 with 14.0 $GgCO_2eq$ while the highest was in 2015 with 118.0 $GgCO_2eq$ (Figure 2.67).

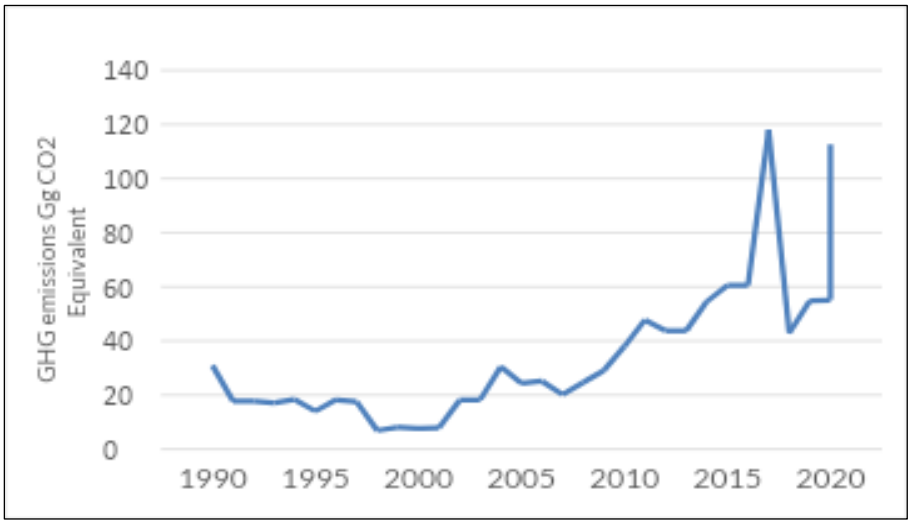


Figure 2.67: Trends of Urea Consumption

Direct N2O Emissions from Managed Soils

The emissions from Urea application have been varying from 1990 to 2022. The emissions in 1994 were estimated at 100 $GgCO_2eq$ while the highest was in 2022 with 989.0 $GgCO_2eq$ (Figure 2.68).

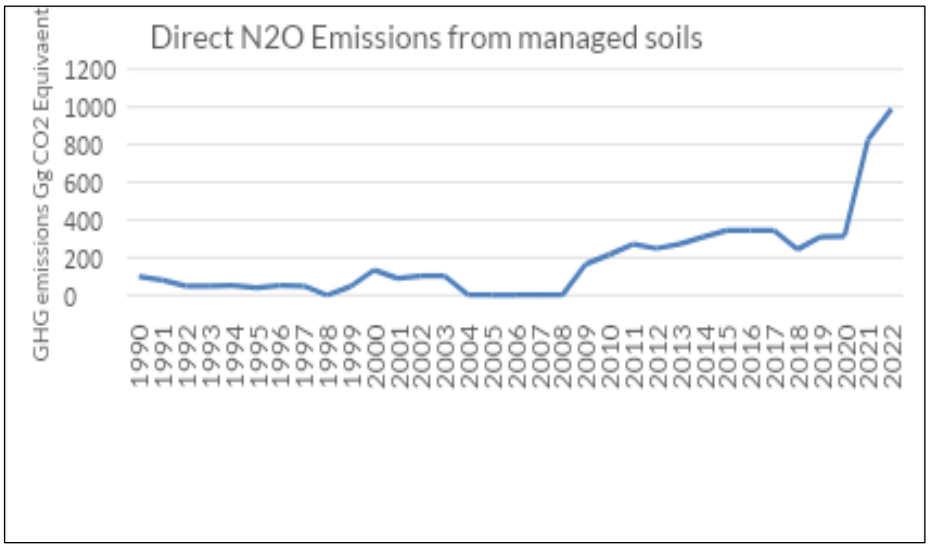


Figure 2.68: Trends of Emissions for Direct N2O Emissions from Managed Soils

Indirect N_2O Emissions from Managed Soils

The emissions in 1990 were estimated at 19.0 $GgCO_2eq$ while the highest was in 2022 with 131.3 $GgCO_2eq$ (Figure 2.69).

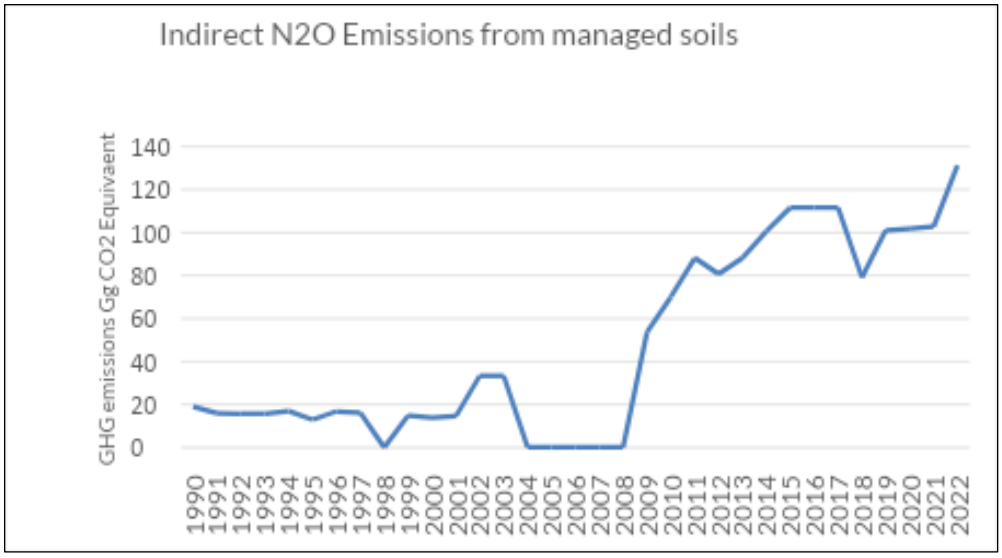


Figure 2.69: Indirect N2O Emissions from Managed Soils

Rice Cultivation

The emissions from Rice cultivation increased from 27.5 $GgCO_2eq$. in the base year 1990 to 178.9 $GgCO_2eq$. in the current year 2022 (Figure 2.70)

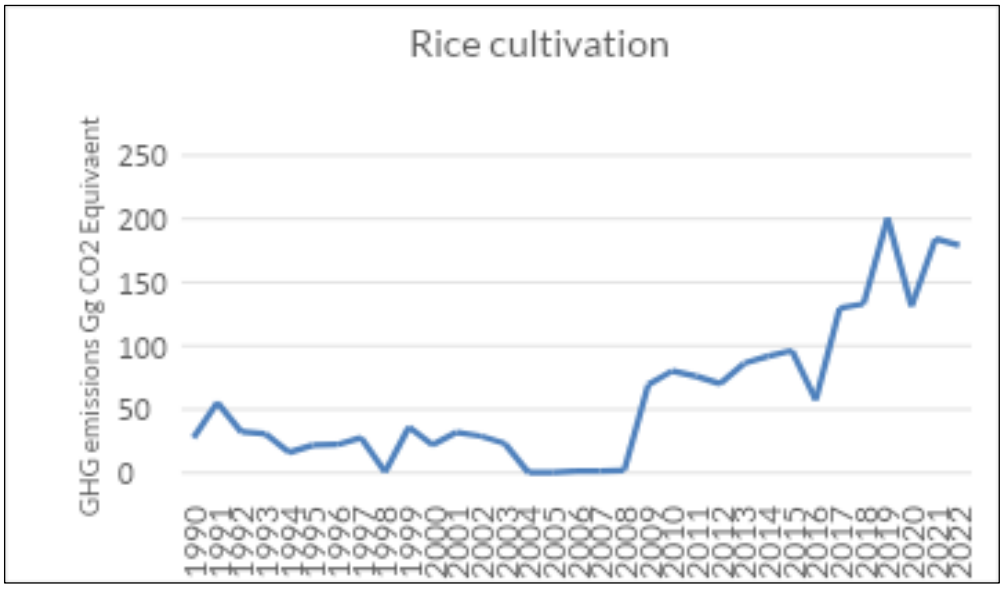


Figure 2.70: Emissions from Rice Cultivation

2.3.4.6.5 Quality Assurance/Quality Control Measures

Activity data used in estimating GHG emissions from the AFOLU was obtained from Forest Department (ILUA II data set), ZamStats, and Zambia Revenue Authority (ZRA). Efforts were made to compare data from various sources and compile the most suitable data sets for use in emissions estimates. Efforts were made to check and verify the data from all sources to ensure good quality data was utilised in the inventory preparation from the AFOLU sector.

2.3.4.6.6 Sectoral Uncertainties

The Uncertainty Analysis (UA) was estimated using approach 1 and computed using the IPCC 2006 software and is provided in Annex I. Data for estimating emissions in the Land category was obtained from the ILUA data and ZamStats with uncertainty of ±5%.

2.3.4.6.7 Planned Improvements

Data Gaps

a) There is a lack of data on biomass burning on cropland in terms of areas specific to crop types. This problem can be addressed through the use of remote sensing to map cropland in terms of crop types with the help of field surveys.
b) There is no data on crop residue management practises practices among farmers across the country. This poses challenges to emissions estimations from crop residues. There is a need to conduct a survey to establish crop residue management practices across the country.
c) Lime data collected through the Crop Forecast Survey by the Ministry of Agriculture and CSO does not distinguish the lime as dolomitic or calcitic. Additionally, it appears that the data is underreported in terms of quantities used. Future Crop Forecast surveys should categorize agriculture lime as calcitic or dolomitic and endeavor to address the problem of underreporting.

Improvements

a) The annual crop forecast survey conducted by the Ministry of Agriculture and CSO need to be customised to the data requirement of the GHG inventory where there are data gaps in the survey.
b) There is a need to establish country-specific emission factors.
c) The crops must be studied inclusive of the crop-watch softwares and google real time images. While for fertilizers real data from both the farms and suppliers must be used to come up with exact estimates.
d) Activity data collection on cropland should be customised to the requirement of the GHG inventory.
e) There is a need to produce annual cropland maps, with fine resolution and crop type mapping, to monitor fires and cropland expansion.,

Propose Emission Factor and Activity Data Research Areas/Projects for Inventory Improvement Projects

a) There is a need to conduct research/projects to establish country-specific emission factors for emissions from aggregate sources and non-CO2 emissions on land.

b) There is need to invest in research that generates country specific emission factors. Further, detailed livestock surveys, including its management systems are required to graduate to Tier 2 methodology for GHG emissions from the livestock sector. Additionally, there is need to update the existing soil map using the latest ILUA II data as well as to enhance the forest classification from 5 to 17, including enhancement of data collection on forest disturbance. There is also need for improvement in data collection for fertilizer and lime use by commercial farmers

c) There is need to invest in research that generates country specific emission factors. Further, detailed livestock surveys, including its management systems are required to graduate to Tier 2 methodology for GHG emissions from the livestock sector. Additionally, there is need to update the existing soil map using the latest ILUA II data as well as to enhance the forest classification from 5 to 17, including enhancement of data collection on forest disturbance. There is also need for improvement in data collection for fertilizer and lime use by commercial farmers.

2.3.5 Waste

2.3.5.1 Overview

According to the Environmental Management Act No. 12 of 2011 as read together as one with the Environmental Management (Amendment) Act No. 8 of 2023, Solid waste in Zambia is managed and regulated by the Local Authorities under the supervision of Ministry of Local Government and Rural Development (MLGRD) and is responsible for regulating solid waste under the Solid Waste Regulation and Management Act No. 20 of 2018. The Act shifted the regulatory responsibility for solid waste management from ZEMA to the MLGRD. MLGRD provides for overall oversight by setting national policies and standards. Local authorities are responsible for implementing these policies and managing waste collection, transportation, and disposal within their jurisdictions.

Despite the regulatory framework in place the sector experiences significant challenges driven by rapid urbanisation, population growth, limited infrastructure, and inadequate waste management services. For a developing country like Zambia, municipal solid waste management plays a key role in ensuring accelerated development, public health, socio-economic and environmental protection.

Urbanisation and Population Growth

The preliminary findings of the 2022 Census of Population indicate Zambia's population was estimated at 19,610,769, with an average annual growth rate of 3.4%. Compared to 2010, the population and average annual growth rate increased from 13,092,666 and 2.8% respectively. This represents a 49.8% increase in population. The average annual growth increased from 2.8% between 2000 and 2010. Zambia has experienced a rapid increase in urban populations, particularly in metropolitan cities such as Lusaka, Ndola, Kitwe, and Livingstone. Smaller transit towns, such as Choma, Kabwe, Kapiri Mposhi, and Petauke, have also seen an increase in population by 55%, 51.1%, 59.5% and 62.8% respectively. Arguably this population increase can be attributed to the growth of economic activities to meet the demands of transit towns.

The urban population expansion has resulted in increased waste generation, placing a significant strain on municipal waste management systems. These systems face financial and infrastructure limitations, making it difficult to keep up with the increased demand for waste disposal services. The resultant effect has been inadequate municipal solid waste disposal, burning and burying of waste, in both formal and informal settings. Cities and town streets are visibly choked with piles of waste before collection.

Waste Collection and Transportation

Historically, municipal solid waste has been collected directly by local authorities using equipment i.e. tractors and tipper trucks. Occasionally, some local authorities such as, Lusaka, Livingstone, Kitwe, Ndola, Chipata and others have received support from the MLGRD in terms of equipment such as skip trucks, compactors trucks and tipper trucks for waste collection. The collected waste is then transported to final disposal sites, mostly un-engineered sites commonly known as dumpsites, where crude dumping or un-engineered dumping is practiced. The sector has been inundated with or by informal waste collectors, often using end of life state of equipment leading inefficiency and haphazard collection systems. This results in accumulation of waste in compounds, residential areas among others.

Disposal Sites

Zambia has 116 districts, towns and cities with more than 99% of these using disposal sites that are not engineered and thus practice crude dumping. Regulation of access to these sites is inadequate causing women, children and the old accessing these dumps to recover valuable materials for sale. The lack of engineered disposal sites is mainly due to limited finances to construct such infrastructure that protects public health and the environment from hazards as a result of waste disposal. This may contribute to the risk of disease outbreaks and extensive underground water contamination from the leachate at these sites. Limited finances to support sustainable maintenance regime have led to limited equipment lacking appropriate equipment such as bull dozers, excavators and front-end loaders for managing these sites. This is worsened by inadequate sanitation infrastructure and welfare for personnel found at these sites. On average, waste disposed at disposal sites is relatively low, around 30% of the annual generated quantities.

Waste Recycling

The recycling sector in Zambia has experienced some growth, providing jobs for thousands in both the formal and informal sectors. However, recycling remains underdeveloped, with only a small percentage of the total waste generated being recycled. The lack of a national recycling policy, infrastructure, and incentives has stifled the growth of the recycling industry. There have been isolated efforts to increase recycling rates, such as the installation of a Material Recovery Facility (MRF) at Longacres Market in Lusaka, which utilizes organic waste from restaurants. This initiative, in partnership with BORDA Zambia and the Lusaka Integrated Solid Waste Management Company, highlights the potential for recycling organic waste into compost and other by-products. However, the recycling of plastics, metals, and other waste streams remains limited, contributing to the increased volume of waste destined for dumpsites.

Liquid Waste

Liquid waste in Zambia is regulated primarily by the National Water Supply and Sanitation Council (NWASCO) and ZEMA (Act No. 28 of 1997; Act No. 12 of 2011). NWASCO, established in 1997, has the primary mandate to regulate water supply and sanitation services, including Commercial Utilities (CUs) and Private Schemes. Its oversight extends to onsite sanitation and faecal sludge management, within the country. Wastewater is generated by both domestic and industrial activities. In other cases, waste water is collected at individual households and company sites and delivered to the municipal sewage system where it is mixed with network sewage. However, the transportation of domestic and industrial wastewater is not separated because the system of transportation is combined[67]

There are a total of 11 water commercial utilities (CUs) operating in all the ten (10) provinces of Zambia. The CUs are the main providers of waste water treatment services to urban and peri-urban areas. The CUs were formed by Local Authorities (LAs) following the 1994 - 1997 Water Sector Reforms. The reforms provided for the formation of joint ventures by Local Authorities to provide water supply and sanitation services and established the National Water Supply and Sanitation Council as a service regulator[68] . However, despite the numerous gains that were achieved through the reforms, there has been inadequate investment focusing on wastewater treatment facilities. This is due to inadequate allocation of funds in the national budget. In addition, the sector is perceived to be less lucrative to attract private sector investment.

Most of the infrastructure were constructed more than over 60 years ago and have been inadequately maintained and developed resulting in absolute and insufficient existing infrastructure for sanitation systems in both old and new areas[69]. As though this is not enough, where these facilities are in existence, critical components such as bulk meters at inlet and outlet points are either broken or missing rendering such facilities unreliable for primary data capture. This is also coupled by new challenges emanating in the sector such as encroachment of land harboring waste-water treatment facilities by illegal land developers due to rapid population growth and a in adequate of enforcement of Laws by Local Authorities. As such, compliance on the number of samples done, volume and quality of effluent discharged to the environment barely meets minimum requirements as demanded by ZEMA.

[67] (GRZ, 2011). GRZ. 2011. National Urban Water Supply and Sanitation (2011-2030): MLGH.
[68] NWASCO. (2016). Sector Report. NWASCO.
[69] GRZ, 2011). National Urban Water Supply and Sanitation (2011-2030): MLGH

2.3.5.2 Methodology

This section provides respective emissions, activity data and emission factors and methodologies for solid waste disposal, Incineration and Open Burning of Waste, and Wastewater Treatment and Discharge categories.

Solid Waste Disposal

Treatment and disposal of municipal, industrial and other solid waste produces significant amounts of methane (CH_4). Biogenic CO2 and NMVOCs, N_2O, NOx and CO are also produced in SWDS. Methane was the dominant gas in the solid waste disposal.

The estimations in this category were made using Tier 1(Equations 2.39-2.41) based on the IPCC First Order Decay (FOD). This method assumes that the decaying organic component (degradable organic carbon) in waste decays slowly throughout a few decades, during which methane is formed. The FOD method requires data on solid waste disposal amounts and composition to be collected for at least 50 years. Zambia does not have 50 years of historical statistical data or equivalent data on solid waste disposal and as such, estimates were made using surrogates, extrapolated with population and GDP.

$$CH_{4\ generatedT} = DDOCm_{\ decompT} * F * 16/12 \qquad \text{Equation 2.39}$$

Where: $CH_{4\ generatedT}$ = amount of CH_4 generated from decomposable material; $DDOCm_{\ decompT}$ = DDOCm decomposed in year T, Gg; F = fraction of CH_4, by volume, in generated landfill gas (fraction); 16/12 = molecular weight ratio CH_4/C (ratio).

$$DDOCma = DDOCmd_T + (DDOCma_{T-1} * e^{-k}) \qquad \text{Equation 2.40}$$

$$DDOCm_{\ decomp\ T} = DDOCma_{T-1} * (1 - e^{-k}) \qquad \text{Equation 2.41}$$

Where**:** T = inventory year, $DDOCma_T$ = DDOCm accumulated in the SWDS at the end of year T, Gg; $DDOCma_{T-1}$ = DDOCm accumulated in the SWDS at the end of year (T-1), Gg.

Incineration and Open Burning of Waste

The Tier 1 method (Equation 2.42) was used in estimating emissions under this category. Data on the amount of waste incinerated/open-burned was used together with default data on characteristic parameters (such as dry matter content, carbon content and fossil carbon fraction) for different types of waste (MSW, sewage sludge, industrial waste and other waste such as hazardous and clinical waste). The calculation of the CO2 emissions is based on an estimate of the amount of waste (wet weight) incinerated or open-burned taking into account the dry matter content, total carbon content, fraction of fossil carbon and oxidation factor.

$$CO_{2\ Emissions} = \sum_i \ (SW_i * dm_i * CF_i * FCF_i * OF_i) * 44/12 \qquad \text{Equation 2.42}$$

Where**:** $CO_{2\ Emissions}$ = CO_2 emissions in inventory year, Gg/yr; SW_i = total amount of solid waste of type i (wet weight) incinerated or open-burned, Gg/yr; dm_i = dry matter content in the waste (wet weight) incinerated or open-burned, (fraction); CF_i = fraction of carbon in the dry matter (total carbon content), (fraction); FCF_i = fraction of fossil carbon in the total carbon,

(fraction) OFi = oxidation factor, (fraction) 44/12 = conversion factor from C to CO_2 ; i = type of waste incinerated/open-burned

Clinical waste and cremation are the only category that was used to determine the emissions from incineration because of lack of data for the other categories mentioned in the IPCC guideline. The amount of Health Care Waste incinerated was determined using the average for the generation rate per patient per day depending on the type of health facility and the number of hospital beds. Default values were used for the Dry matter content, fraction of carbon in dry matter, fraction of fossil carbon in total carbon and oxidation factor.

Under open burning an average between peri-urban and urban area of per capita waste generation rate was used. According to the 2015 Living Conditions Monitoring Survey, 68% of the population use pits to manage waste and based on expert judgement, what goes into pits is usually burnt as per current practice. A default value from the IPCC Guidelines was used to determine the fraction of the waste amount burned relative to the total amount of waste treated.

Wastewater Treatment and Discharge

The Tier 1 method (Equation 2.43) was used to estimates emissions and applies default values for the emission factor and activity parameters for estimating CH_4 and N_2O emissions. This method is considered good practice for countries with limited data.

$$CH_{4\ Emissions} = \{\sum_{ij} \quad (U_i * T_{ij} * EF_j)\} * (TOW - S_i) - R \qquad \text{Equation 2.43}$$

Where: CH_4 Emissions = CH_4 emissions in inventory year, kg CH_4/yr; TOW = total organics in wastewater in inventory year, kg BOD/yr; S = organic component removed as sludge in inventory year, kg BOD/yr; U_i = fraction of population in income group i in inventory year,; $T_{i,j}$ = degree of utilisation of treatment/discharge pathway or system, j, for each income group fraction i in inventory year; i = income group: rural, urban high income and urban low income; j = each treatment/discharge pathway or system; EF_j = emission factor, kg CH_4 / kg BOD R = amount of CH_4 recovered in inventory year, kg CH_4/yr.

2.3.5.3 Activity Data

Waste Generation Rates

In 2022, Zambia's population was estimated at 19,610,769 and per capita household waste generation (kg/day) in Zambia ranged from 0.413 to 0.859, with an average of 0.564[70]. Thus, the total Municipal Solid Waste (MSW) generated in the city in a day (House - Holds (HH) + Institution + Commercial + others like streets and parks) were estimated to 0.673 kg/day. Based on the 0.673 kg/day per capita waste generation rates and the population in 2022, the total MSW in the surveyed municipalities (38 towns) was 7,444 tons/day, with 5,726 tons/day from households, representing about 77% of the MSW generated, compared to 1,722 tons/day generated from institutional and commercial establishments, representing approximately 23%. Of the waste generated, only 15% of MSW, amounting to 1,117 tons/day, is either recovered or recycled.

[70] ZEMA, 2024)

Overall, only 3,006 tons/day are collected and disposed of at disposal facilities, representing only 40 % of waste disposed. The largest category in household (residential) waste is organic waste (59.60%), followed by plastic (11.35%), sanitary pads and diapers (10.36%), Glass (6.42%) and inert material that constitutes mainly sweeping in households accounted for 4.70%, while remaining fractions are negligible. From these results, approximately 60% of the residential waste disposed of in Zambia is degradable and will produce methane when disposed of.

Actual waste data was not used in the greenhouse gas inventory estimations because the data collected was inadequate. There were inconsistencies in the available data submitted by organisations and also the data was incomplete. Waste data estimations were done using other available data. These were

1) For solid waste generation disposal, peri-urban and urban population and gross domestic product per year was used to estimate solid waste generation at 0.146 kg per capita
2) Incineration of clinical waste, number of hospital beds per year were used to calculate health care waste generated at a generation rate of 0.2 kg per person per day
3) For open burning, a default factor of 0.6 from the IPCC software was applied of total solid waste generated
4) For domestic water, the default factor from the IPCC software was used.

Generally, the emissions from waste have consistently increased due to economic growth. Most waste disposal sites country wide are unmanaged shallow with depths less than 5 metres. For a few towns (i.e., Lusaka and Luanshya) that are designed to be managed waste disposal sites, they do not operate as such due to poor waste management practices and have been classified under 'unmanaged waste disposal sites'.

Activity data on population, fraction of waste disposed in landfills, per capita waste generation, were used to estimate emissions from waste disposal sites. Figure 2.71 presents the trend and amount (kilo tonnes) of waste disposed in solid waste disposal sites.

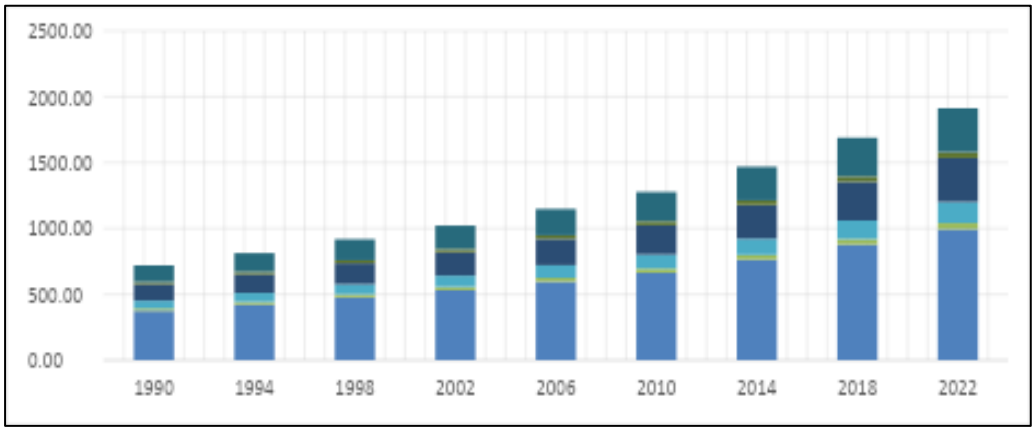


Figure 2.71: Quantities of Solid Waste (tonnes/yr) Openly Burnt by Waste type

Provided in Table 2-43 is waste characterization data used in the estimation of the emissions. Waste generation was 146 kg/capital.

Table 2-43: Solid Waste Characterisation in Percentages

Food Waste	Garden	Paper	Wood and Straw	Textiles	Disposable nappies	Plastics and other inert
32.7	5.45	19.07	13.63	8.17	2.72	18.26

Source: Ministry of Local Government

Biological Treatment of Solid Waste

Biological treatment of waste has not been occurring for the period of the time series and hence emissions were not estimated for this source.

Incineration and Open Burning of Waste

The activity data used to estimate emissions under this category included the population, fraction of the population practicing burning waste and the per capita waste generation. were used in the emissions for open burning of waste. In case of incineration, data on clinical waste was used. Figure 2.72 provides the quantities (tonnes) of solid waste openly burnt disaggregated by type.

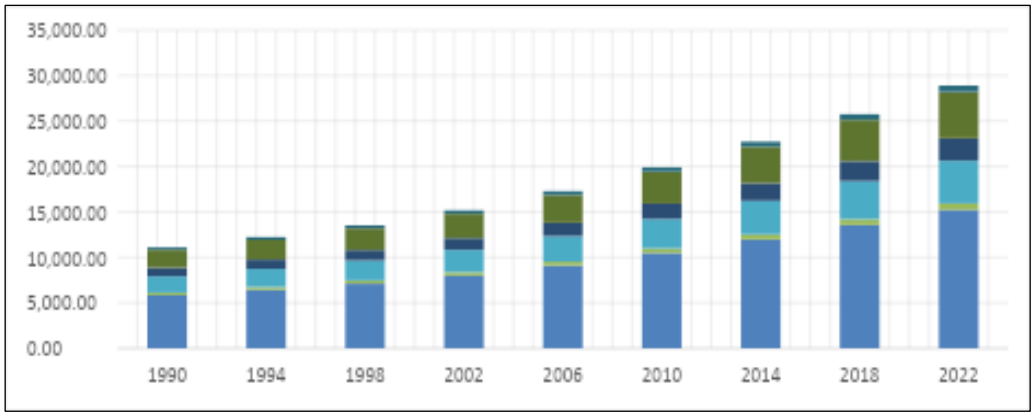


Figure 2.72: MSW Openly Burnt (tonnes/yr)

Wastewater Treatment and Discharge

The activity data for this source category was the total amount of organically degradable material in the wastewater (TOW) (Figure 2.73). This parameter is a function of human population and BOD generation per person. It is expressed in terms of biochemical oxygen demand per annum (kg BOD/year). The average value used was 13.24 kg BOD/year per capita. Maximum methane producing capacity - BO [kg CH4/kg BOD] was 0.6. The activity data used to estimate emissions was the population using various wastewater disposal systems including pit latrines, sewer system and/ or septic tanks, as provided in figure 2.73.

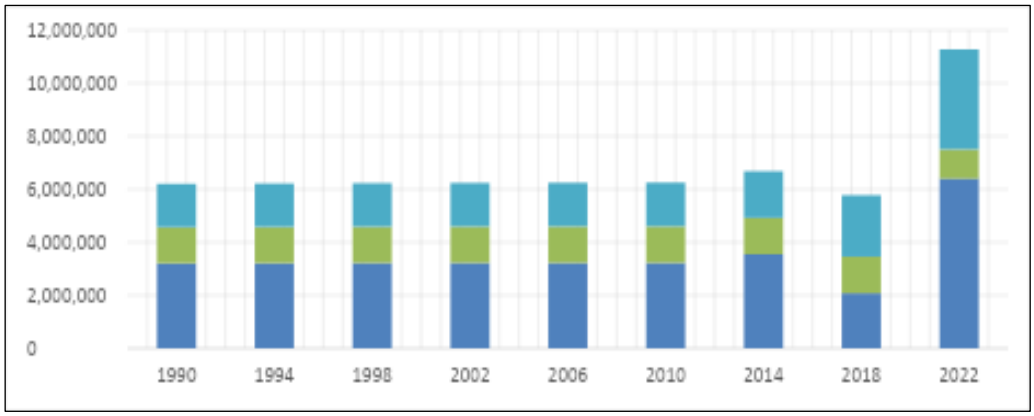


Figure 2.73: Population using Various Waste Treatment System

There was a steady increase in the population that was serviced during the period under review. However, the volume of wastewater treated was inconsistent due to non-submission of accurate data by some commercial utilities. This was attributed to defective or missing meters and dilapidated infrastructure at the treatment facilities.

The availability of data on the number of pit latrines and population served by the commercial utilities was not consistent and had numerous gaps. Therefore, the activity data required for this purpose was estimated using expert judgement and literature from the available Central Statistics Office reports. The assumptions made were as follows:

a) The number of persons per household was estimated to be six (6), based on the WHO/UNCEF Joint Monitoring Programme (JMP) standard set of household categorization. The number of households was estimated by dividing the number of persons per household with the population.
b) The average households using pit latrine was estimated to be 74.8 percent, based on the 2015 Living Conditions Monitoring Survey report.

2.3.5.4 Waste Sector Emissions

GHG emissions from the Waste sector were calculated from solid waste disposal, incineration and open burning of waste and wastewater treatment and discharge. Methane (CH_4) emissions from Solid Waste Disposal Site (SWDS) are the largest source of GHG emissions in the Waste Sector. Methane (CH_4) was also emitted from wastewater treatment and discharge. Carbon Dioxide (CO_2) and Nitrous Oxide (N_2O produced during incineration and open burning of waste containing fossil carbon (e.g., plastics) are the primary sources of emissions in the Waste Sector. Emissions from Biological treatment of solid waste were not calculated because the activity does not occur in Zambia. The emissions in the Waste sector increased by 145% from the base year (1990) of 854.9 $GgCO_2eq$ to 2.094.58 $GgCO_2eq$ in the current year (2022) as presented in Figure 2.74.

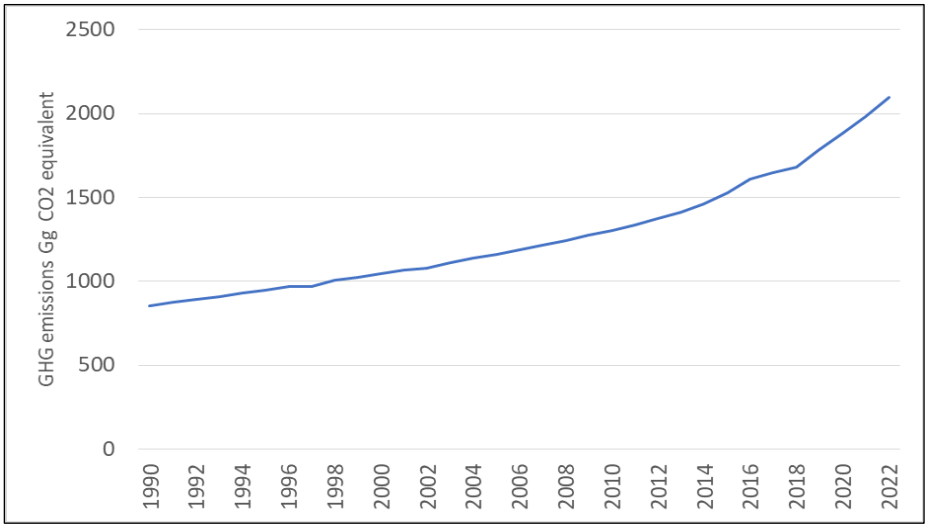


Figure 2.74: GHG Emission Trends in the Waste Sector

2.3.5.4.1 Emissions Trends by Categories

Since 1990 across the time series, solid waste has been the highest source emissions followed by wastewater as presented in Figure 2.75.

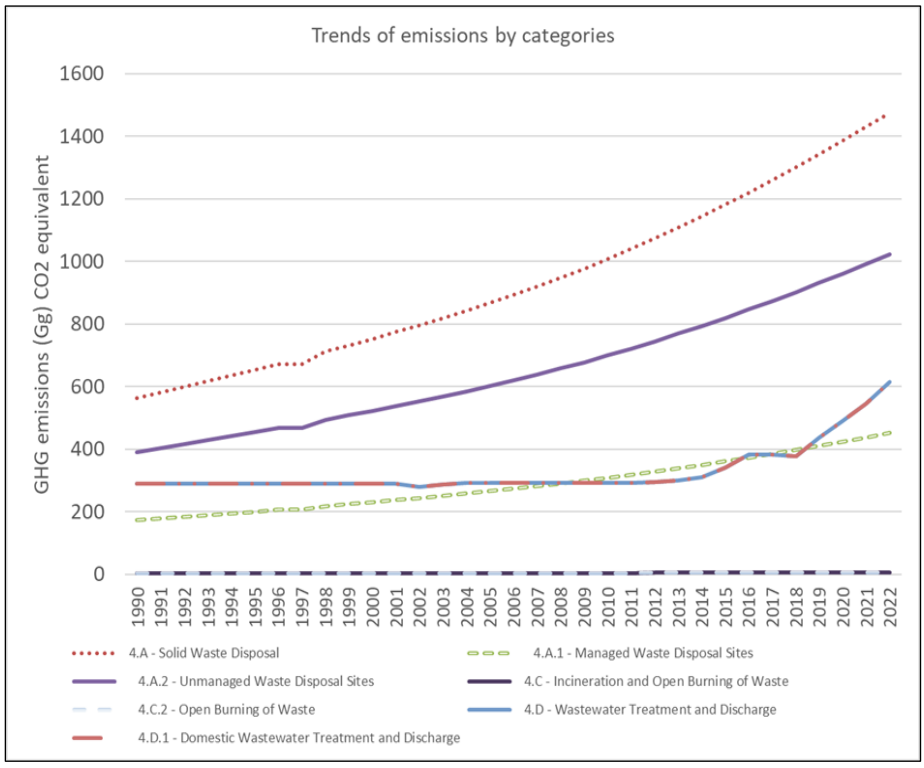


Figure 2.75: Trends of GHG Emissions by Category

Solid Waste Disposal emissions increased from 563.1 in the base year (1990) to 1,474.4 $GgCO_2eq$ in current year (2022). Incineration and Open Burning of Waste increased from 2.42 to 6.29 $GgCO_2eq$ during the same period. Biological Treatment of Waste was non- occurring.

With regards to wastewater Treatment and Discharge, emissions increased from 289.5 in the base year (1990) to 618.9 $GgCO_2eq$ in the current year (2022). (Table 2-44).

Table 2.44: Trends of GHG Emissions by Category ($GgCO_2eq$)

	4.A - Solid Waste Disposal	4.A.1 - Managed Waste Disposal Sites	4.A.2 - Unmanaged Waste Disposal Sites	4.C - Incineration and Open Burning of Waste	4.C.2 - Open Burning of Waste	4.D - Wastewater Treatment and Discharge	4.D.1 - Domestic Wastewater Treatment and Discharge
1990	563.1	172.4	390.7	2.4	2.4	289.5	289.5
1991	580.8	177.8	403.0	2.5	2.5	289.6	289.6
1992	598.6	183.3	415.4	2.5	2.5	289.7	289.7
1993	616.8	188.8	428.0	2.6	2.6	289.9	289.9
1994	635.1	194.4	440.7	2.7	2.7	290.0	290.0
1995	653.7	200.1	453.6	2.7	2.7	290.2	290.2
1996	672.7	205.9	466.8	2.8	2.8	290.3	290.3
1997	672.7	205.9	466.8	2.8	2.8	290.3	290.3
1998	711.7	217.9	493.8	2.9	2.9	290.6	290.6
1999	731.8	224.0	507.8	3.0	3.0	290.3	290.3
2000	752.4	230.3	522.1	3.1	3.1	290.9	290.9
2001	773.6	236.8	536.8	3.2	3.2	290.0	290.0
2002	795.6	243.6	552.0	3.3	3.3	280.5	280.5
2003	818.4	250.5	567.9	3.4	3.4	287.4	287.4
2004	842.1	257.8	584.3	3.5	3.5	291.5	291.5
2005	866.7	265.3	601.4	3.6	3.6	291.6	291.6
2006	892.4	273.2	619.2	3.8	3.8	291.7	291.7
2007	919.3	281.4	637.9	3.9	3.9	291.8	291.8
2008	947.5	290.1	657.5	4.0	4.0	292.0	292.0
2009	977.1	299.1	678.0	4.2	4.2	292.2	292.2
2010	1008.0	308.6	699.4	4.3	4.3	292.2	292.2
2011	1040.2	318.4	721.8	4.5	4.5	291.5	291.5
2012	1073.7	328.7	745.0	4.6	4.6	295.3	295.3
2013	1108.5	339.3	769.1	4.8	4.8	299.0	299.0
2014	1144.4	350.3	794.1	4.9	4.9	309.9	309.9
2015	1181.5	361.7	819.8	5.1	5.1	341.2	341.2
2016	1219.9	373.4	846.4	5.3	5.3	382.1	382.1
2017	1259.4	385.5	873.9	5.4	5.4	383.1	383.1
2018	1300.1	398.0	902.1	5.6	5.6	376.9	376.9
2019	1342.0	410.8	931.2	5.8	5.8	435.6	435.6
2020	1385.1	424.0	961.1	6.0	6.0	491.6	491.6
2021	1429.2	437.5	991.7	6.1	6.1	545.4	545.4
2022	1474.4	451.3	1023.0	6.3	6.3	613.9	613.9

In 2022, emissions from Solid Waste Disposal accounted for 70.4% of emissions, Waste-Water Treatment and Discharge was 29.3% and Incineration and open Burning of Waste at 0.3%, Biological Treatment of Waste was non-occurring as presented in Figure 2.76.

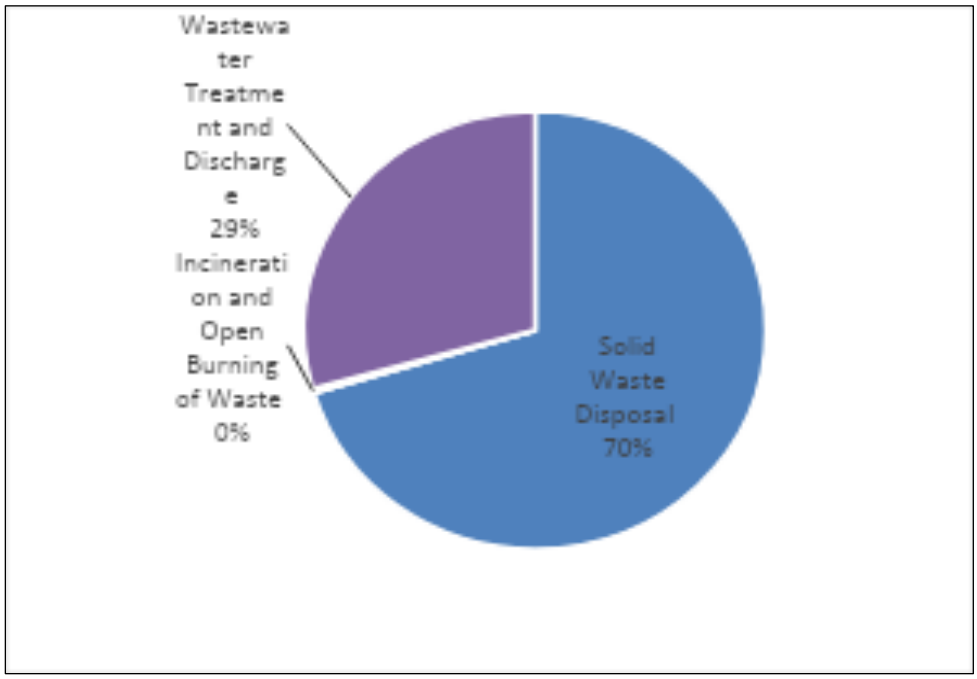


Figure 2-76: Emissions Contributions by Category in 2022

Trends by gas as given in Figure 2.77, indicates that CH_4 increased from 854.6 in the base year 1990 to 2,093.5 $GgCO_2eq$ equivalent in the current year 2022 while CO_2 increased from 0.16 to 0.42 $GgCO_2eq$ during the same period.

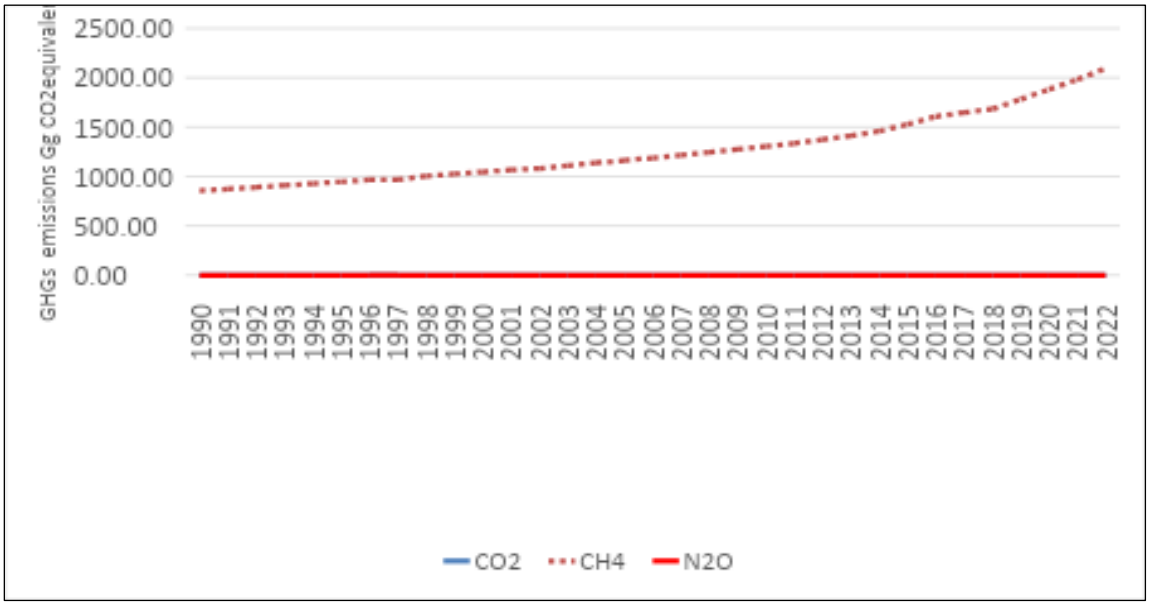


Figure 2.77: GHG Emission Trends by Gas in the Waste Sector

As regards N_2O, it increased from 0.23 in 1990 to 0.61 $GgCO_2eq$ in 2022.

By gas, CH_4 accounted for 99% followed by CO_2 at 0.02%, the least was N_2O at 0.03% as illustrated in Figure 2.78.

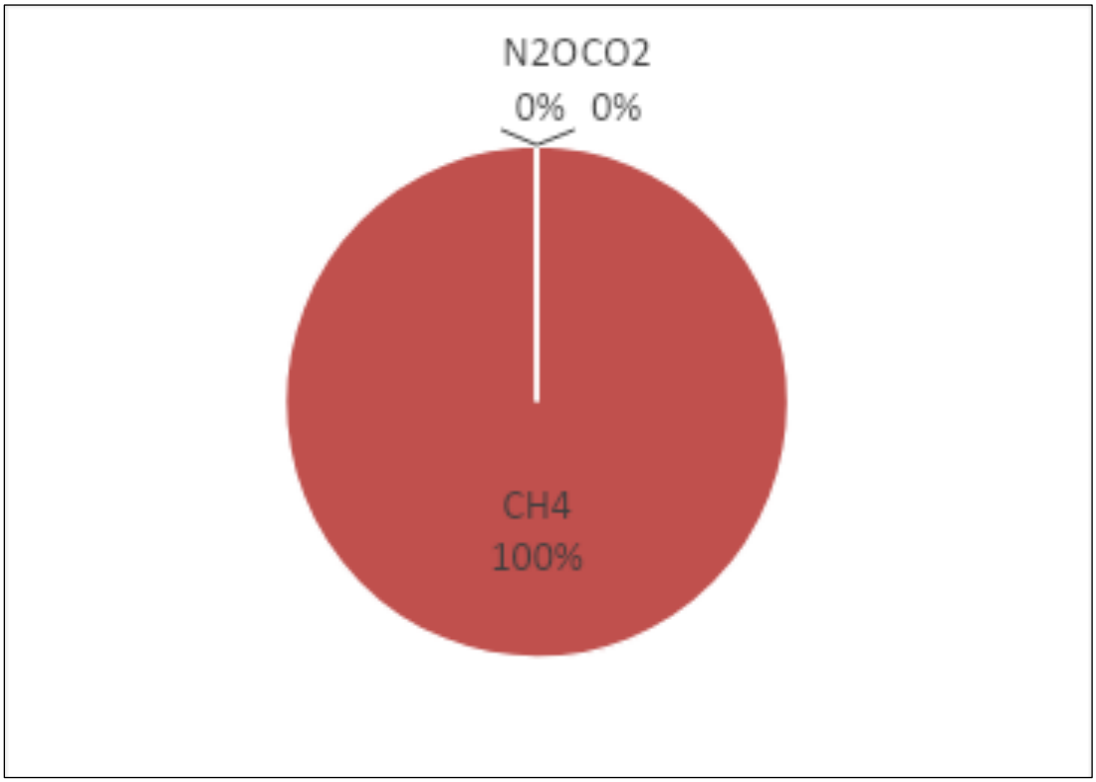


Figure 2.78: GHG Emissions by Contributions by Gas in 2022 in the Waste Sector

Provided in table 2-45 trends of emissions for precursor gas emissions for waste sector.

Table 2-45: Precursor Gases Emissions for Waste Sector

Gas (Gg)	NOx	CO	NMVOCs	SO2
1990	0.035267	0.000619	0.086044	0.00122
1991	0.036176	0.000635	0.088661	0.001251
1992	0.037066	0.000651	0.091304	0.001282
1993	0.037969	0.000667	0.093983	0.001313
1994	0.038902	0.000683	0.096704	0.001346
1995	0.039866	0.0007	0.099473	0.001379
1996	0.040891	0.000718	0.102305	0.001414
1997	0.041927	0.000736	0.105185	0.00145
1998	0.043025	0.000755	0.108141	0.001488
1999	0.044167	0.000775	0.111172	0.001528
2000	0.045407	0.000797	0.111651	0.001571
2001	0.046787	0.000821	0.117562	0.001618
2002	0.04824	0.000847	0.118124	0.001669
2003	0.049753	0.000873	0.124468	0.001721
2004	0.051246	0.0009	0.128089	0.001773
2005	0.05309	0.000932	0.131968	0.001836
2006	0.054957	0.000965	0.135993	0.001901
2007	0.056933	0.001	0.140217	0.001969
2008	0.059003	0.001036	0.144644	0.002041
2009	0.061138	0.001073	0.149269	0.002115
2010	0.063314	0.001112	0.154086	0.00219
2011	0.065489	0.00115	0.159074	0.002265
2012	0.067687	0.001188	0.164233	0.002341
2013	0.069747	0.001225	0.169493	0.002413
2014	0.072246	0.001268	0.175079	0.002499
2015	0.07459	0.00131	0.175985	0.00258
2016	0.076975	0.001351	0.181684	0.002663
2017	0.079409	0.001394	0.187557	0.002747
2018	0.081878	0.001437	0.198832	0.00011
2019	0.084378	0.001481	0.205185	0.002919
2020	0.08689	0.001525	0.21169	0.003006
2021	0.089394	0.001569	0.218332	0.003092
2022	0.091894	0.001613	0.225103	0.003179

Provided in Table 2-46 on the following page are emissions trends from the Waste Sector by gas.

Table 2-46: Emissions Summary Report for Waste Sector for 2022

Categories	Emissions [Gg]						
	CO_2	CH_4	N_2O	NOx	CO	NMVOCs	SO_2
4 - Waste	0.420	74.770	0.002				
4.A - Solid Waste Disposal		52.655					
4.A.1 - Managed Waste Disposal Sites		16.119					
4.A.2 - Unmanaged Waste Disposal Sites		36.536					
4.A.3 - Uncategorised Waste Disposal Sites		0.000					
4.B - Biological Treatment of Solid Waste							
Composting							
Anaerobic digestion at biogas facilities							
Other							
4.C - Incineration and Open Burning of Waste	0.420	0.188	0.002				
4.C.1 - Waste Incineration	0.000	0.000	0.000				
4.C.2 - Open Burning of Waste	0.420	0.188	0.002				
4.D - Wastewater Treatment and Discharge		21.927	0.000				
4.D.1 - Domestic Wastewater Treatment and Discharge		21.927	0.000				
4.D.2 - Industrial Wastewater Treatment and Discharge		NO	NO				
4.E - Other (please specify)	NO	NO	NO				

2.3.5.4.2 Incineration and Open Burning of Waste

Waste incineration is defined as the combustion of solid and liquid waste in a controlled facility. Types of waste incinerated include: Municipal solid waste (MSW), industrial waste, hazardous waste, clinical waste and sewage sludge. However, in Zambia incineration is mainly done for clinical waste. Emissions from incineration and open burning of waste increased by 160% from 2.42 $GgCO_2eq$ in the base year 1990 to 6.29 $GgCO_2eq$ in the current year 2022 as shown in Figure 2.79.

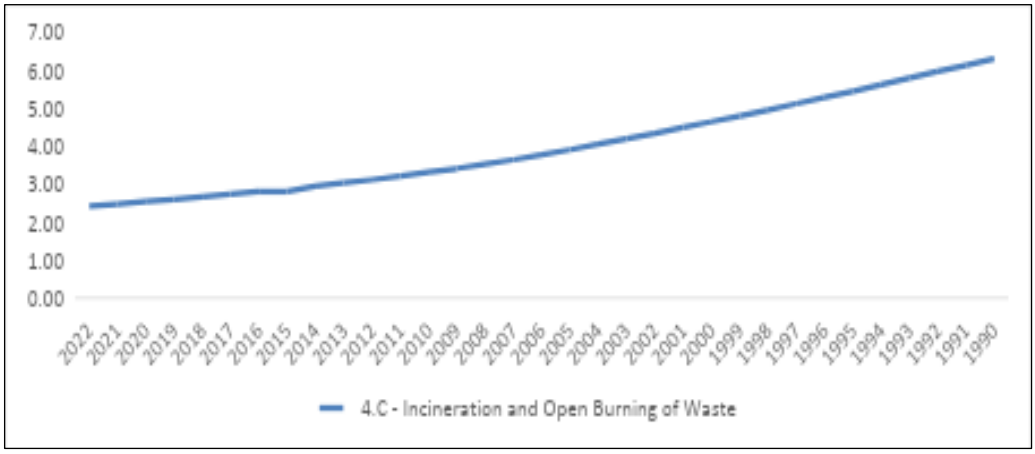


Figure 2.79: Emissions from Incineration

In 2022, by gas, CH_4 was the major contributing gas to emissions under incineration and open burning of waste with 83.6%. Other gases contributing to emissions under this category were N_2O at 9.7% and CO_2 at 6.7%. In Zambia, clinical waste is incinerated and to a small extent cremation is practiced. Cremation in the country is often done by the Asian community for religious reasons. Open burning of waste is a waste management practiced widely in Zambia in both rural and urban areas.

2.3.5.4.3 Wastewater Treatment and Discharge

Wastewater can be a source of CH_4 when treated or disposed anaerobically. It can also be a source of nitrous oxide emissions. Carbon dioxide emissions from wastewater were not considered because these are of biogenic origin and should not be included in national total emissions. Wastewater originates from a variety of domestic, commercial and industrial sources, may be treated on site (uncollected), sewered to a centralised plant (collected) or disposed untreated nearby or via an outfall. Domestic wastewater is defined as wastewater from household water use, while industrial wastewater is from industrial practices only. Domestic wastewater is treated in centralised plants, pit latrines, septic systems or disposed of in unmanaged lagoons or waterways, via open or closed sewers[71].

Total emissions from waste water treatment increased by 112% from 289.45 $GgCO_2eq$ in 1990 to 613.95 $GgCO_2eq$ in 2022. The assessment considered pit latrines, septic tanks and central

[71] IPCC 2006 Guidelines, Chapter 4. Waste Sector

sewer systems in accounting for emissions under this category. Figure 2.80 shows the trend of emissions, in $GgCO_2eq$, during the period under review.

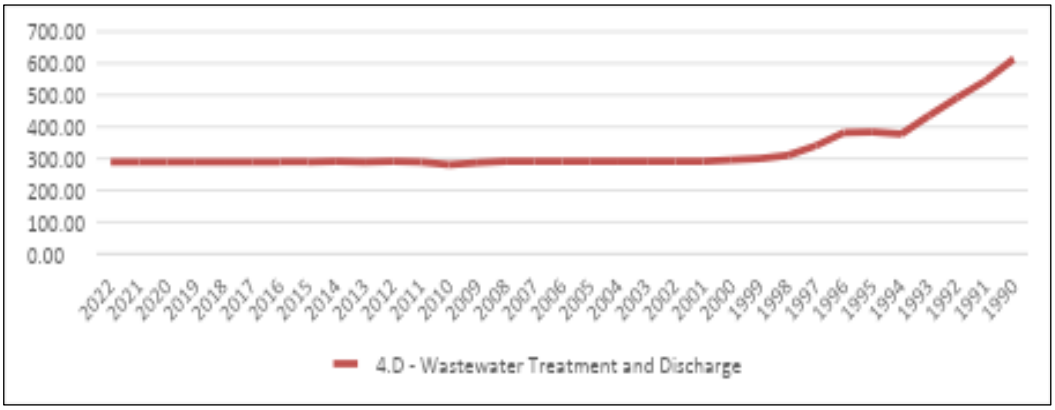


Figure 2.80: Trends of Emissions during the Period under review (Gg CO2 eq.)

2.3.5.5 Quality Assurance/Quality Control Measures

The data used for estimating emissions for solid waste disposal, incineration and open burning of waste were based on population, GDP and per capita waste generation. Data on population and per capita waste generation was obtained from ZamStats. Whilst part of the GDP data was obtained from ZamStats, the other data came from World Economy Report and the World Bank data base**.** Data on wastewater treatment and discharge were based on installed capacities. Default values for Biochemical Oxygen Demand (BOD) generation per capita were used.

2.3.5.6 Waste Sector Uncertainties

The Uncertainty Analysis (UA) for the year 2010 for Waste sector was estimated using approach 1 and computed using the IPCC 2006 software and is provided in Annex II. Data for estimating emissions in the Waste sector was estimated from population, GDP, and other factors to include waste characterization. It was for this reason that the uncertainty was estimated to be ±50%. For wastewater activity data was obtained from installed capacities, thus the uncertainty was estimated at ±30%.

2.3.5.7 Planned Improvements

Gaps on Activity Data Collection, Emission Factors

There were so many gaps in the activity data due to inadequacy of data for all the sub categories. As a result, default values from the IPCC Guidelines and software were used as the sector lacks emission factors in all the sub categories. Generally, activity data collection needs to improve in order to move to higher tiers.

Planned Improvements

There were some data gaps identified in all the sub categories; the notable ones include the following:

1. It was difficult to determine the quantities of waste disposed of as most of the designated dump sites do not have weighbridges to record quantities of solid waste received. There has been no framework to continuously generate and update data on solid waste disposal. The majority of accumulated waste that has been accumulated on land or burned was difficult to account for. This problem can be addressed if there could be a system, programme or strategies developed to segregate waste at household, company, market and waste disposal site levels. Further, there is a need to have functional weighbridges to collect quantities of waste dumped.

2. Biological waste treatment. There was no available data on biological waste treatment subcategory. This problem can be addressed if there could be a system or programme developed to collect data on waste composting or sludge digestor.

3. There was no data on quantities of waste incinerated and cremated. Therefore, there is a need to develop a strategy or programme for the collection of waste incinerated and cremated. There is also need to conduct surveys on types and conditions of incinerators used in health care facilities and the temperatures at which healthcare waste is being incinerated. Further, there is a need to conduct studies on different institutions that incinerate their waste.

2.4 Conclusions

This GHG Inventory covers the period 2017 to 2022 with re-calculation from 2016 back to the base year (1990). The GHG emissions were estimated in accordance with the IPCC 2006 Guidelines and its 2019 refinements (tiers 1 and 2 appropriately) using the IPCC software, version 2.930.8992.13493 released on 14th August 2024. Further, the assessment relied on the European Environment Agency EMEP/EEA air pollutant emission inventory guidebook 2023 for estimation of precursor gases. The inventory preparation process was accompanied by dedicated quality control to ensure use of acceptable quality data across all inventory sectors.

The assessment reviewed that Zambia remained a net sink for the years 1990 to 2006 and transitioned into a net source in 2007 and it remained a net source for all the years to 2022. The country's total GHG emissions (with AFOLU) stood at 216,629.3 $GgCO_2eq$ in 2022, representing an increase of 116.3% against the 1990 base year. The GHG removals (sink) reduced by 2.6% from -164,745.1 $GgCO_2eq$ in 2022 to -160,443.0 $GgCO_2eq$ in the base year (1990). The net GHG emissions indicate that Zambia was a net Sink for the period 1990 to 2007 and a net source from 2007 to 2022.

In 2022, most of the GHG emissions existed as CO_2 (87%) followed by CH_4 at 11%, N_2O was 2% while HFC and SF_6 were negligible. Contribution of SF_6 and HFC to the emissions was negligible. SF_6 has been largely negligible across all the years. The emissions of CO_2 increased by from 181,269.6 $GgCO_2eq$ in the 1990 base year to 190,541.8 $GgCO_2eq$ in 2022 representing a 5 % increase. In the same period, CH_4, N_2O, and HFCs increased from 9,437.3 $GgCO_2eq$,

633.2 $GgCO_2eq$, 4.3 $GgCO_2eq$ and 0.2 $GgCO_2eq$ in 1990 to 23,296.7 $GgCO_2eq$, 3,561.6 $GgCO_2eq$ and 69.3 $GgCO_2eq$ in 2022, respectively.

In terms of share representation of individual gases, CO_2 continued to be the most dominant gas among the GHGs emitted in Zambia, followed by CH_4 and N_2O. Other gases are HFC and SF_6 from refrigeration and electrical equipment, respectively.

Chapter 3: Information Necessary to Track Progress Made in Implementing and Achieving Nationally Determined Contributions under Article 4 of the Paris Agreement

3.1 Introduction

This chapter provides information necessary to track Zambia's progress in implementing and achieving its Nationally Determined Contribution (NDC) under Article 4 of the Paris Agreement. It presents Zambia's NDC commitments and updates, describes the indicators and methodologies used to assess progress, and outlines the mitigation policies and measures being implemented across key sectors. The chapter also highlights adaptation actions that generate co-benefits for mitigation. The information presented is consistent with the modalities, procedures, and guidelines (MPGs) for the Enhanced Transparency Framework (ETF).

3.2 Description of a Party's Nationally Determined Contribution under Article 4 of the Paris Agreement, Including Updates

The country signed the Paris Agreement on 20th September 2016 and ratified it on 10th November 2016. The Paris Agreement seeks to hold the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels.

Zambia submitted its first NDC on 9th December 2016, highlighting its mitigation and adaptation ambitions based on the country's national circumstances, in line with UNFCCC decisions 1/CP.19 and 1/CP.20. This NDC was submitted with a conditional pledge of reducing GHG emissions by 25% (20,000 $GgCO_2eq.$) by 2030 against the base year of 2010 under the Business-as-usual (BAU) scenario with limited international support, or, by 47% (38,000 $GgCO_2eq.$) with substantial international support. On 30th July 2021, Zambia submitted a revised (and updated) NDC to the UNFCCC pursuant to Decisions 1/CP.19, 1/CP.20, and 1/CP.21 of the Conference of Parties (COP) for countries to enhance their climate ambitions. This NDC revision broadened the scope of sectors under mitigation by adding transport, liquid waste, and coal (production, transportation, and consumption) and elaborated the adaptation component by developing indicators for tracking progress made towards building adaptive capacity and resilience to negative impacts of climate change.

Zambia outlined the approach to implementing its updated ambition in the 2021 NDC through 11 sectors (including mitigation, adaptation and cross-cutting sector). A total of 18 outcome indicators, 135 output indicators and 158 key performance indicators were identified and elaborated in the 2023 NDC Implementation framework. As such, GHG emission reduction

targets were envisaged to be achieved through mitigation actions in six (6) sectors of the economy, including agriculture, forestry, energy , transport, coal and waste.

The adaptation component of Zambia's 2015 NDC focused on increasing adaptive capacity and resilience of strategic productive systems in agriculture, wildlife, and water, strategic infrastructure and health systems, enhanced capacity building, research, technology transfer, and finance. The 2023 NDC Implementation Framework has elaborated further on the adaptation sectors to include Agriculture, Water, Infrastructure, Health and Livestock.

3.3 Determined Contribution under Article 4 of the Paris Agreement Information Necessary to Track Progress Made in Implementing and Achieving its Nationally Determined Contribution

Indicators identified to monitor progress towards the implementation and achievement of the NDC under Article 4 include; adaptation, mitigation and support indicators. These indicators are elaborated further in the following section.

3.3.1 Adaptation Indicators

The adaptation indicators are listed as follows:

a) Water security of all Zambians is promoted and protected, via gender-responsive and climate-smart water infrastructure
b) Strengthened climate resilience of Agricultural production and productivity
c) Enhanced early warning systems
d) Adoption of improved livestock management practices that enhance livelihoods
e) Increased resilience of the health sector to climate change
f) Catchment areas restored

3.3.2 Mitigation Indicators

The mitigation indicators are given for the sectors- energy, forestry, agriculture, and waste and are listed as follows:

a) Energy

- Number of megawatts of electricity generated and supplied into the grid
- Number of bio digesters constructed
- Energy savings in industrial energy efficiency
- Number of efficient cookstoves installed
- Coal consumed
- GHG emissions reduced

b) Forestry

- Number of Hectares of Forests put under Sustainable Forestry Management (SFM)
- Number hectares of forests affected by forest fires (Disturbance)
- Number of Hectares of Forests put under Assisted Natural Regeneration
- Number of Hectares of forests under sustainable charcoal production
- Number of Hectares of forests planted and managed under afforestation and reforestation.

c) Agriculture

- Hectares of land under conservation farming
- Hectares of land under Agro-forestry
- Quantity of efficient fertilizer applied.

d) Waste

- Installed power capacity (MW) based on solid or liquid waste feedstock
- Tonnes of organic waste biologically composited (% of organic waste composted)
- Percentage of municipal solid waste diverted from landfill/incineration.
- Percentage of population with access to formal solid waste collection services.
- Recycling rate (% of total solid waste recycled).
- % Of wastewater treated to national/international standards.
- Volume of wastewater treated using low-emission technologies.

3.3.3 Most Recent Information for Each Selected Indicator

A carbon stock-take was conducted to assess progress in implementing mitigation actions across the energy, agriculture and forestry sectors. The assessment covered the period from 2016 and 2023 and evaluated associated greenhouse gas (GHG) emissions reductions resulting from these actions. Over this period, implemented mitigation measures are estimated to have contributed to cumulative emission reductions of approximately 9,609 $GgCO_2eq$.

This represents a reduction of 25.3% against Zambia's conditional Nationally Determined Contribution (NDC) target of 38,000 $GgCO_2eq$ (subject to substantial international support), and 48.1% relative to the Business-as-usual (BAU) scenario under conditions of limited international support. In 2023, Forestry sector initiatives, particularly those involving Sustainable Forestry Management (SFM) and Assisted Natural Regeneration (ANR) accounted for 66% to the total emissions reductions, followed by energy sector at 27%, and agriculture at 7% (Figure 3.1).

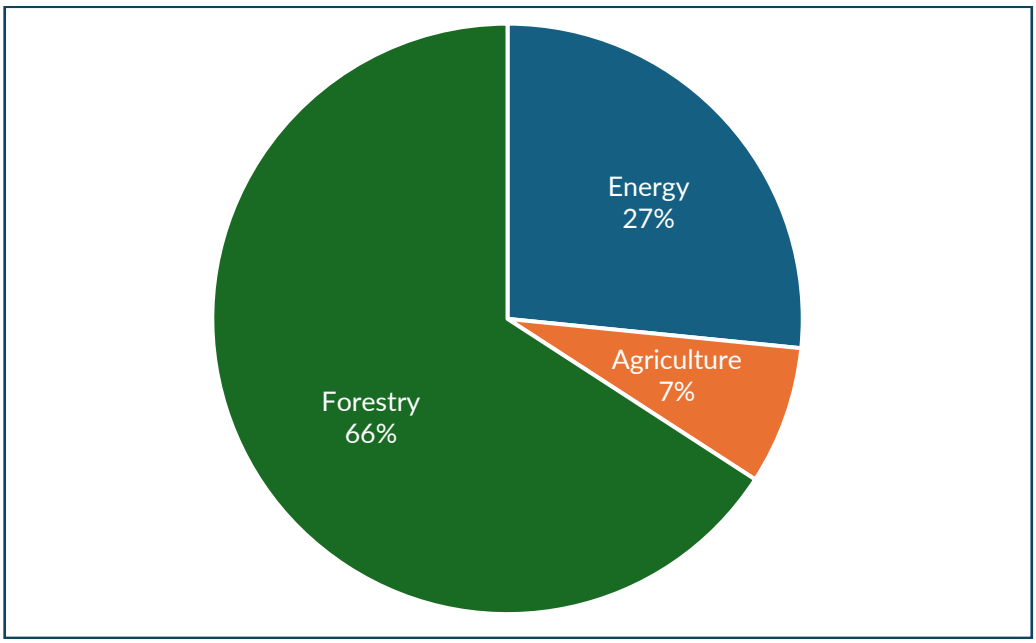


Figure 3.1: Sectoral Contributions to the Total Emissions Reduction

Provided in Table 3-1 is the summary of emissions for energy, agriculture and forestry for the years 2016 to 2023.

Table 3-1: Summary of Emissions for Energy, Agriculture and Forestry for the years 2016 to 2023 (GgCO2eq)

	2016	2017	2018	2019	2020	2021	2022	2023
Energy	14.0	424.7	879.6	862.4	1125.7	1421.1	2506.7	2554.6
Agriculture	702.4	702.0	704.7	714.8	716.0	719.5	720.2	727.4
Forestry	16	1,875	3,554	4,033	5,538	5,544	5,526	6,327
Total	732	3,002	5,139	5,610	7,380	7,685	8,753	9,609

In the energy sector, GHG emission reductions increased significantly from 14.0 $GgCO_2eq$ in 2016 to 2554.6 $GgCO_2eq$ in 2023. Similarly, the agriculture sector recorded a modest increase in emission reductions, rising from 702.4 $GgCO_2eq$ in 2016 to 727.4 $GgCO_2eq$ in 2023. The forest sector showed the most substantial growth, with emission reductions increasing from 16 $GgCO_2eq$ in 2016 to 6,327.0 $GgCO_2eq$ in 2023.

3.3.4 Methodology

This section of the report presents methodologies used in estimating emissions from mitigation interventions. Country specific grid emission factors for renewable energy and energy efficiency were used for estimating emissions reduction and these are provided in
Table 3.2 Sampling Framework.

Table 3-2: Sampling Framework

Grid Emission Factor	Emission Factor (in t-CO2 /MWh)	Source
Grid Emission Factor-wind	0.2614	Grid emission factor for SPAR6C report
Grid Emission Factor-Solar	0.2614	
Grid Emission Factor-Other	0.3734	

Agriculture

For conservation farming, the carbon sequestered in above ground biomass was assumed to be 0.18 Mg carbon per hectare per year which is the mean between the lower and upper bound values (Table 3-3).

Table 3-3: Carbon Sequestration Factor for Conservation Farming

Parameter	Emission factor	Source
Carbon sequestration (t C ha/year)	0.05	Significant build-up of soil organic carbon under climate-smart conservation farming in Sub-Saharan Acrisols Vegard Martinsen a, ∗, Jose Luis Munera-Echeverri a, Alfred Obia b,c , Gerard Cornelissen a,b , Jan Mulder

Global Warming Potential

The global warming potential used was based on the Fifth Assessment Report (AR5).

3.4 Adaptation

3.4.1 Carbon Stock-take

Zambia has continued to implement various adaptation-related measures across all NDC targeted sectors to address climate vulnerability as indicated in the carbon stock-take report. In the energy sector, adaptation initiatives include small hydropower, solar home systems, solar utility scale, and solar mini-grids and promoting of Energy efficiency management programmes (i.e., engaging and sensitizing communities in clean cooking methods and technologies).

In agriculture, conservation farming and agro-forestry, both of which contribute to adaptation and mitigation are being promoted to enhance adaptive capacity. For the water sector, watershed management and borehole drilling for irrigation were identified as key adaptation interventions. Infrastructure related adaptation actions include the construction of climate-resilient roads and the clearing of canals. Despite these efforts, the carbon stocktake study revealed that Zambia's overall resilience and adaptive capacity remain low and require urgent strengthening. This is evidenced by the significant impacts of low precipitation during the 2015/2016 and 2023/2024 rainy seasons, which adversely affected the agriculture, energy and water sectors.

3.4.2 Challenges in Implementing Adaptation Interventions

Low rainfall has resulted in low yields and crop failure, leading to high levels of hunger in many districts. Farmers also lack funds to acquire proper equipment for alternative energy sources that could be used to irrigate their crops. Electricity supply disruptions have further reduced irrigation capacity and contributed to low yields among farmers connected to the national grid. In addition, pests are increasing as a result of prolonged drought conditions.
Despite the availability of seed, the intense droughts experienced in the region led to lower-than-expected crop yields. However, yields were still better among farmers who practiced conservation farming compared to those who did not. Conservation farming enabled farmers to maintain soil moisture, fertility, and structure. The use of early-maturing crop varieties also contributed to ensuring household food availability during the last farming season.

The vulnerability of the roads to extreme weather conditions such as heavy rainfall, flooding and high temperatures has compromised their longevity and safety. Annually, approximately 500 kilometres of roads get damaged due to the effects of Climate Change. The bilateral nature of the Mwenda-Kasomeno Road project between Zambia and the DRC presents challenges such as difficulties in coordination due to differing policies and priorities, and complex funding management. Approximately about 9 - 10 bridges per year since 2016, were damaged or washed away due to increase of the rainfall pattern.

3.4.3 Research and Technology Transfer

During the period under review the country received support from USAID in research and technology transfer through the Tenure and Global Climate Change (TGCC) and USAID SUNTA projects.

Tenure and Global Climate Change (TGCC)

This project kicked off in Eastern Province and in the design of the land certification process, the project developed a mobile application to secure tenure (MAST) tools that included spatial surveys for recording household, village, or resources boundaries and points of interest, land conflicts, and administrative processes.

USAID SUNTA

This project started in February 2019 in Chibombo, Chisamba, Kabwe, Kapiri Mposhi, Kaputa, Kasama, Kitwe, Luano, Luwingu, Mansa, Mbala, Mumbwa, Nchelelenge, Ndola, Ngabwe, Samfya and Shibuyunji. The sectors involved are predominately Agriculture, Livelihoods, Health & Nutrition, and WASH. The initiative in involved in technology development and transfer only through the private sector.

3.4.4 Finance

The World Bank has been providing support towards NDC implementation. Provided below are the adaptation and mitigation actions based on NDC prioritized sectors which the Bank is supporting:

- Transforming Landscapes for Resilience and Development in Zambia (TRALARD): $87.2 million)
- Green, Resilient and Transformational Tourism Development Project (GREAT-TDP): $100 million)
- Zambia Strengthening Climate Resilience (PPCR Phase II)
- Zambia Integrated Forest Landscape Project (ZIFLP)
- Eastern Province Jurisdictional Sustainable Landscape Program - Emissions Reduction Project ((EP-JLSP):
- National Energy Advancement and Transformation Program: $100million
- Zambia Growth Opportunities Program: $300 million
- Irrigation Development Support Project (IDSP)
- Transport Corridors for Economic Resilience (TRACER)
- Scaling-Up Shock Responsive Social Protection Project
- Zambia COMACO Landscape Management
- Zambia Agribusiness and Trade Project
- Zambia Scaling Renewable Energy Program Investment Plan: $300,000 Project documents
- Electricity Service Access Project: $33.5 million– Project documents

USAID Zambia, launched a national multisectoral project launched in 2024 called "Mobilizing Finance for a Resilient Zambia Activity (MFRZA)" estimated at USD $2 million. The initiative aimed to leverage USAID's resources to create a pipeline of high-quality bankable projects that delivered meaningful climate resiliency and adaptation benefits to local communities. MFRZA will work with local Zambian private sector entities to increase their capacity to access climate finance.

3.5 Mitigation Policies and Measures, Actions and Plans, Including Those with Mitigation Co-benefits Resulting from Adaptation Actions and Economic Diversification Plans, Related to Implementing and Achieving a Nationally Determined Contribution Under Article 4 of the Paris Agreement

Zambia has continued to re-affirm its commitment towards the global fight against climate change through various measurable efforts aimed at creating an enabling environment for implementation of climate actions, reflected in the country's governance, political support, legal reforms and financial incentives, among others which are elaborated below.

3.5.1 Political Support and Commitment

Zambia's commitment is enshrined in its governance structure and decisive political support to initiatives targeted at mitigation and adaptation outcomes. In 2021, government created the

Ministry of Green Economy and Environment (MGEE) mandated to "promote effective and sustainable use of the environment, while also facilitating support for adaptation, and mitigation of climate change". This has streamlined government's function by creating a dedicated oversight on the need to combat climate change. Further, during the period under review, the government continued to champion bilateral and multilateral ties aimed at fostering reduction of GHG emission, increasing resilience, and promoting environmental protection and sustainability.

At sub-national provincial level, Government was considering a multi sector approach in achieving sustainability and resilience against climate shocks and restoration of natural resources. Similarly, at district level, there exists a shared concern regarding the impacts of climate change on local communities in both rural and urban areas, thereby calling for the following initiatives;

- Capacity Building: This emphasizes and advocates for capacity building at district and local authority level to enhance Measuring, Reporting and Verification (MRV) measures.
- Bottom-up Approach: This emphasizes the importance of engaging local communities in climate change initiatives, highlighting that participation and community engagement from the grassroots enhanced ownership and sustainability.

3.5.2 Legal and Regulatory Environment

During the period under review, Zambia continued to refine its legal and regulatory framework with a view to facilitate implementation of climate change activities. Table 3-4 provides a list of some key policies, strategies, plans and frameworks developed and/ or revised, during the period under consideration, which support climate actions in Zambia. Overall, these provisions seek to promote the sustainable utilisation of natural resources as the country pursues its climate change adaptation and mitigation actions in tandem with the country's development aspirations.

Table 3-4: Key Policies and Strategies

Name	Classification	Objective	Action/ Year
Forest Act	Act	To offer a conducive legal framework for Sustainable Forest Management while recognising the forest as being central to sustainable development, climate change mitigation and adaptation, and biodiversity conservation.	2015
National Policy on Climate Change	Policy	To support actions aimed at mitigating and adapting to the impacts of climate change and promote green-growth across all sectors of the economy.	Developed in 2016
National Guidelines for Community Forestry In Zambia	Guidelines	To provide a framework for strengthening the stewardship of forests on customary land through communal control, use, and management.	Developed in 2018
Community Forestry Management Regulations	Regulation	To support the decentralization of forest management by empowering local communities to take an active role in managing forest resources on customary land	Developed in 2018
National Energy Policy	Policy	To achieve optimal energy resources utilization to sustain the country's needs, at the lowest economic, financial, social, environmental and opportunity cost	Revised in 2019
8th National Development Plan	Plan	Outlines the vision, objectives, policies and strategies for socio-economic transformation and improved livelihoods in Zambia. The plan is anchored on 4 key pillars which includes environmental sustainability.	Revised in 2021
Renewable Energy Strategy and Action Plan	Strategy	Aimed at increasing the share of renewable energy in the national energy mix.	Developed in 2022
Energy Efficiency and Action Plan	Strategy	Intended to promote efficient use of energy.	Developed in 2022
National Adaptation Plan	Plan	Lays out a framework for integrating climate change adaptation into medium and long term development planning in various sectors.	Developed in 2023

National Green Growth Strategy	Strategy	aims at integrating green growth principles into the national development agenda and support. The GGS is designed to transition Zambia's transition towards a low carbon, resource efficient economy by 2030 and aligning with the NDC.	Developed in 2024
Nationally Determined Contribution Implementation Framework	Plan	Aims to highlight outcomes, outputs, key performance indicators for implementation of the NDC. The Framework contains costs associated with the KPIs critical for monitoring, verification and measurement of the NDC targets.	Developed in 2023
Green Economy and Climate Change Act No. 18 of 2024.	Regulation	Aims to provide for climate change adaptation and disaster risk reduction, provide for climate change mitigation, low emission development, green economy and related actions, regulate carbon markets, provide for environmental and social safeguards in climate change actions, establish the Climate Change Fund and domesticate the United Nations Framework Convention on Climate Change and the Paris Agreement	Developed in 2024
Interim guidelines on Carbon Trading and Marketing	Guideline	Aims at ensuring that Zambia's trade of carbon meets international best practice but, most importantly, benefits local communities that own the natural resources.	
Draft Statutory Instrument (SI)on Carbon Markets (2025)	Statutory Instrument		Underdevelopment

3.5.3 Fiscal and Non-Fiscal Incentives

The Government of Zambia has recognised the critical role of fiscal and monetary instruments in creating an enabling environment and mobilising innovative sources of finance for climate change adaptation and mitigation. To support this a range of fiscal and non-fiscal incentives have been introduced to encourage stakeholder participation in climate-smart initiatives across key sectors. Between 2016 and 2024, targeted incentives have been implemented in the energy, agriculture, forestry and social sectors.:

Energy Sector

In the energy sector, Zambia has advanced efforts to promote renewable energy and improve energy efficiency as part of its transition to a low carbon and climate-resilient economy. These efforts focus on diversifying the energy mix, expanding access to clean energy and improving energy use across key sectors. Key interventions include the deployment of solar mini grids, development of grid connected renewable energy projects, establishment of energy efficiency standards for and the creation of incentive frameworks to attract private sector investment and promote sustainable development.

The following initiatives have been implemented to promote investment in renewable energy and energy efficiency:

1. Tax exemptions on importation of renewable energy products to make them more affordable.
2. Establishment of the solar centre of excellence which promotes solar technology.
3. Development of solar standards and the custom handbook.
4. Reduced approval time for solar projects.
5. Establishment of energy efficiency standards,
6. Promotion of energy efficiency and clean cooking solutions to minimize energy intensity and reduce dependency on woodfuel. Zambia targets to reduce consumption of woodfuel by 40% by 2030, while the A2C project targeted to achieve a 25% reduction in charcoal consumption between 2021 and 2026.
7. Establishment of a one-stop shop (Energy Single Licensing System) to enable smooth and timely project development.
8. Promotion of net-metering to increase uptake of renewable energy by prosumers.
9. The government decentralised rural electrification planning to speed up delivery of access to clean energy in rural areas of Zambia.
10. Removal of import duty on electric motor vehicles

3.5.4 Sectoral Actions

Forest Sector

Zambia has implemented several initiatives and incentives to promote sustainable forest management (SFM). Some of the key initiatives are provided below.
Key Incentives include:

1. Creation of Community Forest Management (CFM): This is aimed at empowering local communities to manage forest resources on customary land. It ignites communities' legal rights and responsibilities, thereby encouraging them to engage in sustainable practices.
2. Supporting Joint Forest Management (JFM): This promotes collaboration between local communities and the government to restore and manage forest reserves, by assuring benefit sharing and sustainable use of forest resources.
3. Establishing Community Forest Buffers and Public-Private Partnerships (PPP): This aims to protect forest areas around protected zones and involve private sector participation in sustainable forest management.
4. Smallholder Private Forest Management: This encourages small-scale private ownership and management of forest resources, promoting sustainable practices at a smaller scale.
5. Incentive and Market-Based Mechanisms (IMBM): This provides financial incentives and market access to communities engaged in sustainable forest management.

.
These initiatives and incentives are part of Zambia's broader strategy to combat deforestation, promote sustainable land management, protect and restore the ecosystem and improve livelihoods of the beneficiary communities.

Agriculture Sector

In the Agriculture sector, government is promoting Climate Smart Agriculture (CSA) as a strategic approach to enhance resilience, productivity and sustainability in the face of Climate Change. Guided by national policies such as the National Agriculture Investment Plan and the CSA Strategy, government aims to improve smallholder farmer livelihoods through sustainable practices that increase yields and build resilience to climate related shocks such as droughts and floods.

Key interventions include farmer training through lead farmer models and field schools, improved dissemination of agro-meteorological information, and investment in critical infrastructure such as irrigation systems and storage facilities. The government is also supporting the adoption of technologies including drones for crop protection and strengthening public-private partnerships to drive innovation and investment in CSA. In addition, the distribution of drought -tolerant seeds, promotion of diversified crops and support for agricultural research are key components of the national strategy to enhance food security and contribute to the country's climate goals under its NDCs.

Key flagship initiatives include projects such as Conservation Agriculture Scaling Up (CASU) project, Zambia Integrated Forest Landscape Project (ZIFLP), Strengthening Climate Resilience of Agriculture Livelihoods (SCRALA), ZAMGROW and Transforming Landscapes for Resilience and Development Project (TRALARD) are being implemented to scale up CSA practices, with hundreds of thousands of farmers trained across multiple provinces.

The CASU project for example was implemented from 2013 to 2017 and its objective was to scale up conservation agriculture in 31 districts of Zambia in order to increase productivity and production of crops for food security and income generation. It also aspired to address low crop

production and productivity that are exacerbated by soil degradation, high inputs prices, poor produce markets and poor farming practices. By 2015, 19,500 Lead Farmers and 207,000 Follower farmers registered under CASU. As of 2019, the Ministry of Agriculture estimated area under conservation farming was 260,000 hectares. More than 600 Ministry of Agriculture extension officers, Provincial and District agricultural officers and private sector agro-dealers improved their Conservation Agriculture (CA) skills through intense technical training provided by CASU. More than 100,000 small scale farmers improved their skills on sustainable land preparation, 6,300 used pigeon peas as part of crop rotations and about 1,500 farmers started practicing agro- forestry[72].

Other organizations are also involved in promotion of conservation farming such as the Non-Governmental Gender Organisations Coordinating Council (NGOCC) while partnering with organisations such as COMACO and SNV. In addition, distribution of drought -tolerant seeds, promotion of diversified crops and support for agricultural research are key components of the national strategy to enhance food security and contribute to the country's climate goals under its NDCs.

In the agriculture sector, Zambia has implemented several initiatives and incentives to promote sustainable and climate-smart practices. These key initiatives include the following, among other:

1. Farmer Input Support Programme: This government-led initiative aims at improving the accessibility of quality agricultural inputs for small-scale farmers at a reduced cost, thereby enhancing their productivity.
2. Conservation Farming: The government encourages farmers to adopt conservation farming practices, such as minimal soil disturbance, crop rotation, and the use of cover crops to improve soil health and reduce erosion.
3. Agroforestry: The government also promotes the planting of trees and integrating trees into farming systems to enhance biodiversity, improve soil fertility, and provide additional income sources.
4. Use of Green Manure and Lime: The use of organic fertilizers like green manure and lime is being encouraged to enhance soil fertility and reduce the need for chemical fertilizers.
5. Efficient Water Use: The government also promotes efficient use of available water resources for irrigation, preferably solar-powered irrigation, to embrace productivity throughout the year, reduce dependency of rain-fed farming and increase productivity.
6. Crop Diversification: Farmers are encouraged to diversify their crops, including the production of oilseed crops like soybeans, sunflowers, and groundnuts, to reduce fertiliser costs and increase farm yields. Further, farmers are encouraged to grow drought-resistant crops like sorghum, millet, etc., to reduce the risk of crop failure in the face of climate change.

[72] https://ec.europa.eu/europeaid/case-studies/conservation-agriculture_en

7. Capacity Building: Strengthening the capacity of small-scale farmers through training and extension services to adopt sustainable agricultural practices and improve productivity.
8. Access to Land and Credit: The government, through the Ministry of Land and Natural Resources, facilitates acquisition of title deeds by farmers, which enhances their collateral value and enables them to access credit.

Energy Sector

The energy sector plays a key role in national development, serving as a critical input in the production and consumption of goods and services. Energy is also essential for everyday needs such as food preparation and preservation, space heating, cooking, lighting, and transportation, including the operation of motor vehicles, trains, and aircraft. Zambia is endowed with diverse energy resources, including extensive woodlands for wood fuel, hydro-power potential, coal reserves, and renewable energy sources such as small hydro, solar, wind, and geothermal energy. Notably, petroleum remains the only energy source that is wholly imported.

The Republic of Zambia commits to achieving universal urban electrification (11.4 million people) and increasing rural electrification to 50% by 2030 (6.1 million people), deploying 900,000 energy efficient cooking stoves by 2025 (4.5 million people), meeting 30% of Zambia's energy needs with renewable energy (excluding large hydro) by 2030 and decreasing energy intensity by2%/year over the 2019-2030 period.[73]

i) Renewable Energy

In 2023, the total national installed electricity generation capacity for both on-grid and off-grid systems reached 3,811.3 MW, an increase from 3,777.3 MW in 2022.

On the mitigation front, CEC has embraced renewable energy technologies and has installed a total of 94MW of solar PV (1MW in 2018, 33MW in 2023 and 60MW in 2024) with energy production of 195GWh. Further, the company embarked on phasing out SF_6-charged switchgears by introducing eco-friendly ones. The utility's network has about 100 switchgears and 15 have so far been replaced following their operation life cycle.

Actions which were observed during the study to have been contributed to mitigating GHG emissions as part of the NDC in the energy sector were: rural and urban electrification, electricity generation (i.e. from on-grid solar PV utility scale and hydro), energy efficiency in industries, and biogas.

ii) Electrification

The Rural Electrification Authority was created by Act No. 20 of 2003 which has since been repealed and replaced by Act No. 5 of 2023 as a special purpose vehicle to increase access to electricity in rural areas. In order to reach the target beneficiaries, the Authority uses five options which include Grid Extension, Biomass, Wind, Solar Energy and Mini-Hydro. The Authority has implemented projects using different technologies across the country. Furthermore, rural wards, schools, Chiefdoms, Rural Health Centres, Mini Hospitals have been connected. About 33.8 % of households in rural areas had connection to an electricity source

[73]National Energy Compact, 2025

while 66.2 % were not connected. In urban areas 80.2 % of households had connection to an electricity source while 19.7 % were not connected. At national level, 33.9 % of households used electricity as a main source of lighting energy. This was followed by torch, used by 31.1 percent of the households[74].

Electrification of rural and peri-urban areas reduced GHG emissions and contributed to the NDC target through switching from use of firewood and charcoal to electricity in electrified houses. The mitigation analysis for electrification took into consideration that the switch from charcoal or firewood to electric stoves was not 100% after a household is electrified. Households still continue to use charcoal even after being electrified but the quantities reduced considerably. The projects considered in this study are those implemented by the Rural Electrification Authority (REA) and these include; the Subsidy Connections under the World Bank Funded Electricity Services Access Project (ESAP), Grid Intensification Projects, and Grid Extension Technology.

iii) On-grid Solar PV Utility Scale

A number of initiatives are currently being implemented to upscale deployment of solar photovoltaic (PV) utility scale in Zambia. These initiatives are being spearheaded by a number of institutions which include; Industrial Development Corporation (IDC), ZESCO Limited, Rural Electrification Authority (REA). The 34 MW Ngonye Solar PV Plant, which is located in the Lusaka South Multi-Facility Economic Zone, in 2018, a 54 MW Solar PV Plant was commissioned for the Bangweulu Power Company Limited in the Lusaka South Multi Facility Economic Zone. The plant is the first large-scale solar power plant to be commissioned in Zambia. It is an SPV with 20% ownership by IDC and 80% by Neon of France (IDC, 2020) (2). The Bangweulu solar power plant feeds into the Zesco grid. The construction of the solar power plant had an estimated cost of US$ 57.3 million (ERB, 2018).

iv) Energy Efficiency

Recently there have been a number of initiatives to promote energy efficiency in Zambia. Energy efficiency projects currently under implementation include: solar street lighting retrofits, power factor correction, light-emitting diode (LED)/compact fluorescent lamp (CFL) in household and the switch to solar water heaters.

v) On-grid electricity generation

The hydroelectric generation intervention considered in this study which contributed to emissions for the period under review were Kariba North Bank Extension (KNBE)and Kafue Gorge Lower.

vi) Biogas

The Netherlands Development Organisation (SNV) is a non-profit international development organisation that focuses mainly on three sectors namely, agriculture, energy and water, sanitation and hygiene or WASH. SNV has been a leading organisation in promotion and support of development and upscaling of biogas digesters in rural areas for provision of energy

[74]https://www.idc.co.zm/president-lungu-urges-idc-to-accelerate-solar-power-projects/

in rural areas in Zambia. To date, about 3300 biogas digesters have been constructed. Recently the Rural Electrification Authority has been promoting the construction and use of biogas digesters.

Waste

It was established that there were no major interventions to reduce emissions for liquid and solid waste. However, there are intentions by local authorities and water utility companies to take action to reduce GHG emissions. These companies include; Kafubu Water and Sanitation Company (KWSC), Nkana Water and Sanitation Company (NWSC), North-Western Water and Sanitation Company (NWWSC), Western Water Supply and Sanitation Limited (WWSSCL) and Southern Water Supply and Sanitation Company Limited.

The key actions to focus on will include:

Solid Waste Management (SWM)

- Controlled Disposal: Continuing to operate and plan for more engineered sanitary landfills to replace open dumpsites and reduce uncontrolled methane emissions.
- Methane Abatement: Plan to implement landfill gas (LFG) collection and utilisation systems, such as flaring or energy conversion, at various locations.
- Waste Diversion: Providing a framework for improvements in recycling and resource recovery through Extended Producer Responsibility (EPR) and other private sector and community interventions
- Biological Treatment: Promoting composting of organic waste and piloting Waste-to-Energy (WtE) technologies.

Wastewater Treatment and Discharge

- Biogas Technology: Investing in and implementing sanitation projects focusing on wastewater treatment, onsite sanitation services and the use of biogas digesters that capture methane for renewable energy.
- Regulation: Enforcing regulations to ensure appropriate wastewater treatment, thereby minimising methane and nitrous oxide releases from untreated effluent.

In summary, Zambia is pursuing an integrated approach that links improved public health and resource management with tangible climate benefits by focusing on modernising disposal infrastructure, waste diversion, and methane capture.

3.6 Summary of Greenhouse Gas Emissions and Removals

3.6.1 Summary of Greenhouse Gas Emissions and Removals

In 2022, Zambia's total greenhouse gas (GHG) emissions, including the AFOLU sector amounted to 220,462.1 $GgCO_2eq$, representing a 121% increase compared to the 1990 base level of 99,578.7 $GgCO_2eq$. Over the same period, GHG removals (carbon sinks) declined by 2.6% from -160,443.0 $GgCO_2eq$ in 1990 to -164,745.1 CO_2eq in 2022.

Excluding AFOLU, Zambia's total GHG emissions in 2022 stood at 18,410.3 $GgCO_2eq$, a 209.81% increase from the 1990 levels of 5,942.5 $GgCO_2eq$. GHG emissions without AFOLU increased steadily from 1990 to 2008, followed by a sharper upward trend through 2022.

The net GHG emission trend indicates that Zambia was a net carbon sink from 1990 to 2006, but transitioned to a net emitter from 2007 to 2022 (Figure 3.2) primarily due to rising emissions and declining removals in the AFOLU sector.

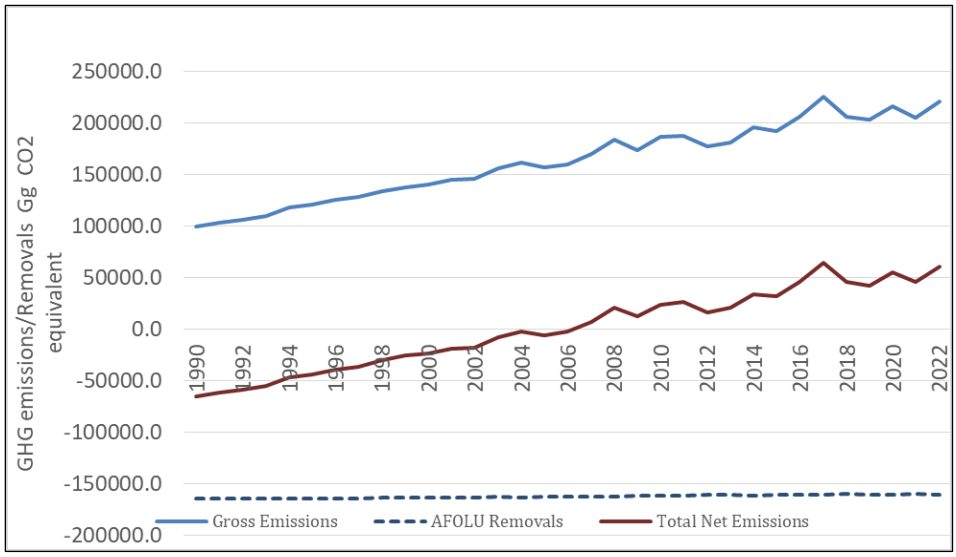


Figure 3.2: Trends of Emissions, Removals and Net Emissions

According to Approach 1 Level Assessment the Key Categories were Forest land Remaining Forest land, Land Converted to Grassland, Land Converted to Cropland, Enteric Fermentation, Energy Industries - Solid Fuels, Land Converted to Forest land, Road Transportation - Liquid Fuels, Lime production, Burning, and Other Sectors - Biomass solid.

3.6.2 Precursor Gases

Between 1990 and 2022, Zambia experienced a significant increase in emissions of the precursor gases namely carbon monoxide (CO), non-methane volatile organic compounds (NMVOC), nitrogen oxides (NO_x), Sulphur dioxide (SO_2) and ammonia (NH_3). The largest contributors were the AFOLU sector (62%) and the energy sector (38%) while emissions from IPPU and waste remained significantly low. Carbon monoxide was the dominant precursor gas, accounting for 71% of total emissions in 2022, followed by NOx (13 %), NMVOCs (9%), SO_2 (6%) and NH_3(1%). Over the period, CO emissions rose sharply by over 500 %, from 1,244.5 Gg in 1990 to 7,756.6 Gg in 2022, primarily due to increased fossil fuel combustion for electricity generation and transport and inefficient biomass use and open burning. NMVOC and NOx emissions increased by 443 % and 313%, respectively while NH_3 emissions rose by 400 %, though its overall contribution remained low. These trends reflect growing energy demand, land use pressures and limited adoption of clean combustion technologies.

3.6.3 Projections for GHG Emissions and Removals

Baseline emissions were estimated using historical trends in Gross Domestic Product (GDP) and population growth. An average annual GDP growth rate of 3.32% (based on data from 1961 to 2023) and a population growth rate of 3.1% (average of 2.8% for 2000-2010 and 3.4 % for 2011-2022) were applied. Annual projections were calculated separately based on GDP and population growth rates with the final baseline emission estimates derived from the average of the two, at 3.1% growth rate, ensuring a balanced reflection of both economic and demographic trends.

Under a business-as-usual (BAU) scenario, net GHG emissions are projected to rise from 60,019.1 $GgCO_2eq$ in 2022 to 76,622.81 $GgCO_2eq$ by 2030. Without mitigation, emissions are expected to increase by 16,603.71 $GgCO_2eq$ by 2030 (Figure 3.3).

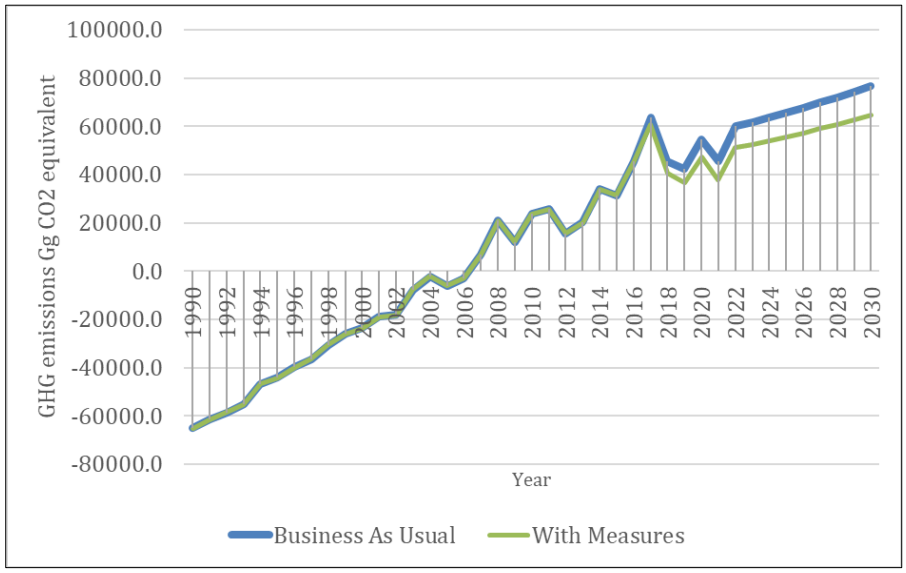


Figure 3.3: Emission Trends under Business as Usual and with Measures

However, with mitigation measures in place, emissions are projected to increase more modestly from 8,752.6 $GgCO_2eq$ in 2022 to 11,987 $GgCO_2eq$ by 2030, resulting in emission reductions of 3,234.4 $GgCO_2eq$ by the 2030 compared to the unmitigated scenario (Table 3.5).

Table 3-5: Projected Emissions under Business as Usual and with Measures

	Emissions							Business As Usual	With Measures
	Total Emissions	**Total Without AFOLU**	**Energy**	**IPPU**	**Waste**	**AFOLU Emissions**	**AFOLU Removals**	**Total Net Emissions**	
1990	99578.7	5942.5	3926.2	1161.3	855.0	93636.2	-164745.1	-65166.4	-65166.41
1991	103184.0	5328.2	3314.6	1140.8	872.8	97855.7	-164778.3	-61594.3	-61594.34
1992	106047.8	6060.3	4018.1	1151.3	890.9	99987.5	-164678.5	-58630.7	-58630.72
1993	109367.9	6083.6	3997.4	1176.9	909.2	103284.3	-164665.4	-55297.5	-55297.51
1994	117907.3	5982.7	3901.5	1153.3	927.8	111924.7	-164652.3	-46744.9	-46744.94
1995	120532.6	5922.7	3879.6	1096.5	946.7	114609.9	-164621.5	-44088.9	-44088.91
1996	124896.2	6042.3	3988.6	1088.0	965.8	118853.9	-164716.0	-39819.8	-39819.78
1997	128317.3	6207.5	4157.7	1084.0	965.8	122109.8	-164720.5	-36403.2	-36403.25
1998	133204.0	5847.1	3776.7	1065.1	1005.2	127357.0	-163737.4	-30533.4	-30533.38
1999	137430.2	6226.1	4139.5	1061.4	1025.1	131204.1	-163510.9	-26080.7	-26080.69
2000	139927.8	6228.2	4100.2	1081.6	1046.4	133699.6	-163476.7	-23548.9	-23548.94
2001	144441.9	6594.2	4450.2	1077.2	1066.8	137847.7	-163345.8	-18903.9	-18903.89
2002	145149.7	6447.4	4256.1	1111.9	1079.4	138702.3	-163222.3	-18072.7	-18072.69
2003	155359.7	7116.6	4829.1	1178.3	1109.2	148243.2	-163076.9	-7717.1	-7717.13
2004	161741.1	7339.3	4959.7	1242.5	1137.1	154401.8	-163930.5	-2189.4	-2189.43
2005	156700.0	7757.6	5295.9	1299.7	1161.9	148942.4	-162841.0	-6141.0	-6141.03
2006	159791.8	8732.7	6236.2	1308.6	1187.9	151059.1	-162726.9	-2935.1	-2935.09
2007	169949.6	8390.3	5848.2	1327.1	1215.0	161559.3	-162909.9	7039.7	7039.68
2008	183223.1	8427.6	5808.9	1375.2	1243.5	174795.5	-162327.8	20895.4	20895.35
2009	173524.0	8700.3	5917.5	1509.4	1273.5	164823.7	-161498.4	12025.6	12025.61
2010	185957.4	9042.0	6222.2	1515.3	1304.5	176915.4	-162184.5	23772.9	23772.91
2011	187688.7	9635.5	6807.6	1491.7	1336.2	178053.2	-161887.0	25801.7	25801.68
2012	176618.6	9727.7	6725.7	1628.3	1373.7	166890.9	-161045.4	15573.2	15573.23
2013	181092.6	10252.4	7094.4	1745.7	1412.3	170840.1	-160900.5	20192.1	20192.06

2014	195444.0	10647.1	7598.2	1589.6	1459.3	184796.9	-161451.7	33992.3		33992.31
2015	192055.3	10874.2	7458.3	1888.0	1527.8	181181.1	-160609.0	31446.3		31446.26
2016	205958.3	13541.5	9860.4	2073.8	1607.3	192416.8	-160414.2	45544.1	732.4007909	44811.70
2017	224974.8	14125.6	10681.6	1796.0	1648.0	210849.2	-161171.1	63803.8	3001.633939	60802.13
2018	205908.2	16012.5	12456.4	1873.4	1682.7	189895.8	-160176.9	45731.3	5138.734303	40592.59
2019	203220.8	16880.0	13316.1	1780.5	1783.5	186340.8	-160881.9	42338.9	5610.243839	36728.69
2020	215477.7	16483.7	12834.1	1767.0	1882.6	198994.0	-160737.2	54740.5	7379.681477	47360.79
2021	205140.5	17361.9	13615.0	1766.2	1980.7	187778.6	-159743.1	45397.4	7684.598964	37712.77
2022	220462.1	18410.3	14571.4	1744.3	2094.6	202051.8	-160443.0	60019.1	8752.568477	51266.54
2023	227537.03	19001.10	15039.05	1800.24	2161.81	208535.93	-155294.13	61879.59	9609.071893	52270.52
2024	234839.01	19610.87	15521.68	1858.01	2231.18	215228.14	-150310.53	63797.86	9917.440497	53880.42
2025	242375.32	20240.21	16019.79	1917.64	2302.79	222135.11	-145486.85	65775.59	10235.70508	55539.88
2026	250153.49	20889.75	16533.89	1979.18	2376.68	229263.74	-140817.97	67814.63	10564.18323	57250.45
2027	258181.26	21560.13	17064.48	2042.69	2452.96	236621.13	-136298.93	69916.89	10903.20269	59013.68
2028	266466.66	22252.03	17612.11	2108.25	2531.67	244214.64	-131924.90	72084.31	11253.10177	60831.21
2029	275017.95	22966.12	18177.30	2175.90	2612.92	252051.83	-127691.25	74318.92	11614.2296	62704.69
2030	283843.66	23703.14	18760.64	2245.73	2696.77	260140.52	-123593.46	**76622.81**	11986.94653	64635.86

Chapter 4: Climate Risks and Adaptation

4.1 Introduction

Zambia is increasingly affected by extreme climatic conditions, including droughts, seasonal and flash floods, extreme temperatures and irregular wet and dry spells events, that are growing in frequency, intensity and magnitude. The country has experienced a rising temperature trend of 0.34 degrees per decade, alongside increased rainfall variability of about 1.9 mm per month. Climate hazards pose significant and escalating risks to Zambia's social-economic development and sustainability of its environmental systems. If left unaddressed, they threaten to undermine national development goals and progress toward the Sustainable Development Goals (SDGs).

This chapter presents an overview of observed and projected climate risks, sector-specific vulnerabilities, and the adaptation measures undertaken to address the challenges. It outlines Zambia's adaptation priorities, key interventions and progress made in enhancing climate resilience, in alignment with the National Adaptation Plan (NAP), relevant sectoral strategies, and Nationally Determined Contributions (NDCs). The chapter also highlights monitoring and evaluation mechanisms and emphasizes the critical role of adaptation in supporting inclusive climate -resilient and sustainable development pathways.

4.2 Climate Impacts, Risks, and Vulnerabilities

4.2.1 Temperature Trends in Zambia

Observed minimum and maximum temperature trends across 10 provinces in Zambia show a consistent and statistically significant ($p<0.05$) increase in surface air temperatures (Figure 4.1 and Figure 4.2). This upward trend is expected to have a wide-range of implications across multiple sectors, including agriculture (crops, livestock, fisheries, and aquaculture subsectors), energy, health, infrastructure, mining, tourism, wildlife, forest, transport, manufacturing, finance and water resources[75].

Regional and local climate modeling efforts, typically begin with outputs from Global Climate Model (GCM), which are then downscaled to capture localised Climate dynamics to inform sector -specific impact assessments and adaptation planning[76]

[75] Chisanga, Charles Bwalya; Nkonde, Edson; Mubanga, Kabwe H.; Phiri, Darius; Chemura, Abel; Kipkulei, Harison K (2025): SPI-based drought characteristics using CHIRPS over Zambia: 1981–2024. Journal: All Earth (online), Volume: 37

[76] David W. Pierce, Tim P. Barnett, Benjamin D. Santer, and Peter J. Gleckler (2009): Selecting Global Climate Models for Regional Climate Change Studies. Proceedings of the National Academy of Sciences (PNAS), Volume: 106,Issue: 21

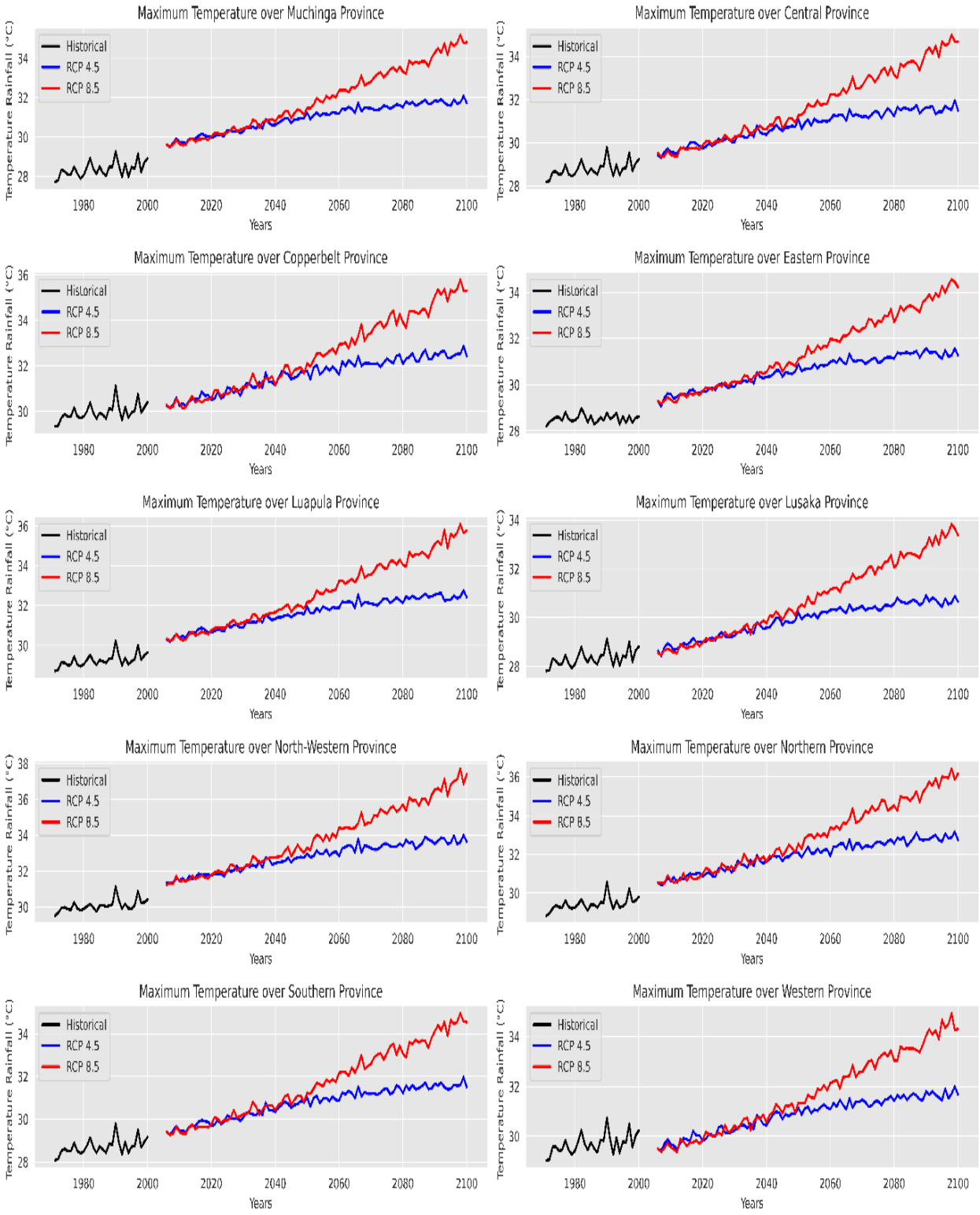


Figure 4.1: Maximum Temperature distributions from 1971 to 2000 (RCP4.5, RCP8.5), 2010-2039 (RCP4.5, RCP8.5), 2040-2069 (RCP4.5, RCP8.5) and 2070-2099 (RCP4.5, RCP8.5) at Provincial level

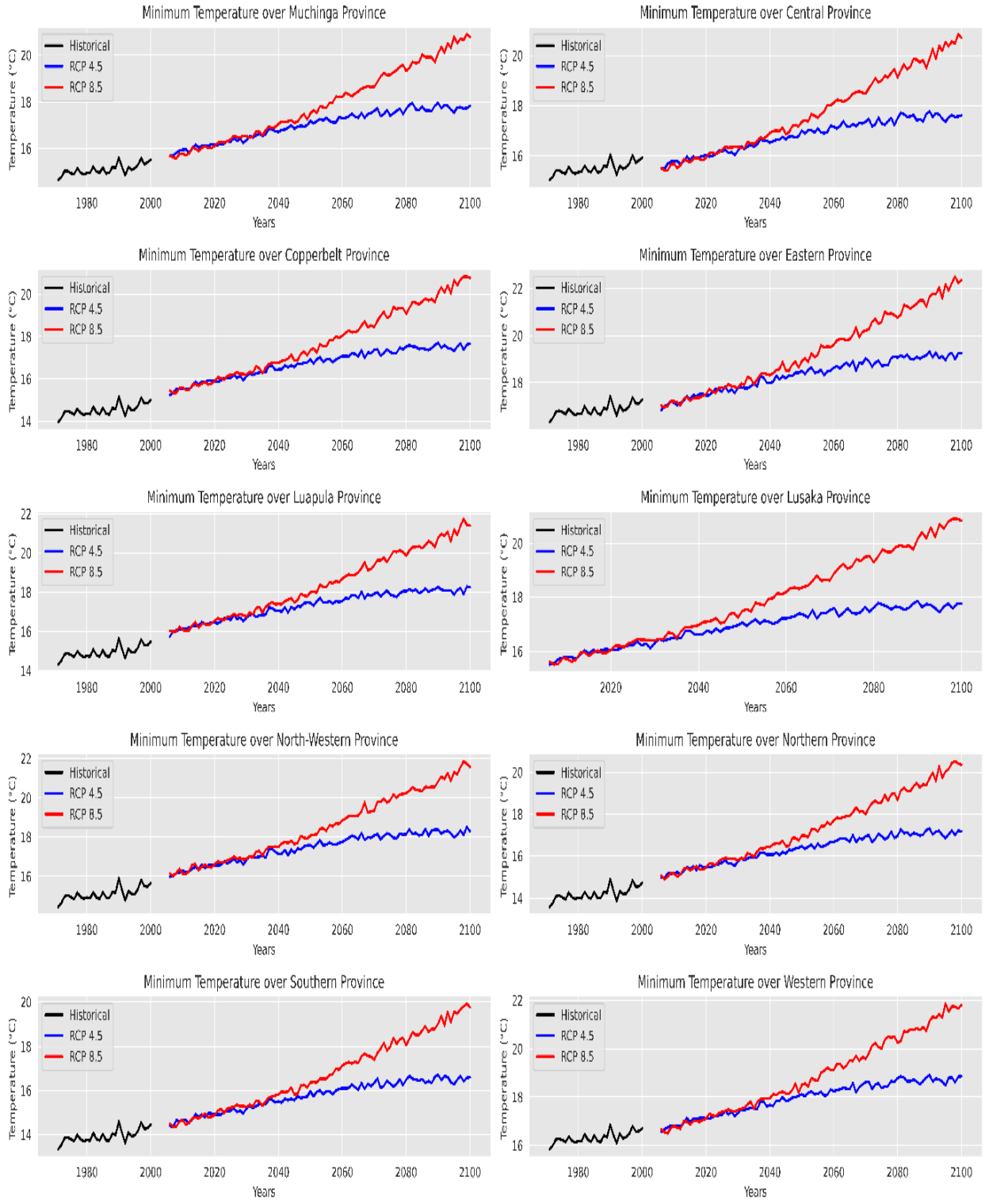


Figure 4.2: Minimum Temperature distributions from 1971 to 2000 (RCP4.5, RCP8.5), 2040- 2069 (RCP4.5, RCP8.5) and 2070- 2099 (RCP4.5, RCP8.5) at Provincial level

4.2.2 Rainfall Trends and Variability in Zambia

Provincial level time series of rainfall trends indicate a general decline in precipitation across Zambia, with both spatial and temporal variability observed (Figure 4.3 and Figure 4.4).

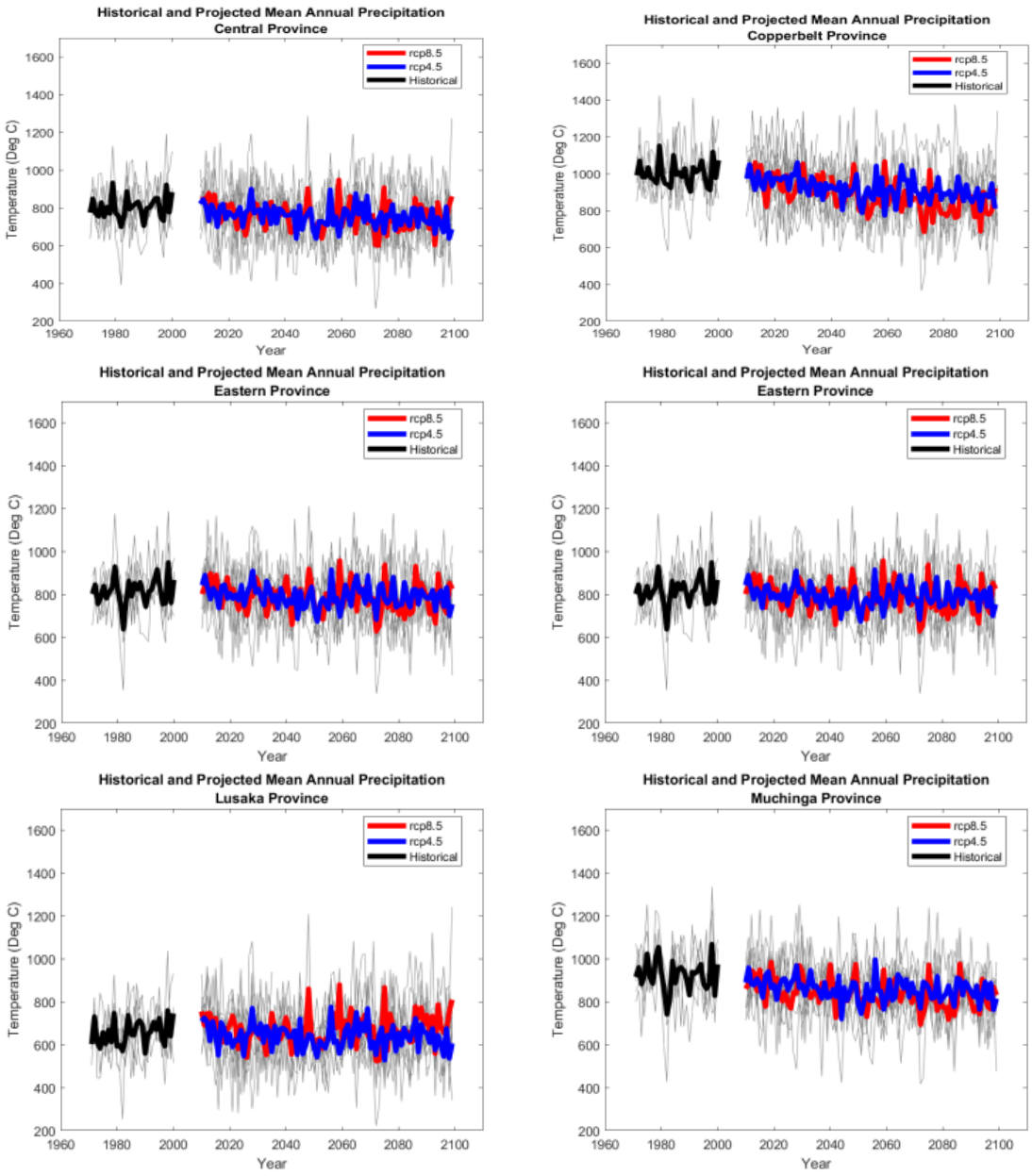


Figure 4.3: Rainfall distributions from 1971 to 2000 (RCP4.5, RCP8.5), 2040- 2069 (RCP4.5, RCP85) and 2070- 2099 (RCP4.5, RCP8.5) at Provincial level

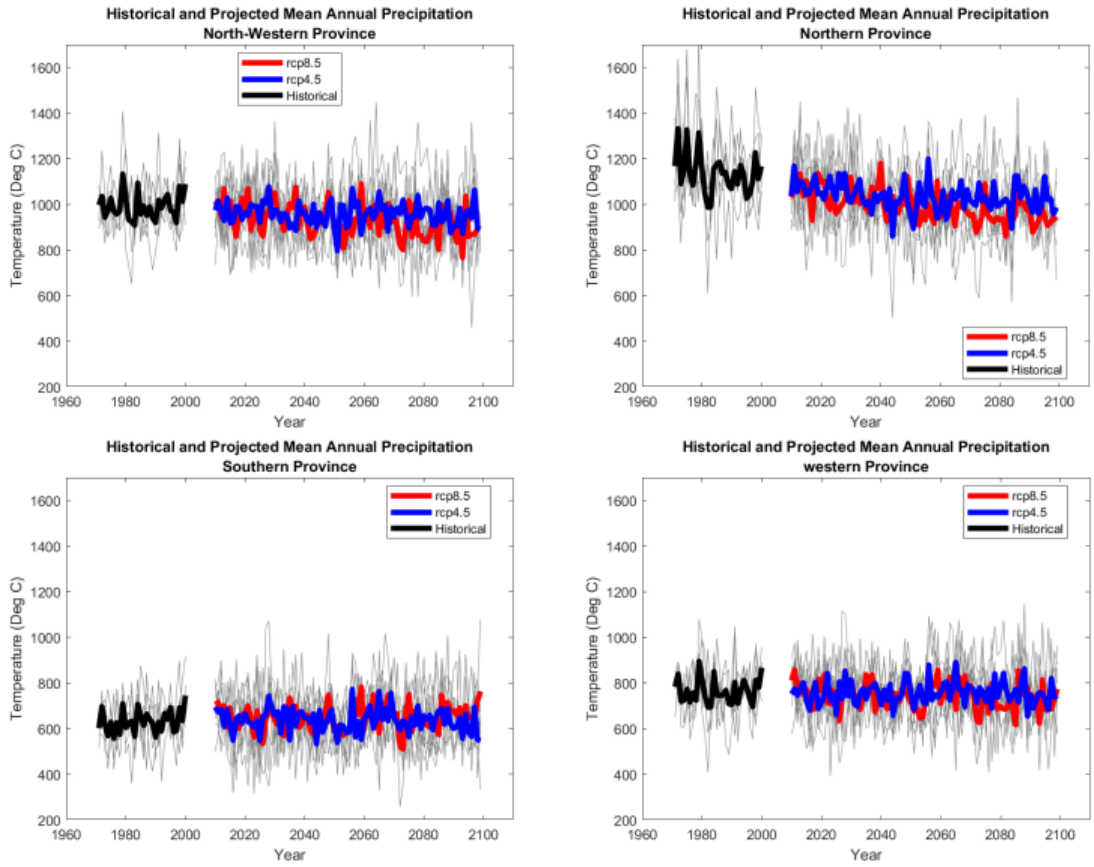


Figure 4.4: Rainfall distribution from 1971 to 2000 (RCP4.5, RCP8.5), 2010- 2039 (RCP4.5, RCP8.5), 20240- 2069 (RCP4.5, RCP8.5) AND 2070- 2099 (RCP4.5, RCP8.5) at Provincial level

Projections under RCP4.5 and RCP8.5 scenarios suggest a continued reduction in rainfall across Zambia from 2010-2099, with impacts on all key sectors including agriculture (crops, livestock, fisheries, and aquaculture subsectors), energy, health, infrastructure, mining, tourism, wildlife, forest, transport, manufacturing, finance and water (NAP 2023).

Historical climatic data reveal a nationwide decrease of 58 mm in average rainfall over the period 1971-2000, while long-term records indicate total annual rainfall decrease of approximately 1.9 mm per month (2.3%) per decade since 1960 77.

Future rainfall changes are expected to vary between provinces and across Agro-ecological Regions (AERs; AERI, AERIIA, AERIIB, AERIII) 78.

While some periods in history have recorded statistically insignificant increases and decreases in rainfall attributed to natural long-term and season to season variability, extreme weather events have intensified. Between 2000 and 2007, Zambia experienced two drought years, two

[77] Lupele, J (20200): National Climate Change Learning Strategy for Zambia. National Climate Change Learning Strategy for Zambia.

[78]Hunter et al., (2020): Climate Change and Future Crop Suitability in Zambia. University of Cape Town, South Africa, in support of the Adaptation for Smallholder Agriculture Programme (ASAP) Phase 2, International Fund for Agricultural Development (IFAD), Rome.

flood years and only two years of normal condition rainfall (10), with 2006/2007 flood season causing severe impacts on food security (10). More recently, the 2023/2024 agricultural season was characterized by the most severe drought in over four decades, driven by El Niño conditions. This drought affected 84 out of 117 districts, led to total crop failure across nearly one million hectares of maize, and disrupted livelihoods, electricity production, and food systems nationwide.

It is important to understand broad-scale changes in the climate (ibid). However, the most acute impacts of weather and climate are often felt during extreme meteorological events such as heavy rain, droughts, heat waves, heat stress, and storms, including tropical storms (ibid). Further, these can lead to or exacerbate other high-impact events such as flooding and wildfires, posing growing risks to livelihoods, ecosystems and economic development.

4.2.3 Vulnerabilities of Key Economic Sectors

Zambia continues to increasingly experience extreme climatic events, including prolonged droughts, seasonal and flash floods, extreme temperatures and erratic wet and dry spells. These climatic hazards are growing in intensity, frequency and magnitude undermining the productivity of rainfed agriculture, livestock, fisheries and aquaculture sectors that form the backbone of Zambia's economy and rural livelihood [79].Climate variability poses a significant threat to the sustainability of Zambia's agricultural systems, leading to reduced yields, increased outbreaks of crop and Livestock pest and diseases, degradation of natural resource, and heighted food insecurity. These impacts are further exacerbated by limited adaptive capacity among smallholder farmers, and inadequate investments in research and development, technology transfer and institutional support challenges which risk reversing progress toward rural poverty reduction and economic transformation.

[79] Rosemary Fumpa-Makano (2011): Forests and Climate Change: Integrating Climate Change Issues into National Forest Programmes and Policy Frameworks. Food and Agriculture Organization (FAO).

4.3 Adaptation Priorities, Strategies, and Policies

4.3.1 Adaptation Measures

Zambia has identified key sectors to drive the economic development under its Eighth National Development Plan (8NDP), with Agriculture envisaged to contribute 10% to the country's GDP. Other critical sectors include infrastructure, water, health, mining, forestry, livestock and fisheries, tourism and wildlife. These sectors however, are highly vulnerable to adverse impacts of climate change as highlighted in the vulnerability and adaptation assessment report[80]. If not addressed adequately, climate risks are likely to intensify, and these vulnerabilities could undermine achievement of the national developmental goals and efforts to build a climate-resilient economy outlined in the NDC and Vision 2030.

To address these vulnerabilities, Zambia has developed the National Adaptation Plan (NAP), which provides an overarching medium to long-term strategic framework for adaptation planning and implementation. The 8NDP and NAP outline sector-specific adaptation priorities aimed at reducing vulnerability, building resilience across key economic sectors and vulnerable populations, and safeguarding development gains.

Key priority adaptation measures include the following:

- enhancing water resource management to reduce drought related impacts on agriculture, fisheries and aquaculture;
- promoting climate resilient agriculture and crop diversification to strengthen food security;
- investing in climate resilient infrastructure including early warning systems and flood protection.
- Advancing reforestation and sustainable forest management for supporting ecosystem-based adaptation and emissions reductions.
- Scaling up renewable energy technologies, such as solar and wind to reduce reliance on wood fuel and fossil fuels, while improving energy security and supporting low -carbon development.

A summary of adaptation priority actions by sector are outlined in Table 4.1.

The detailed sector specific priority actions and activities disaggregated in accordance to sensitivity, risk level and provinces are elaborated in Zambia's National Adaptation Plan (NAP, 2023). The Implementation of prioritized adaptation actions has the potential to significantly reduce the vulnerability of Zambia's key economic sectors to the adverse impacts of climate change. Further, these actions contribute directly to the national adaptation strategy which aims to minimize exposure to climate-related hazards, reduce sectoral sensitivity and enhance overall resilience to climate change.

[80] Chisanga, Charles Bwalya; Nkonde, Edson; Mubanga, Kabwe H.; Phiri, Darius; Chemura, Abel; Kipkulei, Harison K (2025): SPI-based drought characteristics using CHIRPS over Zambia: 1981–2024. Journal: All Earth (online),Volume: 37

Table 4-1: Adaptation Priorities Actions per Sector

No.	Sector	Adaptation Priorities
1.	Agriculture	**Vision**: An efficient, competitive and sustainable agricultural sector, which assures food and nutrition security, increased employment opportunities and incomes
		Diversification of agriculture to improve on food and nutrition security
		Promotion of climate smart agriculture
		Research & Development and Promotion of drought resilient crop varieties
		Post-harvest management, preservation and value addition
		Enhance climate smart water harvesting techniques and infrastructure technologies for irrigation
		Promotion of agroforestry practices.
		Upscaling gender sensitive sustainable agricultural technologies.
		Enhancing market linkages for drought resilient crop varieties.
		Design meaningful and appropriate agricultural insurance schemes targeting small scale farmers
		Adoption and conservation of indigenous crop varieties
		Promotion of appropriate mechanization and support
		Increased support and investment in early warning systems
		Upscaling on dissemination of climate services
		Enhance crop diseases and pest surveillance
2.	Water	***Mission***: Optimally harnessing the water resource for the efficient and sustainable utilization of this resource to enhance economic productivity and reduce poverty
		Water demand management and Efficiency water use
		Public education and sensitization on water utilization
		Improve accessibility and use of weather and climate information
		Protection of wetlands and recharge zones
		Monitoring and management of water resources (water quantity and quality)
		Strengthening of water governance structures at all levels through IWRM and WEFE nexus
		Water harvesting
		Waste water recycling
		Construction of climate smart water infrastructure (dams, canals, urban and rural supply infrastructure etc)
		Inter-basin water transfer schemes
3.	Energy	***Mission***: Ensure increased access to sustainable energy
		Investment in decentralised energy systems
		Adopting alternative clean cooking and heating technologies
		Diversification of the energy mix
		Establishment and expansion of hydroelectric power in less drought prone areas
		Promotion of energy efficient technologies
		Augment processes for transitioning to renewable energy technologies.

		Conduct research and produce an atlas of Zambia's renewable energy hot spots
4.	Health	**Mission**: To provide equitable access to cost effective, quality health care services as close to the family as possible
		Water quality monitoring and promotion of treatment options at domestic level
		Management of solid and liquid waste
		Planning for curative measures towards climate sensitive diseases.
		Environmental management, pollution and vector control
		Establishment of a robust response framework for disease intelligence (Surveillance, early warning, preparedness and disease control Establish) emergency of climate sensitive diseases.
		Promotion of research and development (R&D)
		Up-scaling nutrition awareness
5.	Infrastructure	**Mission**: To facilitate and undertake the construction, rehabilitation, maintenance and management of public infrastructure and affordable housing in order to active social- economic development
		Increased investment in the provision of green buildings
		Increased investment in the development of new climate resilient transport infrastructure
		Development and enforcement of climate smart and green construction codes and standards.
		Development and enforcement of grading codes for climate-smart buildings
		Providing resource for improved enforcement climate smart and climate resilient of building codes
		Regular maintenance of existing transport infrastructure
6.	Livestock	**Vision:** National Livestock and Development Policy, 2020 - To transform the livestock industry in order to enhance socioeconomic development
		Promote increased Livestock-Crop integration
		Improved disease control including use of indigenous knowledge
		Promotion of value chains (e.g. livestock & Fish value Chains)
		Promotion of production, processing, storage of forage resources
		Increased support to research and development
		Promotion of indigenous strains
		Promotion of Index based livestock insurance
7.	Fisheries and aquaculture	**Vision**: (National Fisheries and Aquaculture Policy, 2023) - To transform the fisheries and aquaculture subsector in order to enhance sustainable fisheries and aquaculture development.
		Promote climate smart infrastructure for aquaculture e.g., Improve design of fish ponds such as increase height of embarkments
		Promote integrated land use practices that enhance sustainable fisheries management using landscape approach
		Strengthen protection of fish breeding areas/reserves that enhance community participation
		Promote low carbon fish processing technologies (solar dryers, sustainably harvested wood, briquettes etc)
		Adoption of alternative livelihoods by households in fish dependent communities.
		Sensitize communities towards sustainable fish farming practices
		Improve provision and access to climate information services for capture fisheries and aquaculture
		Strengthen fisheries Monitoring Controls and Surveillances (MCS)
		Promote research in genetic improvement programmes (GIP) and use of indigenous fish species for aquaculture.
		Mapping, zoning and protection of ecologically sensitive areas.
8.	Mining	National Mineral Resources Development Policy (2022-2027). "Aims to close regulatory gaps in the mining sector and stimulate domestic and foreign investment".

		Promote Afforestation in mining areas.
		Promote tailings neutralization.
		Improve dust suppression measures
		Promote community water projects
		Recycle water in mining industry
		Install appropriate and adequate cooling facilities underground to protect the health of workers
		Promote alternative power sources
		Design mine pits that are responsive to the threat of flooding.
9.	Tourism and wildlife	**Mission**: to facilitate and promote a sustainable tourism development and, culture preservation for socio-economic development
		Enhanced water reticulation in fenced National Parks and Game Management Areas
		Identify and strengthen development of tourism destinations and packages
		Develop and update existing and implement new medium and long term monitoring plans for priority communities
		Develop and review general management plans for NPs and GMAs
		Construction of climate resilient infrastructure in NatiPs and GMAs
		Develop and update existing and implement new medium and long term monitoring plans for priority species
		Awareness of animal behaviour and how to interact with wildlife.
		Training community members as blasters aimed at scaring animals from humans.
		Promote public private community partnerships in the sustainable management of wildlife resources.
10	Forestry	**Mission**: Ensure protection of the environment management and development of natural resources and efficient use
		Participatory forestry management
		Prepare forest management plans to guide forest management and utilization activities.
		Promote sustainable forestry management practices anchored on ecosystem and landscape approaches.
		Prepare forest management plans to guide forest management and utilization activities.

4.3.2 Barriers to Implementation of Adaptation Priorities

Zambia's efforts to effectively implement prioritized climate change adaptation actions in its NAP however, faces a range of systemic and cross-cutting barriers. These barriers if not addressed could constrain adaptation choices, reduce efficiency and effectiveness of adaptation interventions. Identifying and addressing these barriers is critical to strengthening national resilience, achieving adaptation goals, and fulfilling Zambia's commitments under the Paris Agreement.

4.3.2.1 Financial Barriers

Limited financial resources remain a primary constraint to the implementation of prioritized adaptation actions. Adequate and sustained financing is essential for infrastructure development, technology adoption, and capacity-building initiatives. However, funding shortfalls hinder investment in climate resilient infrastructure and limit access to appropriate technologies.

Smallholder farmers, who form the backbone of Zambia's agricultural sector, face restricted access to credit and insurance. This severely inhibits their ability to invest in climate-resilient agricultural practices, further undermining the sector's sustainability and productivity.
To overcome these financial constraints, there is an urgent need for enhanced domestic resource mobilization, innovative financing mechanisms and increased access to International Climate Finance, including through the Green Climate Fund (GCF) and other multilateral channels.

4.3.2.2 Social and Economic Barriers

Zambia's economy is heavily reliant on climate sensitive natural resources, including land and water for agriculture, forest resources for commercial Logging and energy (wood fuel) production. Although these sectors are highly vulnerable to climate change, economic and social pressures often constrain the shift towards more sustainable and climate resilient practices.

Social and economic factors significantly affect the acceptance, implementation and sustainability of adaptation measures. Resistance to behavioural change, adherence to unsustainable traditional practices, and limited awareness among local communities pose challenges to scaling up adaptation efforts.

4.3.2.3 Technology and Technological Barriers

Technology is a critical enabler of climate change adaptation, strengthening the ability of sectors and local communities to anticipate, absorb and recover from climate related shocks. In Zambia, however, the adoption and effective use of climate resilient technologies are constrained by a range of interrelated barriers. These include limited availability and high costs of appropriate technologies, restricted access, insufficient technical capacity and weak institutional frameworks. Together these challenges hinder the adoption, development, diffusion and scaling up of climate-resilient technologies and innovations essential for building long term adaptive capacity across key sectors. The detailed technological barriers are outlined below:

a) Limited availability of Appropriate Technologies
   - Many climate -resilient technologies such as drought-tolerate crop varieties, conservation agriculture equipment and efficient irrigation systems are either not readily available or are not widely disseminated in Zambia;
   - Technologies for climate monitoring, forecasting and early warning systems remain insufficiently deployed, particularly in rural and high-risk areas limiting preparedness and response capacities.

b) High Cost and Limited Affordability
   - The high initial investment costs of climate resilient technologies (e.g., Solar powered irrigation, water harvesting facilities and automated weather stations) deter adoption, especially among smallholder farmers and low-income communities;
   - There is limited access to financial instruments (grants, subsidies, low-interest loans) that could make these technologies more affordable and accessible for large-scale uptake.

c) Inadequate Technical Capacities and Skills
   - There is a notable shortage of skilled personnel across sectors to support the deployment, maintenance and adaptation of technologies to local conditions.
   - Limited extension services and inadequate technical advisory support further constrain technology transfer and knowledge sharing, particularly in agriculture and water resource management

d) Weak Research, Development and Innovation Systems
   - Investment in local research and development remains low, le to reliance on imported technologies that may not be well suited Zambia's specific climatic ecology or social economic contexts;
   - Collaboration between research institutions, the private sector, and government agencies on adaptation technology development is limited

e) Barriers to Technology Transfer and Localization;
   - Regulatory and institutional challenges slow down transfer of technology from international partners to local stakeholders
   - Intellectual property concerns, lack of supportive policy frameworks and insufficient incentives hinder private sector participation in adaptation technology innovation and localization

f) Limited integration of Indigenous and Tradition Knowledge
   - Traditional practices and indigenous knowledge systems which offer locally viable adaptation solutions, are underutilised or not systematically Integrated with modern technologies.
   - There is need to develop hybrid approaches that combine traditional knowledge with innovative technologies in a culturally acceptable and technically effective manner;

Overcoming technological barriers will require a multi- pronged approach that includes increasing investment in climate -resilient technologies, building local technical capacities, strengthening national innovation systems and improving access to international technology transfer mechanisms under the Paris Agreement, including the Technology Mechanism and Climate Technology Centre and Network (CTCN).

4.3.2.4 Governance and Institutional Barriers

Zambia has made notable progress in integrating climate change into national development planning through its National Adaption Plan (NAP) processes. However, challenges remain in the form of insufficient coordination and collaboration among key stakeholders, including government institutions, local communities, non-governmental Agencies, (NGOs), civil society and private sectors. These gaps have often resulted in fragmented efforts and inefficiencies in the design and implementation of adaptation strategies

In addition, cultural norms and competing economic interests continue to create resistance to behavioural and institutional change, thereby limiting the adoption of climate-resilient technologies and practices.

Strengthening institutional capacity, fostering inclusive stakeholder engagement and enhancing policy coherence are critical to improving the effectiveness and sustainability of adaptation planning and implementation in Zambia.

4.3.2.5 Information and Knowledge Barriers

Inadequate or uncertain data related to climate change impacts, vulnerabilities, and risks can hinder effective decision-making and planning for adaptation. Data and information gaps, such as inadequate weather forecasting systems, make it difficult to anticipate and respond to climate-related events. Since the implementation of prioritized adaptation actions demand the participation of different stakeholders, limited awareness and knowledge about adaptation strategies among different stakeholder especially in rural communities can hinder implementation of the prioritized options. This demands the implementation of robust awareness programs.

Land tenure security affects long term investments. Inefficient land tenure systems in some communities could impede sustainable land management practices, and social inequalities may exacerbate vulnerability to climate impacts, particularly among women and marginalized groups. Addressing these barriers is essential to enhance Zambia's resilience to climate change and safeguard the well-being of its population and ecosystems.

4.4 Adaptation Strategies, Policies, Plans, Goals and Actions to Integrate Adaptation into National Policies and Strategies

The country has taken significant strides in integrating climate change adaptation into its national development agenda through the development of enabling policy and institutional frameworks. Central to these efforts is the National Adaptation Plan (NAP), which serves as the overarching medium to long -term strategic framework guiding Zambia's adaptation planning and implementation. The NAP outlines key vulnerabilities, identifies priority adaptation actions, and establishes mechanisms for integrating climate adaptation into national, sectoral and subnational development processes.

The NAP is closely aligned with Zambia's NDC under the Paris Agreement and the Eighth National Development Plan (8NDP), ensuring that adaptation measures are systematically embedded within national development planning and resource allocation. The plan prioritizes adaptation actions across sectors vulnerable to climate change including agriculture, water resources, health, infrastructure, energy, forestry and tourism.

The NAP is complemented by the national Policy on Climate Change (NPCC) of 2016, which provides a policy framework for mainstreaming climate change across sectors. Supporting the policies and strategies include the National Climate Change Response Strategy (NCCRS) and the National Adaptation Programme of Action (NAPA).

To ensure inclusivity and relevance, Zambia has emphasised a participatory approach in adaptation planning. Stakeholders including government institutions, Civil Society organizations (CSOs), the private sector, academia, traditional leaders, women, youths, persons with disabilities and local communities are actively engaged in implementation of adaptation measures. The Climate Change Gender Action Plan, further supports the inclusion of gender responsive strategies, recognising the disproportionate impacts of climate change on women and marginalized groups.

Several sector specific policies and strategies have also been updated to mainstream climate adaptation, including:

Health Sector:

- The National Health Adaptation Plan (HNAP) identifies climate sensitive health risks such as vector-borne, water-borne, and food-borne diseases. It outlines measures including disease surveillance, early warning systems preparedness and resilient healthcare service delivery during climate -induced disasters:

Agriculture and Food Security:

- The Second National Agricultural Policy (2016) promotes climate resilient agricultural practices and institutional capacity building for climate risk assessment
- The Climate Smart Agriculture Investment Plan (SCAIP, 2018) identifies investment priorities and local benefits of climate smart practices

Forestry and Ecosystem Management:

- The Forestry Policy (2009) and the National Parks and Wildlife Policy (2018) promote sustainable forest and wildlife management, with climate adaptation mainstreamed into ecosystem protection strategies

Fisheries and Livestock:

- The Fisheries and Aquaculture Policy promotes smart aquaculture and integrated ecosystem management.
- The Livestock Development Policy (2020) highlights the importance of climate information and early warning systems

Water Resources:

- The National Water Policy (2010) integrates climate change through public awareness campaigns, ecosystem monitoring and investments in resilient infrastructure such as irrigation and clean water systems;

Energy and Tourism:

- The Energy Policy (2019) recognises the need for climate mainstreaming and promotes low-carbon, renewable energy sources
- The National Tourism Policy (2015) emphasizes sustainable tourism development based on well conserved natural resources and cultural heritage

Mining Sector:

- The National Mineral Resources Development Policy (2022) encourages climate resilient and environmentally sound mining practices, supported by regulatory strengthening and improved technologies;

Social Protection:

- The National Social Protection Policy (2014) promotes climate smart technologies to enhance community resilience and sustainable development

4.4.1 Progress of Implementation of Adaptation Actions and Community Level Implementation

Zambia has implemented a number of adaptation projects aimed at enhancing community resilience and adaptive capacity, particularly in vulnerable regions. Key initiatives include:

- Accelerate Water and Agriculture Resources Efficiency in Zambia (AWARE)
- Pilot Programme for Climate Resilience Phase II (PPCR): Strengthening Climate Resilience in the Kafue Sub Basin (SCRIKA)
- Transforming Landscapes for Climate Resilience and Development (TRALARD)
- Ecosystem Based Adaptation (EbA)

- Local Climate adaptive Living Facility (LoCAL)

Civil Society organizations have also played a critical role. For example, World vision, the Voices for Climate Action (VCA) project led by a consortium including WWF, Zambia Climate Change Network (ZCCN) and ActionAid have supported locally driven adaptation initiatives and community development.

However, further efforts need to be scaled up, to strengthen the resilience and adaptative capacity of the rural communities that remain highly vulnerable to adverse impacts of climate change impacts.

4.5 Monitoring, Evaluation, and Lessons Learned

4.5.1 Monitoring and Evaluation of Adaptation Actions and Processes

Zambia monitors, evaluates and reviews progress in implementation of prioritized Adaptation measures through a structured system aligned with the NAP and its Implementation Plan guided by a Monitoring, Evaluation and Learning (MEL) Framework (GRZ-NAP, 2023). This process involves the regular collection and analysis of data against Key performance Indicators (KPIs) derived from the MEL framework for Climate Change adaptation.

At subnational level, District Planning Officers (DPOs) will coordinate regular monitoring activities using existing governance structures, including Ward Development Committees and District Development Coordinating Committees (DDCCs). Data is submitted to the Provincial Development Coordinating Committee (PDCCs) through the respective Provincial Planning Offices.

At national level, provincial and sectoral reports will be consolidated by the Ministry of Green Economy and Environment (MGEE) in collaboration with Ministry of Finance and National development (MFND). The MGEE is responsible for synthesizing these inputs into national adaptation Progress reports. These national adaptation reports provide input into the Biennial transparency reports coordinated by the Zambia Environmental Management Agency as part of the UNFCCC Enhanced Transparency Framework (ETF).

Currently the only monitoring and evaluation conducted for the NAP has been through the NDC platform[81].

4.5.2 Tracking Progress on Adaptation and Mitigation Implementation

To ensure transparency, accountability and continuous improvement in adaptation planning and implementation, Zambia is developing and operationalising systems to monitor and evaluate both adaptation and mitigation actions. These systems are critical for tracking progress towards building climate resilience and meet the country's commitments under its NDC.

[81] Zambia Environmental Management Agency (2020): Third National Communication to the United Nations Framework Convention on Climate Change (UNFCCC) – Zambia

To support this, Zambia has established three primary integrated data collection and reporting tools, designed to enhance coordination, facilitate reporting and inform decision making at national and international levels.

- **Integrated Monitoring, Reporting and Verification (MRV) Tool**
  The national MRV tool is designed to track adaptation and mitigation activities, including financial, technological transfer and capacity building support provided for implementation of actions and to generate data for national and international reporting. Hosted by the Zambia Environmental Management Agency, the MRV platform will be publicly accessible via a dedicated website. Although still under development, the tool is expected to enhance transparency and support evidence-based decision making

- **NDC Partnership Online Portal**
  As a member of the global NDC Partnership, Zambia has developed an NDC implementation Framework that allows for structured reporting on adaptation and mitigation progress. The portal facilitates knowledge exchange and learning from best practices among participating countries

- **National Carbon Registry**
  Zambia has developed a National Carbon Market Framework aimed at mobilising carbon finance to support the implementation of its NDC and to attract foreign direct investments in green growth sectors. The framework is designed to unlock new financing opportunities for climate mitigation while delivering tangible benefits to local businesses and communities.

  To facilitate participation in international carbon markets, Zambia has signed multiple bilateral cooperation agreements under Article 6 of the Paris Agreement and is actively developing a national Carbon registry to be hosted at the Zambia Environmental Management Agency. The registry will enable the transparent tracking of mitigation outcomes and support the issuance, transfer and retirement of carbon credits in both voluntary and compliance carbon markets. These efforts position Zambia to effectively engage in global carbon trading mechanisms while ensuring environmental integrity and national oversight.

Looking ahead, Zambia aims to scale up its adaptation and mitigation efforts by leveraging international climate finance, strengthen institutional frameworks, and expanding partnerships with non-state actors to ensure that adaptation and mitigation is not only nationally driven but also locally led and inclusive.

4.6 Loss and Damage Associated with Climate Change

4.6.1 Loss and Damage

Zambia continues to experience increasing loss and damage resulting from the intensifying impacts of climate change, particularly droughts, floods, dry spells and extreme temperatures. These climate related hazards cause widespread economic losses across multiple sectors. In agriculture which supports 70 % of population's livelihoods, climate induced events have led to declining crop yields and livestock productivity, thereby undermining national food security and rural incomes.

During the 2021/2022 rainy season, heavy rains and flash floods in Southern Province exacerbated by Tropical Cyclone Ana, displaced over 38,000 people, destroyed approximately 8,000 hectares of crops and forced the evacuation of 546 households in Namwala District alone. The infrastructure sector has similarly experienced significant economic setbacks, with extensive damage to roads, bridges, schools and electricity grids, resulting in disruptions to essential services and increased recovery and maintenance costs.

Beyond economic losses, Zambia also experiences substantial non-economic losses and damages, which though more difficult to quantify, have profound impacts on social and cultural well-being. Flood related displacement have severely affected housing particularly in rural areas where 91% of households live in traditional mud thatched dwellings. Such disruptions have eroded social cohesion, impacted mental health and contributed to the loss of cultural identity. The Lozi people's Kuomboka ceremony for example, a vital cultural event tied to the Barotse floodplain, has been cancelled in recent years due to insufficient water levels, signifying a loss of cultural heritage and community morale.

In addition, over 51 percent of Zambian households rely on unsafe or unimproved water sources, with rural communities disproportionately affected. Water scarcity, intensified by prolonged dry spells continues to impact sanitation, child health and school attendance, particularly among girls, thereby contributing to malnutrition, disease outbreaks and educational disparities.

4.6.2 Addressing Loss and Damage

While the country does not have a dedicated Loss and Damage policy, key actions to guide averting, minimalizing and addressing climate induced loss and damage, particularly from extreme weather events are embedded within existing frameworks, including the Disaster Management Act (2010), National Disaster Management Policy (2015) and the Disaster Management Framework (2017- 2030). The Disaster Management and Mitigation Unit (DMMU) operating under the Office of the Vice President coordinates preparedness and response efforts, including mitigation, recovery and prevention to climate hazards. The institutional coordination mechanism includes the National Disaster Management Committee, the Disaster Management Technical Committee and the decentralised structures at Provincial, District and Satellite levels. These bodies collectively support the government's ability to respond to disasters with speed, flexibility, ensuring that affected communities receive timely and effective support.

Although DMMU does not currently implement standalone Loss and Damage programs, it provides critical case by case support in response to climate-related events, addressing both economic (crop-failure, damaged infrastructure) and non-economic losses (eg displacements, loss of livelihoods, access to services.

To avert, minimize and address climate related losses and damages, Zambia employs a mix of adaptation, disaster risk reduction and financial protection measures. These include promotion of early warning systems, climate -resilient infrastructure, climate smart agriculture and social protection and safety nets and annual contingency planning led by the Zambia Vulnerability Assessment Committee (ZVAC). The National Contingency plan provides annual forecasts and outlines expected hazards, projected impacts, affected populations, response actions and associated costs informing DMMU, coordinated emergency response[82]. Further, risk transfer mechanisms such as micro- insurance and contingency financing are being explored to help protect Vulnerable communities from future climate shocks.

In alignment with the goals of the Santiago Network on Loss and Damage, Zambia is working towards the development of a comprehensive loss and damage framework and long-term strategy. This will support enhanced technical coordination, resource mobilization and capacity building to address both current and future climate induce losses particularly among the most vulnerable.

4.7 Cooperation, Good Practices, Experience and Lessons Learned

Zambia's climate adaptation efforts have been supported through cooperation with international partners such as the World Bank, UNDP, GIZ, Africa Development Bank among others to implement climate change adaptation projects. Some of the key successes include the promotion of sustainable agriculture particularly among small-scale farmers, early warning systems and the integration of climate adaptation into national planning frameworks and the local disaster risk management frameworks.

Good practices emphasize local empowerment, blending indigenous knowledge with science and inclusive planning particularly involving women and vulnerable groups. Despite the absence of a dedicated loss and damage policy, relevant actions are embedded in national frameworks like the Disaster Management Act (2010), the National Contingency Plans, coordinated by DMMU. Furthermore, Zambia has witnessed an upward increment in incidence of climate sensitive diseases such as Diarrhoeas, malaria and Anthrax (NHSP, 2022- 2026), providing room to establish a robust framework for response to climate sensitive diseases, such as intelligence and early warning systems.

In spite of some achievements, challenges remain in securing sustainable financing, improving data availability and scaling up interventions. Risk communication and social inequalities continue to impede progress. However, Zambia’s adaptive approaches and partnerships provide a strong foundation for building long term climate resilience.

[82] National Contingency Plan 2022

Chapter 5: Financial, Technology Development and Transfer and Capacity Building Support Needed, and Provided and Mobilized

5.1 Introduction

This chapter provides a comprehensive overview of the financial, technology transfer, and capacity building support needed and received for Zambia's climate action implementation. It highlights national context, institutional arrangements and country driven strategies that guide climate support identification, tracking, and reporting. Additionally, it outlines methodologies, definitions, and assumptions used in reporting support needs and support received. This chapter also includes insights on climate research and systematic observation, education, training and public awareness as part of Zambia's Fourth National Communication (NC4).

5.2 National Circumstances, Institutional Arrangements, and Country-Driven Strategies

Zambia's climate support needs and support received align with national commitments under the Nationally Determined Contribution (NDC) and the NDC Implementation Framework. These frameworks are designed to support Zambia's transition towards a low carbon, resilient economy whilst ensuring sustainable development. The country's climate action is further guided by key legislation and policies which includes the Vision 2030, Eighth National Development Plan (8NDP), the National Policy on Climate Change (2016), the Climate Change and Green Economy (Act No. 18 of 2024), Environmental Management Act (No. 12 of 2011 as amended by Act No. 8 of 2023), the Green Growth Strategy (2023) and other sectoral policies and plans.

Zambia's NDC implementation framework identifies priority areas for mitigation and adaptation and other cross-cutting areas requiring significant financial, technological, and capacity-building support for successful execution. National institutions play a critical role in identifying, tracking, and reporting climate support. Some of these institutions include the following:

- *Ministry of Finance and National Planning (MoFNP):* Manages national budgeting, economic planning, resource mobilization, and tracks domestic and international climate finance;
- *Ministry of Green Economy and Environment (MGEE):* Coordinates the implementation of climate change adaptation and mitigation and operates an NDC tracking tool to monitor financial, technological, and capacity-building support. In

addition, the *MGEE hosts the* National Designated Authority (NDA) for The Green Climate Fund and the Adaptation Fund;

- *Zambia Environmental Management Agency (ZEMA*): Responsible for climate reporting through the Biennial Transparency Reports (BTRs) and National Communications (NCs) as well as developing the national MRV system in alignment with the Enhanced Transparency Framework (ETF);
- *Ministry of Technology and Science (MoTS*): Facilitates technology development and transfer and promotes climate-related innovation; and
- *Higher Learning and Research Institutions*: Play a key role in climate capacity-building and research.

Despite progress in institutional arrangements and tracking mechanisms, significant challenges remain in coordinating and reporting support needs and support received for implementation of climate action. These include limited institutional capacity, fragmented financial reporting systems and inconsistencies in donor reporting formats. Therefore, harmonising MRV tracking systems and enhancing institutional capacities will be critical to improving transparency and ensuring the efficient allocation of climate resources. To address these challenges, Zambia is establishing an integrated Measurement, Reporting, and Verification system building on existing frameworks and a national Carbon Registry aligned with the Enhanced Transparency Framework (ETF).

5.2.1 Support Needs for NDC Implementation

The NDC implementation builds on the 8NDP by specifying concrete climate actions and support needs in a log frame format. To strengthen ownership of climate support needs, priority sectors and interventions were identified through stakeholder consultations, ensuring alignment with national sectoral policies and strategies.

Arising from these consultations, six key sectors and subsectors with the highest mitigation potential were identified to effectively reduce greenhouse gas emissions. The priority sectors and subsectors include Agriculture, Livestock, Energy, Forest, Industrial Processes and Product Use, Transport, Coal, and Waste. Additionally, the Framework includes cross-cutting sectors such as Banking and Finance, climate information systems, Climate Transparency, and Environmental Issues. Other sectors, mainly focusing on adaptation, include Agriculture, Buildings and Infrastructure, Health, and Water.

Figure 5.1 below contains details of sectors with their outcomes and output areas. These represent the country's costed qualitative needs in line with elaborated sector and subsector priorities.



Figure 5.1: Zambia NDC Implementation Framework 2023-2030 Overview

5.2.2 Financial Support Needs

The methodologies, definitions and the underlying assumptions for identification of financial support needs for implementation of climate policies and programs for priority sectors in Zambia are outlined in Table 5.1

Table 5-1: Assumptions, definitions, and methodologies used when determining financial support needed

Metric	Description
Currency conversion	USD /ZMW Exchange Rate of 1 USD =K16.9/$
Estimating support needed	Average Inflation rate (2011-2021) – 6.4% Discount rate 6% Price level ration of Purchasing Power Parity (PPP) Conversion factor 2021 - 0.3
Determining reporting year/time frame	Implementation Period: 2017 to 2022. We note that end year for planning purposes is 2030 which represents the NDC timeline.
Identification of support from specific sources	Support sources were identified using the Organisation for Economic Cooperation and Development (OECD) database, government of Zambia for domestic financing through Ministry of Finance and National planning (MOFNP), Websites or databases of support providers such as World Bank, African Development Bank (AfDB), European Union (EU), United Kingdom (UK), United States Aid (USAID).
Type of support	Information is provided in various bilateral and multilateral agreements, programme and project documents. Breakdowns of commitments and disbursements are also included in various reports.
Status of supported activity	Zambia has implemented the Online Partnership Plan Tool (OPPT) which contains information on planned, ongoing and completed projects and programs. The OPPT contains planned activities (needs) as expressed by government and projects (support received) as committed by cooperating partners. The OPPT is updated on a quarterly basis.
Channel type	Bilateral and multilateral Agencies websites, Government Budget statements and financial reports.
Support type	Mitigation, Adaptation and Crosscutting
Financial instrument	Grants, concessional loans, non-concessional loans, equity, Guarantee, Private sector, government domestic expenditure, Public Private Partnership
Sectors and subsectors	Agriculture, Livestock, Energy, Forest, Transport, Industrial processes and Product Use, Waste, Banking and Finance, climate information systems, Climate Transparency, and Environmental Issues and adaptation sectors include Agriculture, Buildings and Infrastructure, Health, and Water
Use, impact and estimated results of support needed and received	Reports are made against 18 Outcomes, 135 Outputs and 158 Key Performance Indicators. The OPPT provides reporting on impacts of interventions.
Contribution to technology development and transfer and capacity building	Technology transfer and capacity building indicators are integrated into the Implementation Framework within sectors and projects. Most projects do not expressly separate technologies and capacity building but are incorporated into the project design as components of projects.
Avoiding double counting	Double counting was avoided by referencing different project source documents to avoid duplication of reporting. Transparency related capacity building is reported based on the information contained in the project reports.

The financial needs assessment draws on data from national and international sources, including government reports, and databases maintained by development partners and multilateral institutions. Sectoral consultations and technical analyses were undertaken to estimate the scale of investment required, taking into account both mitigation and adaptation priorities.

Zambia uses a centralised platform the "Online Partnership Plan Tool (OPPT) to track climate support. This tool provides data on planned, ongoing and completed projects and programmes. It distinguishes between expressed support needs and actual support received, enhancing transparency, coordination and impact monitoring. The tool is updated quarterly and supports reporting on 18 key outcomes, 135 outputs, and 158 key performance indicators, all aligned with the NDC implementation framework

Most climate projects in Zambia integrate technology transfer and capacity building components into their design. While these components are often not reported separately, they play a crucial role in enhancing the effectiveness and sustainability of climate interventions. To ensure accurate reporting and avoid duplication, Zambia cross-references multiple data sources and verifies project information against official documentation. These costed needs form the basis for Zambia's engagement with international partners and funding mechanisms, including the Green Climate Fund (GCF), Adaptation Fund (AF), the Global Environment Facility (GEF), and bilateral and multilateral Finance channels.

5.2.3 Barriers to Attracting Investments

Zambia is listed among the Least Developed Countries characterised by low income, weak human assets, and high economic vulnerability to various local, continental and global shocks. Foreign exchange fluctuations often trigger import price inflation which affects the stability of prices of goods and services. Poverty levels remain high estimated at over 40% overall, affecting mostly the rural communities. Unemployment especially among the youth remains challenging shrinking further the capacity of citizens to participate effectively in economic development and climate investments in general. Specific barriers hindering investment flow for NDC Implementation can be categorised as those influenced by demand side barriers and those triggered by supply side barriers.

Demand-side Barriers

Many businesses in Zambia operate informally, making it difficult for them to access climate finance from commercial banks and other lending facilities. Where such lending avenues exist, the financial cost remains extremely high ranging between 25% and 35% per annum. This is largely due to the perception of risk which is deemed high by lending institutions in the country. Added to the challenge of the high cost of borrowing is the limited asset registration which hinders businesses' ability to secure funding. This is coupled by limited financial literacy which entails that businesses and individual may not fully understand climate finance options or how to access them.

Supply-side Barriers

Supply side barriers mainly deal with climate investments and institutional capacities. Zambia's financial system is somewhat static and limited in responsiveness to rapid shifting global economic trends. Zambia's financial system requires improvement to decrease

prohibitive interest rates and increase access to climate finance. While government offers higher returns to government bonds, this trend also locks out investments in other asset classes, including climate finance. Furthermore, the institutional investor market in Zambia is fragmented, limiting the availability of climate finance.

Additional supply side challenges include limited capacity to develop bankable climate finance proposals, high risks and unclear returns deterring private sector investment in climate projects, limited access to international climate funds, insufficient financial resources allocated to climate change mitigation and adaptation efforts and debt vulnerability.

5.2.4 Financial Support Needed for Implementation of Zambia's NDC

Zambia's Nationally Determined Contribution Implementation Framework clarifies and elaborates the country's climate financial needs. The country's climate support needs are estimated at US$17.2 billion for the period 2016 -2030 [83]. This funding covers the implementation of the INDC (first NDC) (2016), the Revised and Updated NDC covering the 5-year period from 2017 to 2022.

Following extensive consultations, the budget revised to accommodate the macroeconomic factors that threatened the achievement of large-scale financial estimation initially pegged at US$50 billion. Debt obligations accompanied by inadequate institutional and technical capacities informed the conservative adjustments following the Revised NDC Submission in 2021. As such, during the Implementation period of this Framework, total financial resources amounting to US$17.2 billion from domestic and international sources would have been mobilized and expended towards achieving the outputs identified in the Framework. The analysis below highlights the priority sectors, and the intended achievements under each.

Table 5.2 presents financial support needed for implementation of Zambia's NDC.

[83] The 2016 to 2030 period is aligned with the period cooperating partners indicated they provided the support to Zambia on the implementation of the NDC.

Table 5-2: Financial Support Needed for Implementation of Zambia's NDC

Project/Programme Activity or Other	Estimated Amount	Expected Timeframe	Expected Financial Instrument	Type of Support	Contribution to Technology Development and Transfer Objectives	Contribution to Capacity Building Objectives	Whether the activity is anchored in a national strategy and/ or NDC	Expected Use Impact and estimate Results	Additional Information
1.1. Development of the Climate Finance Resource Mobilization Strategy	$67,500	The MoFNP Strategic Plan approved and launched by December of 2023	Grants	Cross-cutting	0	1	1	1.1.1. Climate Finance Resource mobilization Strategy developed	(i) A Strategic Planning Committee constituted in 2021; (ii) The 8th National Development Plan 2022-2026 launched; and (iii) A draft strategic plan for MoFNP for the period 2022 to 2025 has been prepared which incorporates a Climate Finance Resource Mobilisation Strategy
1.2. Establishment and launching of the Climate change Fund	$978,236	Climate Change Bill to establish Fund passed by the Parliament by December of 2023	Grants	Cross-cutting	0	1	1	1.2.1. Climate change bill to establish and pass the fund	(i) Draft Bill in Place and circulated to stakeholders for comments in 2022 (ii) Council of Ministers approved the draft bill in 2022 (iii) Draft is with Ministry of Justice for legal drafting

1.3. Mainstreaming of Climate change into socio-economic planning, budgeting and public financial management	$226,457	Final Guidelines produced by March of 2024	Grants	Cross-cutting	0	1	1	1.3.1. Guidelines for assessing integration of climate adaptation and mitigation in macroeconomic and microeconomic policies	(i) Existing Macroeconomic policies which lack integration of climate change mitigation and adaptation. (ii) Implementation of the climate tagging tool to the Budget Process
1.4. Conduct Climate Change Public Expenditure Reviews	$135,305	Climate Change Public Expenditure Reviews final report by December of 2024	Grants	Cross-cutting	0	1	1	1.4.1 Comprehensive climate change public expenditure and budget reviews conducted	Reconciliation activities on what was funded versus budgeted
1.5. Strengthen Budget Tracking Tool for climate change investments	$50,165	Budget Tracking System is operational by December of 2024	Grants	Cross-cutting	0	1	1	1.5.1. Functional climate change budget Tracking System and Tools in place	Budget tracking reports for 2014 and 2018
1.6. Develop and Operationalise the Climate proofing manual for public financial management policies	$33,772	Climate Proofing final Manual by December of 2023	Grants	Cross-cutting	0	1	1	1.6.1. Climate proofing final manual for integrating climate change into Public Financial Management policies developed and operationalized	Template-Climate proofing manual for Livestock

1.7. Conduct Capacity Building for national and sector working groups	$100,145	100% sector working groups trained by December of 2025	Grants	Cross-cutting	0	1	1	1.7.1 National and sector working groups trained in mainstream climate into sectoral and national development plans	Climate Change mainstreaming tool study report
1.8. Promote and Implement Private Public Partnership Infrastructure on Adaptation and Mitigation	$186,288	TBC projects under implementation phase by December of 2030	Grants	Cross-cutting	0	1	1	1.8.1 Private Public Partnership infrastructure projects implemented	PPP Ministerial Committee constituted supported by the PPP Secretariat in the Ministry of Finance and National Planning
2.1 Bank of Zambia Develop the Green Finance Guidelines and Green Loans Guidelines	$60,000	Green Finance Guidelines Gazetted by April of 2024	Grants	Cross-cutting	0	1	1	2.1.1 Green Finance Guidelines developed	BoZ Green Finance Technical Working Group (TWG) established in 2017; (ii) Produced 2 knowledge products on green finance; (iii) TA obtained from Ministry of Lands and Natural Resources, Alliance for Financial Inclusion, World Bank and Toronto Centre

2.2 Capacity building program and virtual peer exchange for BoZ staff, selected Government officials, and financial institutions on green finance and the operationalization of the guidelines (covering TCFD, TNFD, and Basel recommendations on sustainable finance)	$60,000	100% examiners/inspectors at BoZ, PIA and SEC trained; and 50% of the Financial Sector Policies and Management Unit at Ministry of Finance and National Planning by April of 2024	Grants	Cross-cutting	0	1	1	2.2.1 Manual updated and trainings delivered by April 2024	(i) BoZ Green Finance Technical Working Group (TWG) established in 2017; and (ii) trainings conducted by Toronto Centre; Alliance for Financial Inclusion; Deutche Bundesbank; Bank of England & Bank of Ghana; IMF/Africa South; Bank of England & Reserve Bank of South Africa

2.3 Develop Regulatory and supervisory instruments to operationalize the guidelines (in line with the country context and international best practices such as nature related financial disclosures and climate related financial disclosures and the Basel recommendations on sustainable finance)	$80,000	Regulatory and supervisory instruments for greening the banking sector developed (as guided by the consultant) by April of 2024	Grants	Cross-cutting	0	1	1	2.3.1 Regulatory and supervisory instruments developed by April 2024	(i) BoZ Green Finance Technical Working Group (TWG) established in 2017; (ii) the Tripartite (BoZ, PIA, SEC) Green Finance Mainstreaming Working Group established in January 2021 and partnerships for TA established with Ministry of Lands & Natural Resources, Ministry of Green Economy & Environment, Ministry of Finance & National Planning, UN Biofin Zambia Initiative, World Wide Fund (WWF) Zambia

2.4. Develop Climate Taxonomy for the financial sector	$50,000	Green finance taxonomy developed by December of 2024	Grants	Cross-cutting	0	1	1	2.4.1. Green Finance taxonomy for Zambia developed by December 2024	(i) BoZ Green Finance Technical Working Group (TWG) established in 2017; (ii) the Tripartite (BoZ, PIA, SEC) Green Finance Mainstreaming Working Group established in January 2021 and partnerships for TA established with Ministry of Lands & Natural Resources, Ministry of Green Economy & Environment, Ministry of Finance & National Planning, UN Biofin Zambia Initiative, World Wide Fund (WWF) Zambia

2.5 Develop Incentives for Green Bonds	$50,000	Submission for incentives for green bonds made to Parliamentary Review Committee, and subsequently, the 2023 National Budget included a waiver on the 15% WHT on interest earned on green bonds by January of 2023	Grants	Cross-cutting	0	1	1	2.5.1 Tax incentives provided for green bonds	(i) SEC issued regulations for green bonds; (ii) The Tripartite (BoZ, PIA, SEC) Green Finance Mainstreaming Working Group established in January 2021 with partnerships for TA from Ministry of Lands & Natural Resources, Ministry of Green Economy & Environment, Ministry of Finance & National Planning, UN Biofin Zambia Initiative, World Wide Fund (WWF) Zambia

2.6 Development of Green Bond Market	$50,000	Green Bonds Guidelines reviewing by December of 2023	Grants	Cross-cutting	0	1	1	2.6.1 A Sectoral Green Bond Taxonomy for Zambia developed	(i) SEC issued regulations for green bonds; (ii) The Tripartite (BoZ, PIA, SEC) Green Finance Mainstreaming Working Group established in January 2021 with partnerships for TA from Ministry of Lands & Natural Resources, Ministry of Green Economy & Environment, Ministry of Finance & National Planning, UN Biofin Zambia Initiative, World Wide Fund (WWF) Zambia
		Green Bond Investment online portal development by December of 2023	Grants	Cross-cutting	0	1	1	2.6.2 An online Green Bond Investment Portal (for pipeline projects) for Zambia developed	
		Establishing a pipeline for bond issuers by December of 2023	Grants	Cross-cutting	0	1	1	2.6.3 Technical Assistance services for potential green bond issuers, including capacity building	

2.7 Green Finance Policy and Implementation Plan for Zambia's financial sector	$50,000	GFP Implementation Plan developed by June of 2024	Grants	Cross-cutting	0	1	1	2.7.2 An Implementation Plan for the Green Finance Policy for the financial sector.	The Tripartite (BoZ, PIA, SEC) Green Finance Mainstreaming Working Group established in January 2021 with partnerships for TA from Ministry of Lands & Natural Resources, Ministry of Green Economy & Environment, Ministry of Finance & National Planning, UN Biofin Zambia Initiative, World Wide Fund (WWF) Zambia
2.8 Green Finance Tagging and Reporting System (to report on financial flows related to climate change, biodiversity conservation and green finance) for Zambia's financial sector	$50,000	Green finance tagging / reporting system developed under BoZ regulatory framework by June of 2024	Grants	Cross-cutting	0	1	1	2.8.1 A green finance tagging/reporting system under the BoZ regulatory framework	

		Green finance tagging / reporting system developed under PIA regulatory framework by June of 2024	Grants	Cross-cutting	0	1	1	2.8.2 A green finance tagging/reporting system under the PIA regulatory framework	The Tripartite (BoZ, PIA, SEC) Green Finance Mainstreaming Working Group established in January 2021 with partnerships for TA from Ministry of Lands & Natural Resources, Ministry of Green Economy & Environment, Ministry of Finance & National Planning, UN Biofin Zambia Initiative, World Wide Fund (WWF) Zambia
		Green finance tagging / reporting system developed under SEC regulatory framework by June of 2024	Grants	Cross-cutting	0	1	1	2.8.3 A green finance tagging/reporting system under the SEC regulatory framework	
3.1. Promotion of irrigation and efficient use of water resources.	$61,209,800	80,000 farmers. by December of 2026	Concessional Loan	Financial	0	1	1	3.1.1. Number of farming households surveyed using efficient irrigation system disaggregated by gender & age	

3.2. Increase the use of technologies for soil fertility improvement and moisture storage (including soil conservation measures).	$78,507,486	700,000 farming households by December of 2026	Concessional Loan	Financial	1	1	1	3.2.1 Number of farming households surveyed adopting technologies for fertility improvement and moisture storage disaggregated by gender and age	50,000 farmers.
3.3. Increase the use of indigenous and scientific knowledge on drought tolerant crop types	$173,765,470	750, 000 additional farming households adopting drought resilient crops by December of 2026	Grants	Financial	1	1	1	3.3.1 Number of farming households surveyed adopting drought resilient crops disaggregated by gender and age	100,000 farmers.
3.4. Upscaling access to social cash transfer by the vulnerable farmers.	$877,765,023	1,500,000 vulnerable farmers segregated by gender by December of 2026	Grants	Financial	0	0	1	3.4.1 Number of male and female headed HH of vulnerable farmers covered by social cash transfer schemes	1.15million households representing about 72% of agricultural households. (Source RALS19)
3.5. Increase the use access of farming households to insurance against climate-induced risks related to agriculture and infrastructure	$103,008,759		Grants	Financial	0	1	1	3.5.1 Number of farmers (by season) under weather indexed insurance	1,3 million households (MCDSS Factsheet 2022).

3.6. Accelerate the implementation of Food Security Pack Programme	$975,659,927		Grants	Financial	0	1	1	3.6.1 Number of beneficiaries segregated by age and gender receiving food security packs	In the 2021/2022 agriculture season, FISP will target a total of 1,024,434 farmers across the country. All beneficiaries of the programme each contribute K400 to be eligible to receive inputs, and from this contribution, K100 will be paid as a premium towards the weather index insurance.
3.7. Promote value addition in agriculture production and productivity	$347,616	150 enterprises by December of 2024	Concessional Loan	Financial	1	1	1	3.7.1 Number of enterprises involved in agro - processing and value addition	280,000 (2022/2023, according to Ministry of Community Development)
3.8. Conservation and commercialization of indigenous crop varieties	$6,184,514	160 community seed banks established by December of 2026	Grants	Financial	1	1	1	3.8.1 Number of community seed banks established	55 Enterprises
3.9. Implement Gender sensitive agriculture technologies	$29,154,171	400000 by December of 2026	Concessional Loan	Financial	1	1	1	3.9.1 Number of female farmers trained in gender sensitive agricultural technologies	N/A
4.1. Strengthening of Legal Framework for Meteorological Services	$120,208	Bill enactment by Parliament by December of 2025	Grants	Technical Assistance	0	1	1	4.1.1. Enactment of Meteorology Bill	650,000 households adopting improved technologies by 2014 according to IAPRI

		Meteorological Policy launched by December of 2025	Grants	Technical Assistance	0	1	1	4.1.2. Meteorological Policy	N/A
4.2. Increasing awareness and information about climate change risks and early warning systems	$1,770,841	One product by sector (Water & Energy, DRM, Health & AFOLU) by December of 2025	Grants	Technical Assistance	0	1	1	4.2.1 Climate Information Products and Services tailored to each sector by year	N/A
		7 by December of 2025	Grants	Technical Assistance	0	1	1	4.2.2 Crops covered with climate and weather information services	General Product
4.3. Strengthened coordination and information exchange processes to optimize and potentiate climate actions and build community resilience	$0	Monthly meeting by sector during rainy season by December of 2025	Grants	Technical Assistance	0	1	1	4.3.1 Number of technical meetings with stakeholders on the impacts of weather, climate, climate variability and climate change with each sector annually	1, maize
4.4. Expand Internet bandwidth	$113,383	30Mbps by December of 2025	Grants	Financial	1	1	1	4.3.2 Internet bandwidth expanded	Technical Committee meetings on rainfall season forecast 3 meetings with Agricultural sector
4.5. Develop Applications for accessing weather and climate products	$211,636	One platform per sector (Water & Energy, DRM, Health &	Grants	Financial	1	1	1	4.5.1. Digital Platforms for accessing weather and climate products tailored at the sectoral level developed	10 Mbps 2023

		AFOLU) by December of 2025							
4.6. Digitization of paper records	$4,018,727	2,250,000 hard copy records digitized by December of 2025	Grants	Technical Assistance	1	1	1	4.6.1. Number of hard copy records digitized	26 innovations in digital agriculture in 2022
4.7. Enhance access to modernised computing infrastructure	$349,200	116 computers by December of 2024	Grants	Technical Assistance	1	1	1	4.7.1. Number of computing infrastructure for weather and climate modelling acquired	3,000,000 on paper in 2022
		25 TB of Cloud based Storage and processing by December of 2024	Grants	Technical Assistance	1	1	1	4.7.2. TB of Cloud based Storage and processing	3 high-performance computers 22 Tb & 512 Gb of Memory RAM
4.8. Strengthen linkages between ZMD and radio stations	$207,701	100 by December of 2025	Grants	Technical Assistance	1	1	1	4.8.1. number of linkages with community radio stations	
4.9. Orient and train stakeholders on the development of a user-oriented weather and climate services.	$130,228	450 agricultural extension officers trained by December of 2025	Grants	Technical Assistance	1	1	1	4.9.1 Number of agricultural extension officers trained in the development of user-oriented weather and climate services	17 community radio stations (total of 78 radio stations) Reached in 2022

4.10. Conduct the Mapping of sectors and locations specific areas receiving weather and climate products, services and early warning.	$59,825	Report produced by December of 2024	Grants	Technical Assistance	1	1	1	4.10.1 Mapping report of sectors and locations specific areas generating data and receiving weather and climate products, services and early warning produced	125
4.11. Develop and document Socio-economic value of meteorological services		Assessment report launched by December of 2023	Grants	Technical Assistance	0	0	1	4.11.1 Assessment report on the importance of meteorological services for society and the economy made	0
4.12. Conduct demonstrations of the value of weather and climate services	$2,672,060	4 pilot projects under implementation by December of 2025	Grants	Technical Assistance	0	0	1	4.12.1. One pilot project per priority sector enhancing provision of weather and climate services implemented	Draft
4.13. Establish Community-based workshops to enhance awareness and participation in voluntary rainfall observation.	$706,345	116 by December of 2025	Grants	Technical Assistance	0	1	1	4.13.1. District-based workshops to enhance awareness and willingness to participate in voluntary rainfall observation conducted annually	0
4.14. Establish Research collaborations with learning institutions locally	$80,363	10 by December of 2025	Grants	Technical Assistance	0	1	1	4.14.1. Number of MoU's with research and higher learning institutions established	0

4.15. Promote Joint international Resource Mobilization and implementation projects	$3,967,830	6 by December of 2024	Grants	Technical Assistance	0	1	1	4.15.1. Number of projects undertaken to enhance meteorological service provision	UNZA, CBU, Columbia University, IAPRI
4.16. Conduct staff training in project writing and resource mobilization proposals	$17,032	25 by December of 2024	Grants	Technical Assistance	0	1	1	4.16.1. Number of staff trained to synthesize and feature weather and climate information in sectoral project reports	0
4.17. Expansion and Modernisation of weather and climate observation infrastructure	$15,297,548	Ground station 500 Rainfall station 2400 Upper Air Monitoring Systems 5 by December of 2025	Grants	Technical Assistance	0	1	1	4.17.1 Items procured for the expansion and modernisation of weather and climate observation infrastructure	0
5.1. Enhance the placement Forest under management of communities	$103,364,438	2100000 Ha by December of 2026	Grants	Technical Assistance	0	1	1	5.1.1. Hectares of forest put under community forest management (additional to baseline)	Ground station 210Rainfall station 461Upper Air Monitoring Systems 0 by 2023
5.2. Increase natural forest regeneration	$174,401,315	600000 Ha by December of 2030	Grants	Technical Assistance	0	1	1	5.2.1. Hectares of forest put under assisted natural regeneration interventions in degraded forest ecosystems	2,000,000

5.3. Upscale Tree planting	$10,795,612	7500 Ha by December of 2026	Grants	Technical Assistance	0	1	1	5.3.1. Hectares of trees planting using suitable tree species	N/A
5.4. Increased capacities of forest professionals to enhance their ability in responding to climate change.	$3,017,387	1160 by December of 2026	Grants	Technical Assistance	0	1	1	5.4.1. Number of forestry professionals trained on climate change response disaggregated by gender	N/A
5.5. Conduct Fire Management Training	$1,821,837	185 by December of 2025	Grants	Financial	0	1	1	5.5.1. Trainings in fire management delivered to CF Management Groups	0
5.6. Promote early forest burning clearing practice	Same as E5.5	750000 Ha by December of 2026	Grants	Financial	0	1	1	5.6.1. Hectares of forest burnt early	District level fire departments in operation and with firefighting expertise
5.7. Promotion of alternative Sources of Livelihoods at Household level in forested areas	$2,169,566	60% households report taking up alternative livelihoods in forest areas by December of 2026	Grants	Financial	0	1	1	5.7.1. % Of households reporting taking up alternative livelihoods in forest areas (disaggregated by gender)	Ongoing early fire burning countrywide
5.8. Conduct awareness campaigns on impacts of climate change on forests	$454,121	185 by December of 2025	Grants	Financial	0	1	1	5.8.1. CFMG community awareness campaigns on the impacts of climate change on forests (disaggregated by gender)	N/A

5.9. Improve forest fire management at national and subnational levels	Same as E5.5	90 by December of 2025	Grants	Technical Assistance	0	1	1	5.9.1. Forest fire management plans developed (CFMG)	0
5.10. Establish Forest Early warning and rapid response systems for fire using electronic channels	$4,767,876	1 by December of 2025	Grants	Financial	0	1	1	5.10.1. Forest early-warning and rapid-response systems for fire using electronic channels established	0
5.11. Conduct Research on vulnerable forest ecosystems in Zambia	$263,794	10 by December of 2025	Grants	Technical Assistance	0	1	1	5.11.1. Research reports on vulnerable forest ecosystems in Zambia conducted	0
5.12. Conduct law enforcement operations in gazetted forest and protected areas	$469,003	15000 law enforcement operations conducted in gazetted forests and protected areas by December of 2026	Grants	Financial	0	1	1	5.12.1. Number of law enforcement operations conducted in gazetted forests and protected areas	1
6.1. Develop and disseminate Policy Paper on gender, climate change and forestry	$114,816	Policy Paper on gender, climate change and Forestry developed and disseminated by December of 2024	Grants	Financial	0	1	1	6.1.1. Development of policy paper, including sector baseline diagnostic, on gender, climate change and Forestry developed and disseminated	N/A

6.2. Establish database on participation in forest management	$109,949	Database disaggregated by gender established by December of 2024	Grants	Technical Assistance	0	1	1	6.3.1. Database of disaggregated information with respect to gender, forest and climate change issues developed	CGAP Report, Gender mainstreaming guidelines, Gender Policy
6.3. Increased participation of women in Community Forest Management Groups	$48,037	100 additional annually trained female representatives by December of 2025	Grants	Technical Assistance	0	1	1	6.4.1. Female representatives trained in Community Forest Management Groups (CFMG)	UN REDD database, MRV Systems (ZEMA)
6.4. Produce and publish lesson learnt materials	$51,312	25 Materials on lessons learned developed by December of 2025	Grants	Technical Assistance	0	1	1	6.6.1. Materials on lessons learned developed	0
7.1. Increase solar energy contribution to the national installed electricity generation capacity	$923,599,661	Additional 720 MW under construction or commissioned by December of 2030	Concessional Loan	Financial	1	1	1	7.1.1. Megawatts of solar electricity supplied in the grid	0
7.2. Increase the supply of low carbon based hydro-electricity into the grid	$3,426,902,997	Additional 1400 MW of power generation by December of 2030	Concessional Loan	Financial	1	1	1	7.2.1. Megawatts of hydroelectricity supplied	89MW (Ngonye, Bangweulu)

7.3. Produce and supply wind electricity into the grid	$494,327,586	300MW of power generation by December of 2030	Concessional Loan	Financial	1	1	1	7.3.1. Megawatts of wind electricity supplied into the grid	2354 MW (2019) Large Hydro 43.8MW (2021), Initial Batoka Gorge Feasibility study completed in 1993, another update in 2005 and current 2018
7.4. Generate and supply geothermal electricity into the grid	$66,576,087	17,7MW of power generation by December of 2030	Concessional Loan	Financial	1	1	1	7.4.1. Megawatts of geothermal electricity generated and supplied into the grid	0MW
7.5. Generate Biomass based electricity and supply into the grid	$307,071,125	100MW of power generation by December of 2030	Concessional Loan	Financial	1	1	1	7.5.1 Megawatts of electricity generated through biomass and supplied into the grid	0MW
7.6. Assess the potential of Nuclear based electricity as future source of energy	$5,278,690	Feasibility study concluded by December of 2026	Concessional Loan	Financial	1	1	1	7.6.1. Feasibility study for nuclear power development	40MW (2019) – at Nakambala sugar plant and
7.7. Increase the generation in renewable energy for Off-grid supply	$3,604,698	15 by December of 2026	Concessional Loan	Financial	1	1	1	7.7.1. 15 RE off-grid projects	ZESCO Energy Mix Strategic Plan launched (10-year rolling)
7.8. Increase the number of businesses connected to mini grids	$740,892,423	77299 by December of 2026	Concessional Loan	Financial	1	1	1	7.8.1. Businesses connected to mini grids	Fifteen additional renewable energy off-grid projects will be developed by 2026 in addition to the 7 in 2021 (8 NDP)

7.9. Connect Public and Private Entities to mini grids	$7,645,601	1217 by December of 2026	Concessional Loan	Financial	1	1	1	7.9.1. Public and private institutions connected to mini grids	14,711 businesses connected
7.10. Promote Energy efficiency and conservation		0.25 by December of 2030	Concessional Loan	Financial	1	1	1	7.10.1. % Of surveyed household using alternative cooking solution	ZESCO Energy Mix Strategic Plan launched (10-year rolling)
7.11. Produce and distribute Improved cook stoves across the country		100000 by December of 2027	Concessional Loan	Financial	1	1	1	7.11.1. Improved cookstoves distributed	92% of households using charcoal in 2021
7.12. Conduct mass replacement of Incandescent bulbs with LED/CFL	$9,425,644	3,500,000 LEDs distributed by December of 2027	Concessional Loan	Financial	1	1	1	7.12.1. Number of Incandescent bulbs replaced with LED/CFL	Strategic and Action Plan launched.
7.13. Update legal framework in renewable energy and energy efficiency	$168,954	Renewable Energy Act updated by December of 2026	Concessional Loan	Financial	0	1	1	7.13.1 Legal framework for renewable energy amendment	5,000,000 bulbs in 2017
		Energy Efficiency Act updated by December of 2026	Grants	Technical Assistance	0	1	1	7.13.2 Legal and implementation framework for renewable energy developed	Mini-grid Regulatory framework developed
7.14. Map stakeholders in the energy efficiency and renewable energy sub-sector (province & district).	$99,027	Sub-sector energy efficiency stakeholder mapping full report by December of 2026	Grants	Technical Assistance	0	0	1	7.14.1 Sub-sector energy efficiency stakeholder mapping report done	Mini-grid Regulatory framework developed

7.15. Training of personnel in data capture in energy efficiency and renewable energy technologies	$372,368	300 GRZ by December of 2026	Grants	Technical Assistance	1	1	1	7.15.1. Institutions/persons trained in data capturing in energy efficiency and renewable energy	Stakeholders identified in 2015
7.16. Install data capturing hardware and software tools in energy efficiency and renewable energy		20 focal point data by December of 2026	Grants	Technical Assistance	1	1	1	7.16.1. Functional focal points with data capturing hardware and software tools in energy efficiency and renewable	MRV Focal Points in sectors identified
8.1. Capacity building among staff in design, setting building codes and standards for climate smart infrastructure	$150,377	150 by December of 2025	Grants	Technical Assistance	0	1	1	8.1.1. Number of staff personnel (Engineers, Architects, Surveyors etc.) trained in the design, setting building codes and standards for climate smart infrastructure	MRV Web-based systems operational
8.2. Develop Climate sensitive land use planning guidelines (Urban and Rural)	$131,100	Climate sensitive land use planning guidelines finalized by December of 2024	Grants	Technical Assistance	0	1	1	8.2.1. Climate sensitive land use planning guidelines developed (Urban and Rural)	N/A
8.3. Revise existing National Construction codes and standards	$12,860,613	Revised National Construction codes and standards by December of 2028	Grants	Technical Assistance	0	1	1	8.3.1. Revised National Construction codes and standards developed	Document work in progress

8.4. Undertake compliance visits on building codes and standards frequently (annually) in construction stage	$3,121,548	4 by December of 2030	Grants	Financial	0	1	1	8.4.1.4 NCC compliance visits on building codes and standards undertaken annually in construction stage	Existing general construction codes and standards -2021 Building codes not yet in place but climate resilient codes and standards for roads were concluded in 2021
8.5. Construct demonstration Decent Climate Resilient Housing in Urban and Rural areas	$36,250,050	1000 by December of 2030	Concessional Loan	Financial	0	1	1	8.5.1. Climate resilient housing units constructed in Urban and Rural areas	Schedule of staged construction inspections as per normative
8.6. Construction of Climate resilient roads	$480,114,928	2250 Km. constructed by December of 2030	Concessional Loan	Financial	0	1	1	8.6.1 Km of climate resilient roads constructed	50 social houses in 2022
8.7 Construct climate proofed PPP (buildings, Bridges etc.) infrastructure	$94,145,271	500 by December of 2030	Concessional Loan	Financial	0	1	1	8.7.1. Climate proofed civil infrastructure units constructed through PPPs (buildings, Bridges etc.)	Climate vulnerability assessment report and mapping 2020 The Climate roads resilient codes and standards manual concluded in 2021
8.8. Dredge Kilometres of Canals	$155,515,129	1500 by December of 2030	Concessional Loan	Financial	0	1	1	8.8.1. Km of Canals dredged	Standards and Codes for road Infrastructure developed Strategic Plan
8.9. Climate proof River/Canal Harbours climate	$49,314,997	10 by December of 2030	Concessional Loan	Financial	0	1	1	8.9.1 Quays constructed at harbours	Rehabilitation of Secondary Canals in Western and Luapula Provinces

8.10. Conduct maintenance and upgrade to climate resilience standard of public infrastructure (Roads, Bridges, Housing, Water, Drainage)	No additional cost	15% national budget to maintenance by December of 2027	Concessional Loan	Financial	0	1	1	8.10.1. % Of national budget allocated towards maintenance and upgrade to climate resilience standards of public infrastructure (Roads, Bridges, Housing, Water, Drainage)	Rehabilitation of Harbours in the Country
9.1 Strengthen Waste Management regulatory and policy framework	$99,000	Policy approved and Implementation Plan reviewed by December of 2023	Grants	Technical Assistance	0	1	1	9.1.1 Waste Management Policy finalisation and Implementation Plan review	Currently 3% allocated to road construction and maintenance Need to double check overall data
		Waste Management Regulations passed by December of 2023	Grants	Technical Assistance	0	1	1	9.1.2 Finalisation of Waste Management Regulations by 2023	Draft
9.2. Improve solid waste management and resource recovery	$135,190,541	10 by December of 2030	Grants	Technical Assistance	1	1	1	9.2.1. Number of material recovery facilities established	Draft

9.3. Establishment of Lusaka Waste Management Company		Fully operational by June of 2024	Grants	Technical Assistance	0	1	1	9.3.1. Lusaka Waste Management Company established	Insights from NWASCO AR 2020: NWASCO monitored and licensed 11 Commercial Utilities (CUs) and 5 Private Schemes. ZESCO operated in three Schemes namely Itezhi Tezhi (Central Province), Kafue Gorge (Lusaka Province) and Victoria Falls (Southern Province). ZESCO continued to invest in WSS infrastructure and constructed a new wastewater treatment plant at Kafue Gorge.
9.4. Conduct awareness campaign programmes at national and subnational levels		2784 by December of 2026	Grants	Technical Assistance	0	1	1	9.4.1. Number of awareness programmes/campaigns on waste management conducted at national and sub-national level	
		Yearly campaign from June to December by December of 2026	Grants	Technical Assistance	0	1	1	9.4.2. Mass-media and social media campaign at the national level	Keep Zambia Clean
9.5. Increase waste disposal following sustainable guidelines		15 by December of 2030	Grants	Technical Assistance	0	1	1	9.5.1. Number of Waste disposal facilities complying with waste disposal guidelines	Keep Zambia Clean

9.6. Install power capacity (MW) of waste to energy projects	$242,081,764	MW produced TBC by December of 2030	Concessional Loan	Financial	1	1	1	9.6.1. Installed power capacity (MW) of waste to energy projects	Limited compliance and need to review guidelines
9.7. Install and make operational Commercial aerobic composting plants	$92,163	Pilot operational by December of 2026	Concessional Loan	Financial	1	1	1	9.7.1. Pilot commercial aerobic composting plants installed and functional	Several private developers have expressed interest to undertake feasibility studies for Waste-to-Energy projects in Zambia. (Zambia Power Development Framework)
9.8. Increase methane capture capacity through landfill development	$0	5 by December of 2030	Concessional Loan	Financial	1	1	1	9.8.1. Number of newly constructed landfills	3 or 5 small private facilities
9.9. Increase capacities for data reporting on waste management	$352,789	15 by December of 2030	Grants	Technical Assistance	0	1	1	9.9.1. Number of waste management sites reporting to Zambia's MRV system	N/A
10.1. Strengthen policies and institutional capacities to manage climate change risks in the health sector	$128,527,838	1 by December of 2026	Grants	Technical Assistance	0	1	1	10.1.1 % of districts with functional public health emergency preparedness and response systems for climate sensitive diseases	No waste management site is currently reporting on data related to emissions

10.2. Availability of EH policy that clearly defines the strategies that include climate change for the Ministry of Health	$216,255	EH Strategy approved by December of 2025	Grants	Technical Assistance	0	1	1	10.2.1 Environmental Health policy enacted	The Ministry of Health, in collaboration with partners developed a Health National Adaptation Plan (HNAP) to climate change, which is aimed at ensuring that the health of the population in Zambia is protected from the effects arising from climate change (HNAP, 2019). Further, a Vulnerability Risk Assessment was undertaken.
10.3. Availability of surveillance tools that aid in early warning against climate variability and extreme weather events with a focus on the health sector	Included in J10.1	1 by December of 2026	Grants	Technical Assistance	0	1	1	10.3.1 % of districts with functional surveillance systems for climate sensitive diseases	Draft EH policy in place
	Included in J10.1	1 by December of 2026	Grants	Technical Assistance	0	1	1	10.3.1 % of districts conducting environmental health surveys	Tools not yet developed
10.4. Mainstream climate change across programmes to enhance resilience of the health sector	Included in J10.1	0.8 by December of 2026	Grants	Technical Assistance	0	1	1	10.4.1. % of health care facilities implementing mitigation and adaptation measures to climate change	Tools not yet developed
11.1. Increase Investment in climate resilient water sources infrastructure	$363,827,182	25 Small dams & 1 Large Dam by December of 2026	Concessional Loan	Financial	0	1	1	11.1.1. Number of climate resilient water sources infrastructures constructed	55 % in 2020

11.2. Map and protect Ground water aquifer resources mapped and protected	$83,571,648	41 aquifers mapped and protected by December of 2026	Grants	Technical Assistance	1	1	1	11.1.2 Number of climate resilient water sources infrastructures rehabilitated	Reference year 2022 0 (Target 3)
		1650 exploratory boreholes drilled by December of 2026	Grants	Technical Assistance	0	1	1	11.1.3 Number of climate resilient water sources infrastructures maintained	Reference year 2022 0 (61 identified)
		41 well fields identified and developed by December of 2026	Grants	Technical Assistance	0	1	1	11.2.1 Number of aquifers mapped and protected	Reference year 2022 61
11.3. Capacity building in Aquifer mapping, groundwater exploration and protection	$133,395	8 by December of 2026	Grants	Technical Assistance	1	1	1	11.3.1 Trainings in Aquifer mapping, groundwater exploration and protection (disaggregated by gender)	Reference year 2022 1
11.4. Implement relevant water technologies adopted based on the assessment results and potential	Costs can be shared with C3.1	29000 by December of 2026	Concessional Loan	Financial	1	1	1	11.4.1. Number of beneficiaries trained on the use of climate resilient water technologies disaggregated by gender	N/A
11.5. Establish Ground and surface water monitoring systems	$14,914,745	96 by December of 2026	Grants	Technical Assistance	1	1	1	11.5.1. Number of functional ground water monitoring systems installed	N/A

		211 by December of 2026	Grants	Technical Assistance	1	1	1	11.5.2. Number of functional surface water monitoring systems installed	Baseline: (2023) Ground water monitoring system-77 Surface Water monitoring system-169
11.6. Conduct water deficit/availability assessments in the three agro-ecological regions	$1,735,004	6 by December of 2026	Grants	Technical Assistance	1	1	1	11.6.1. Number of water sources assessment conducted in catchment areas on yearly basis	Baseline: (2023) Ground water monitoring system-77 Surface Water monitoring system-169
		TBD by TBD	Grants	Technical Assistance	0	1	1	11.6.2. Volume of water impounded in constructed dams and desegregated by size in each of the six catchment regions	the Authority planned to carry out water resources assessments to ascertain water availability in all the six catchments. Assessments were however, only carried out in Luangwa, Kafue and Chambishi Catchments. Failure to carry out these assessments in all Catchments was attributed to constraints regarding limited technical human resources

12.1 Strengthen the capacity of Livestock farmers to utilise breeds resilient to climate change	$1,983,677	10000 by December of 2026	Grants	Technical Assistance	0	1	1	12.1.1. Number of livestock units procured for pass-on scheme	TBD
12.2 Establish water points (weirs, dams and boreholes) for livestock management	$12,667,175	65000 by December of 2026	Concessional Loan	Financial	0	1	1	12.2.1 Livestock keeping households with enhanced access to water points	Climate Resilient Livestock Management Project procured 5,640 livestock units by 2021
12.3 Promote the use of good animal husbandry practices among livestock farmers	$5,608,422	400000 new livestock farmers trained by December of 2026	Grants	Technical Assistance	0	1	1	12.3.1. Livestock farmers trained in effective practices disaggregated by gender	N/A
12.4 Enhance index-based livestock insurance (IBLI) scheme in the country	$29,471,485	600,000 registered farmers by December of 2026	Grants	Technical Assistance	0	1	1	12.4.1. Farmers registered for IBLI disaggregated by gender	100,000 livestock farmers were targeted between 2018 and 2020
12.5 Operationalise Livestock Early Warning Information System (LEWIS)	$528,596	1 LEWIS operational by December of 2026	Grants	Technical Assistance	0	1	1	12.5.1. One LEWIS operational	500,000 are currently targeted to register for IBLI countrywide Currently pilot The Minister of Fisheries and Livestock officially launched Weather Insurance Livestock Index (WILI) on 6th October 2020. 2,000 farmers have been enrolled on the scheme

13.1 Increase degraded pasture and vegetation cover with different drought tolerant perennials	$21,564,843	45,100 Ha degraded restored land by December of 2026	Grants	Technical Assistance	0	1	1	13.1.1. Ha of degraded rangeland restored	0
13.2. Sustainable forage seed production programme with private sector participation	$88,578,332	900,000 additional livestock farmers by December of 2026	Grants	Technical Assistance	0	1	1	13.2.1. Farmers receiving improved pasture seeds	4,900 Ha
13.3. Diversification and strengthened livelihoods and source of incomes for rural populations.	$4,059,587	62000 by December of 2026	Grants	Technical Assistance	0	1	1	13.3.1. 4 skin and hides manufacturing plants established by private sector	100,000 livestock farmers were targeted between 2018 and 2020 Yellow Book: a total of 52,392 farmers will be provided with forage seed in 2022
13.4. Develop technical and business capacity for construction of biogas plants for livestock farmers	$33,268,208	19,900 livestock farmers trained by December of 2026	Grants	Technical Assistance	0	1	1	13.4.1. Livestock farmers trained in the construction and use of biogas digesters disaggregated by gender	0
					0	1	1		100 farmers trained
14.1. Reduce Clinker content in cement	$670,000	3 pilot projects reporting clinker reduction by December of 2026	Grants	Private Sector	1	1	1	14.1.1. 3 pilot projects implemented with large cement manufacturers for clinker reduction	Actions starting in 2024

14.2. Reduce Use of fluorinated GHGs	$1,219,130,732	Programme under implementation by December of 2026	Grants	Private Sector	1	1	1	14.2.1. National Program for the reduction of fluorinated gases in intensive industries implemented	111.259 Gg (2016, BUR)
15.1 Develop the Lusaka Tramway System	$1,219,130,732	50 Km of Tramway built (Phase 1 as per NAMA) by December of 2030	Concessional Loan	Financial	1	1	1	15.1.1. KM of Tramway Constructed	Zambia's transport NAMA 0
15.2. Develop Electrified Railway Systems	$2,104,712,143	30% over total railway lines by December of 2030	Concessional Loan	Financial	1	1	1	15.2.1. Km of Power lines connected	Assumed to begin in 2025 and be fully electrified by 2050
15.3. Rehabilitation and Modernisation of railway transport Infrastructure.	$3,199,053,901	1248 KMs of railway rehabilitated under ZRL 884 KMs of railway rehabilitated under TAZARA by December of 2030	Grants	Financial	1	1	1	15.3.1. Km of railway Lines rehabilitated	Construction is due to begin in 2020 and be completed 4 years later (Construction Review Online, 2020), but has been delayed (Malunga, 2020),
15.4 Development of the Urban Mobility Policy and strategy	$2,000,000	Electrical Mobility Policy, Strategy Implementation/Investment Framework by 2025 by	Grants	Financial	1	1	1	15.4.1. Electrical Mobility Policy/Implementation and Investment Framework developed	Transport NAMA

		December of 2025							
16.1. Development of the Green Growth Strategy	$250,000	Green Growth Strategy Finalised and launched by December of 2023	Grants	Technical Assistance	0	1	1	16.1.1. Green Growth Strategy launched	Scoping Report on Green Growth
16.2. Development of the National Policy on Green Growth and Climate Change	$150,000	NPGGCC Finalised and launched by December of 2023	Grants	Technical Assistance	0	1	1	16.1.2. National Policy on Climate Change and Implementation Plan revised and launched	2016 NPCC
16.3. Revision of the NDC	$125,000	NDC revised, finalised and submitted by December of 2025	Grants	Technical Assistance	0	1	1	16.3. NDC Revised	2021 NDC
16.4. Development and Launching of the NDC Implementation Framework	$235,000	NDC Implementation Plan launch by May of 2023	Grants	Technical Assistance	0	1	1	16.1.4. NDC Implementation Framework launched	2018 NDC Implementation Plan
16.5. Designing the NDC Investment Strategy and Plan	$85,000	NDC Investment Strategy and Plan developed by May of 2023	Grants	Technical Assistance	0	1	1	16.1.5. NDC Investment Strategy and Plan launched	2018 NDC Implementation Plan

16.6. Develop the Climate Change Act	$50,000	Climate Change Act enacted by December of 2023	Grants	Technical Assistance	0	1	1	16.1.6. Climate Change Bill enacted by Parliament	2016 National Policy on Climate Change
16.7. Production of the Initial Biennial Transparency Report/4th National Communication report	$517,000	BTR1/NC4 finalised and submitted by December of 2024	Grants	Technical Assistance	0	1	1	16.1.7. BTR1/NC4 finalised and submitted	
16.8. Building the Capacity of key NDC sectors in Green Growth and Climate Change planning and program development	$650,000	30 by December of 2023	Grants	Technical Assistance	0	1	1	16.8.1. Number of people trained in Green Growth and Climate Change for key NDC sectors	2016 NDC, 2016 NPCC
16.9. Development of the NDC Communication strategy	$550,000	Communication and Learning Strategies developed by December of 2022	Grants	Technical Assistance	0	1	1	16.9.1 NDC Communication strategy developed and launched	National Climate Change Communication and Advocacy Strategy of 2022
16.10 Building the capacities of District Level Staff and communities in climate change actions	$3,655,397	1600 District Level staff trained by December of 2026	Grants	Technical Assistance	0	1	1	16.10.1 Number of multidisciplinary district level staff trained in risk analysis for climate change	0
16.11 Enhancing equal participation of women and men in the development of local area plans	$1,404,313	2320 communities trained by December of 2026	Grants	Technical Assistance	0	1	1	16.10.3 Number of communities trained in community livelihood adaptation action plans and micro project proposal development	0

		At least 50% women participating in the development local area plans	Grants	Technical Assistance	0	1	1	16.10.3.Men/women participating in the development local climate change adaptation plans	0
17.1 Operationalise National Enhanced Transparency Framework (ETF)/Measuring Reporting and Verification (MRV) Portal	$5,492,799	MRV launched and operationalized by December of 2026	Grants	Technical Assistance	0	1	1	17.1.1 MRV launched and operationalized with integrated ETF/MRV portal	MRV Framework
17.2 Development of the National GHG Inventory		Final National GHG Inventory ready by March of 2024	Grants	Technical Assistance	0	1	1	17.2.2 1990 - 2022 National GHG Inventory	National GHG Inventory for BTR1/NC4
18.1 Development of Greening Environmental Tools and associated Processes	$500,000	Guidelines for greening ZEMA developed by 2024 by December of 2024	Grants	Technical Assistance	1	1	1	18.1.1 Number of guidelines for Greening of Environmental, Tools and Processes {Environmental Management Strategies, Strategic Environmental Assessment (SEA), Environmental Impact Assessment (EIA's), Life Cycle Assessments (LCA), Research and Development, Environmental Fund}	1

18.2 Revision of the Waste Management Strategy	$645,000	Revised Waste Management Strategy developed by December 2023 by December of 2023	Grants	Technical Assistance	0	1	1	18.2.1 Revised Waste Management Strategy	EMA, 2011, Environmental Management (Licensing Regulations) 2013, Extended Producer Responsibility Regulations 65, 2018, Strategic Environmental Assessment, 68, 2021, Green Jobs Strategy for the Construction Sector,
18.3 Guidelines for Extended Producer Responsibility	$300,400	Producer Responsibility Guidelines developed by December 2024 by December of 2024	Grants	Technical Assistance	0	1	1	18.3.1 Number of Guidelines for Producer Responsibility developed	Waste Management Strategy of 2004
18.4 Electrical and Electronic Waste management regulations and guidelines	$250,000	Hazardous Waste management regulations enacted by December of 2024	Grants	Technical Assistance	1	1	1	18.4.1 Hazardous Waste management Regulations	0
		Electrical and Electronic Waste management (E-Waste) guidelines developed by December of 2024	Grants	Technical Assistance	1	1	1	18.4.2 Electrical and Electronic Waste management regulations	EMA, 2011, Environmental Management (Licensing Regulations) 2013, Extended Producer Responsibility Regulations 65, 2018,

5.2.5 Financial Support Provided and Mobilized for Implementation of Zambia's NDC

Table 5.3 presents financial support provided and mobilised for implementation of Zambia’s NDC.

Table 5-3: Financial Support Provided and Mobilised for implementation of Zambia's NDC

S/N	Project Name	Programme Description	Channel	Recipient Entity	Implementing Entity	Total Budget (USD)	Time frame	Financial Instrument (s)	Status (Committed or Received)	Type of Support	Sector	Sub sector	Contribution to technology development and transfer objectives	Contribution to Capacity Building objectives	Status of Activity	Cooperating Partner	Use, Impact and Estimated Results
1	Irrigation Development and Support	The project aims at enhancing access to irrigation services in various locations of the country, through the establishment of several irrigation schemes and dams,	Multi-lateral	Zambia	Zambia - MoA	14,500,000.00	2011 - 2026	Concessional Loan	Received	Adaptation	Agriculture	Water, Infrastructure	1	1	Ongoing,	World Bank	1. Increased Agricultural Productivity: The project has helped to increase agricultural productivity and incomes for smallholder farmers, particularly in rural areas. 2. Improved Food Security: By supporting the development of irrigation systems, the project has helped to improve food security by increasing the availability of crops and reducing reliance on rain-fed agriculture.3. Enhanced Water Management: The project has promoted sustainable water management practices, reducing the risk of water scarcity and improving the overall efficiency of irrigation systems.4. Job Creation and Economic Growth: The project has created jobs and stimulated economic growth in rural areas, contributing to Zambia's overall economic development.

2	Aquaculture Enterprise Development Project	The Aquaculture Enterprise Development Project is aimed at stimulating a viable aquaculture sub-sector in Zambia to promote economic diversification, food security, and sustainable employment generation, all of which are central priorities of the Government of Zambia	Multilateral	Zambia	Zambia - MoA,Zambia - MWDS	50,891,780.00	2016 - 2024	Concessional Loan,Government Funds	Received	Adaptation	Agriculture	Fisheries, Water	0	1	Concluded	African Development Bank	5 functional Out-grower Clusters; 200 Young Aqua-preneurs completed incubation sessions; 98 million fingerlings produced; 1 Fish standards testing laboratory established , 200 km feeder roads constructed in the 5 aqua-parks
3	Urban Water Supply and Sanitation Chipata	The Urban Water and Sanitation Programme in Chipata, Zambia, is a project to improve the water supply and sanitation in the city. The project includes the expansion, maintenance, and modernization of water supply systems	Bilateral	Zambia	EWSC	4,708,000.00	2019 - 2028	Grant	Received	Adaptation	Water	Infrstructure, technology	1	1	Ongoing	Germany	The primarily poor population living in small, peri-urban communities that form part of the programme towns and cities (around 20,000 residents during phase II at the time of the evaluation). Women and children in particular were intended to benefit from the improved supply.

4	Supporting Developing Countries to Integrate the Agricultural Sectors into National Adaptation Plans (NAPs)	The NAP-Ag is focusing on: strengthening individual and institutional capacities of the agricultural sectors on NAPs, including on climate scenarios, cost-benefit analysis, and gender-sensitive adaptation options and value chains;	Multilateral	Zambia	FAO, UNDP	400,000.00	2015 - 2020	Grant	Received	Adaptation	Agriculture	Gender, Finance	0	1	Concluded	Food and Agriculture Organization	The project produced the following: 1. NAP Roadmap for the Agriculture sectors in 2018 2. Cost-benefit Analysis in 2017 3. Gender mainstreaming in 2017 4. Impact Evaluation in 2017 and resource mobilization in 2017.

5	Agricultural Productivity and Market Enhancement Project (APMEP)	APMEP's objectives are to contribute to economic growth and poverty reduction by enhancing food, income, and nutrition security among participating households.	Multilateral	Zambia	Zambia - MoA	34,870,000.00	2014 - 2023	Grant	Received	Adaptation	Agriculture	Nutrition, Commerce and Trade	0	1	Concluded	African Development Bank	1. Improved Food Security: APMEP has enhanced food security by promoting crop diversification and intensification and supporting the development of irrigation and aquaculture. 2. Increased Productivity: The project has provided productivity enhancement support to 20,079 smallholders, leading to increased agricultural productivity and incomes. 3. Empowered Women: Women have been a major beneficiary of the project, with 54% of the 75,520 people who have benefited from APMEP being women. 4. Job Creation: The project has created job opportunities through the construction of infrastructure, such as livestock service centers, agro-market centers, and access roads. 5. Improved Nutrition: APMEP has provided improved nutrition services to 22,457 beneficiaries, including the distribution of nutritious crops like orange maize seed, iron-rich beans, and orange-fleshed sweet potatoes.

6	Africa Food Trade and Resilience Programme (Regional Programme)	The programme will stimulate an increase in regional food trade in sub-Saharan Africa (SSA), contributing to satisfying a growing food demand and to addressing food shortages through regional food production, processing, and trade, and generating more rural jobs, climate resilience, and income for farmers.	Bilateral	Regional	UK – FCDO	45,647,450.00	2018 - 2026	Grant	Received	Adaptation	Agriculture	Commerce and Trade	0	1	Ongoing	United Kingdom	The programme will (i) work with companies that source, process, and trade food in the region to maximise investment, coordination, and benefits to smallholder farmers and (ii) contribute to improving the transparency and predictability of government policies to unlock regional food trade. By 2023, we expect the program will increase income for 1.8 million farming families.
7	Electricity Service Access Project	The Electricity Service Access Project (ESAP) in Zambia is a World Bank project that aims to improve access to electricity in rural areas.	Multilateral	Zambia	Zambia - MoE	26,500,000.00	2018 - 2022	Concessional Loan	Received	Mitigation	Energy	Commerce and Trade	0	1	Concluded	World Bank	Total connections were 58,257 with households at 49,421 and MSMEs reaching 8,836. Male headed households reached 41,417 while female headed were 16,840 households.

8	Nationally Determined Contributions Support Programme	The Nationally Determined Contributions Support Programme in Zambia refers to a framework designed to assist the country in implementing its Nationally Determined Contributions (NDCs), which are essentially Zambia's climate action plans outlining its commitments to reduce greenhouse gas emissions and adapt to climate change, as outlined in the Paris Agreement;	Multilateral	Countrywide	Zambia - MLNR	806,000.00	2018 - 2019	Grant	Received	cross-cutting	Cross-cutting	Energy, forestry, water	0	1	Ongoing	United Nations Development Programme, NDC Partnership	Zambia produced the 2015 INDC, NDC in 2016, NDC Implementation Plan in 2018 and the Revised Updated NDC in 2021 which was submitted to the UNFCCC.
9	Smallholder Productivity Promotion Programme	The programme's goal is to improve the income levels and food and nutrition security of those poor rural households in the target areas which depend on agriculture and/or agricultural related activities.	Multilateral	Zambia	Zambia - MoA	48,183,287.00	2011 - 2019	Concessional Loan,Grant,Government Funds	Received	Adaptation	Agriculture	Nutrition	0	1	Planned	International Fund for Agriculture Development	Based on the Final Programme Evaluation findings, S3P stakeholders rated the extent at which the Programme contributed to improvement in beneficiary livelihoods at 71%, increase in household assets at 62%, improvement in food and nutrition security at 60%, increase in savings at 57%, reduction in child malnutrition at 65% and increase in household resilience at 63%.

10	KawiSafi II	The KawiSafi II project will create a USD 200 million venture equity fund aimed at closing the investment gap in three key areas where sub-Saharan countries struggle to find investors: energy transition, productivity, and mobility & logistics.	Multilateral	Countrywide	Acumen	6,562,500.00	2022 - 2032	Equity,Grant	Committed	cross-cutting	Energy	Electricity	1	1	Ongoing	Green Climate Fund	Project yet to commence
11	Kariba Dam Rehabilitation Project	The Kariba Dam Rehabilitation Project involves the rehabilitation of the Kariba Dam infrastructure by reshaping the plunge pool and rehabilitating the spillway.	Multilateral	Multi-country Project	World Bank	294,000,000.00	2015 - 2025	Concessional Loan	Received	Adaptation	Infrastructure	Energy	1	1	Concluded	World Bank	Reduction in the risk of failure and potential disaster which could affect an estimated three million people downstream. • Reshaping of the plunge pool to increase stability and reduce the backward scouring toward the dam. • Refurbishment of the spillway for greater reliability and control of the regulatory structures. • Operationalization of an improved Emergency Preparedness Plan. • Improved cooperation in the development of water resources within the Zambezi River Basin.

12	Environment and Natural Resources Management and Mainstreamin Programme	The project is a government initiative aimed at integrating environmental considerations into all aspects of development planning, ensuring that natural resource management is a central focus across different sectors, .	Bilateral	Zambia	Zambia - MLNR	10,800,000.00	2010 - 2015	Grant	Received	Mitigation	Cross-cutting	Mainstreaming	0	1	Planned	Finland	The Project reduced environmental degradation, improved community livelihoods, increased sustainable resource utilization, strengthened institutional capacity for environmental management, and enhanced policy coherence across sectors
13	Zambia Growth Opportunities Project	The objective of the operation is to promote agricultural diversification, sustainability and jobs in the agri-food sector of Zambia	Multilateral	Zambia	Zambia - MoA	300,000,000.00	2022 - 2026	Concessional Loan	Received	Adaptation	Agriculture	Agri-food	0	1	Ongoing	World Bank	5,000 jobs generated in areas benefitting from irrigation support. • 605,000 hectares under climate-resilient technologies and practices for crop production • 600,000 farmers who have received extension services and have completed training on CSA technologies. • 1,400 kilometers of farm feeder roads rehabilitated

14	Decentralised Forest and Natural Resources Management Programe Introduction Project	The Decentralised Forest and Other Natural Resources Programme is designed for a 12-year period to support the government and communities in implementing the Forest Act 2015. The project was linked to Zambia's ongoing decentralisation process and uses a multi-sector integrated approach for planning and implementation of activities.	Bilateral	National	Subnational Government	5,400,000.00	2014 - 2018	Grant	Received	Mitigation	Cross-cutting	Forest	0	1	Concluded	Finland	The project developed sustainable Forest and Natural Resources Management (FNRM) models that can be scaled up and implemented in a wider programme with the long-term vision of providing rural communities with improved livelihoods through fully devolved sustainable forest and other natural resources management system by 2026..
15	Power Africa healthcare electrification grant	Through this new programme, Power Africa and SEforALL will equip target governments and their development partners with the necessary building blocks to identify, power, and sustainably maintain health facilities by 2030.	Bilateral	Zambia	Muhanya Solar,Zambia - CHAZ	250,000.00	2020 - 2021	Grant	Received	Mitigation	Energy	Renewable Energy, Electricity	1	1	Planned	United States	Lighting for emergency care and childbirth, Refrigeration for vaccines and blood, Sterilization facilities, Power for medical devices

16	Support to Civil Society in Environmental Management	The Civil Society Environment Fund, Phase 2 (CSEF2) is a capacity building and environmental grant fund managed by PMTC Ltd and Ecorys on behalf of Ministry of Foreign Affairs of Finland. The Fund is supporting civil society organisations (CSO's) in the Environment and Natural Resource sector, with a special focus on CSO capacity building, networking and coordination.	Bilateral	Zambia	Civil Society	5,540,400.00	2015 - 2019	Grant	Received	Mitigation	Cross-cutting	CSOs	0	1	Planned	Finland	(i) Entered into 24 grant agreements with Zambian CSO's, with a total value of Euro 2,385,240.00 (ii) delivered a diverse portfolio of environmental project grants in areas of climate change, environmental conservation, agriculture, energy efficiency, waste management, sustainable livelihoods, and environmental research, policy and advocacy (iii) commenced the piloting of a CSO Environment Hub which will facilitate coordination and networking amongst environmental CSO's in Zambia. (iv) provided hands-on capacity building training and mentorship to 29 individual CSOs in financial management, strategic planning, project cycle management and monitoring and evaluation

17	Sustainable Water Resources Management and Agricultural Water Use in Zambia AWARE - Accelerate Water and Agricultural Resources Efficiency	In line with Zambia's WRM Act, AWARE supports the development of catchment governance and planning structures, namely the Sub-Catchment Management Plan through the Lower Kafue Sub-Catchment Office (SCO) and the Sub-Catchment Council (SCC).	Bilateral	Lower Kafue Sub-Catchment	GIZ,Zambia - MoA,Zambia - MWDS,Zambia - WARMA	16,742,868.00	2019 - 2023	Grant	Received	Adaptation	Water	Infrstructure	1	1	Ongoing	Germany	Establishment and decentralisation of water resources governance structures • Development of the Kafue Catchment and Lower Kafue Sub-Catchment Management and Water Allocation Plan • Establishment of two Water Users Associations. To achieve the objective, AWARE works on the national as well as decentralised level on water resources management, and supports more than 11,000 smallholders in the sub-catchment to improve their agricultural water management practices.
18	Zambia Integrated Forest Landscape Programme	The objective of Integrated Forest Landscape Project for Zambia is to improve landscape management and increase environmental and economic benefits for targeted rural communities in the Eastern Province and to improve the Recipient's capacity to respond promptly and effectively to an Eligible Crisis or Emergency	Multilateral	Zambia	Zambia - MGEE	32,800,000.00	2017 - 2030	Concessional Loan,Grant	Received	cross-cutting	FOLU	Agriculture	0	1	Concluded	World Bank	The following were implemented (i) Create conditions that will allow livelihood investments (under Component 2) to be successfully implemented and thereby prepare Zambia for emission reduction purchases; (ii) Finance on-the-ground activities that improve rural livelihoods, conserve ecosystems, and reduce GHG emissions (iii) Finance activities related to national and provincial-level program coordination and management; and facilitate the use of International Development Association (IDA) funds in the event of a disaster.

19	Chishimba Falls Hydro Power Station	Chishimba Hydroelectric Power Station is a 15 megawatts (20,000 hp) hydroelectric power station that sits across the Luombe River in Zambia. The power station, first commissioned in 1959, was rehabilitated and expanded in 1971 and again expanded and modernized in the 2020s.	Bilateral	Northern Province	ZESCO,Zambia - MoF	45,774,500.00	2015 – 2025	Private Sector	Received	Mitigation	Energy	Electricity	1	1	Ongoing	Germany	Work involves converting part of the old power station into a tourist museum. Three new electric turbines, each rated at 5 MW will be installed, for a generation capacity calculated at 73 GWh annually. Two new switchyards one of 66 kV and he other of 33 kV will be constructed next to the powerhouse. High voltage transmission lines will connect these switchyards to the existing Kasama substation, where the power will integrate into the Zambian national grid.
20	Green Partnership & Investment Programme along Agriculture, Forestry, Biodiversity, Water and Climate Nexus	The project is aimed at supporting a climate-resilient transition towards green partnerships,sustainable growth and decent jobs in Zambia. The action intends to promote and invest in the green recovery and sustainable growth along the Zambian part of the Greater Kavango Zambezi (KAZA) Trans-Frontier Conservation Area (TFCA).	Bilateral	Countrywide	EU	47,174,000.00	2021 - 2027	Grant	Received	Adaptation	Cross-cutting	Natural resurces	0	1	Planned	European Union	Enhance climate resilience in Zambia's agriculture, forestry, and biodiversity sectors, Promote sustainable development and reduce poverty in rural communities, Biodiversity, Protect and conserve Zambia's rich biodiversity, including endangered species and ecosystems

21	Scaling Up Shock Response Social Protection (SSR-SP)	Component 1: Social Cash Transfer supports the financing of cash transfers, currently reaching 973,323 poor and vulnerable households across 116 districts, with plans to scale up to 1.3 million nationally by end 2023.	Multilateral	Countrywide	Government	182,930,000.00	2022 - 2025	Concessional Loan	Received	Adaptation	Agriculture	Social Protection	0	1	Concluded	World Bank	The Scaling Up Shock Responsive Social Protection (SSRSP) Project has progressively scaled up coverage with over 1.31 million households having been reached by the end of 2023, exceeding the end-project target. It is noteworthy that the current caseload has been estimated to represent 39 percent of the population and 82 percent of the extreme poor, one of the best safety net coverages in the region with strong pro-poor elements, although ensuring the adequacy of the transfer value in the face of persistently high inflation remains a challenge.

22	Green Growth Promotion & Diversification (GEPD) Programme	The specific objective of this call for proposals is: to support the creation and consolidation of MSMEs and start-up companies, particularly created or/and managed by women and young entrepreneurs, in sectors outside the agriculture, forestry, and biodiversity nexus, which invest in green, circular, climate smart and digital business solutions and that create decent jobs along sustainable value chains for goods and services in Zambia.	Bilateral	Countrywide	EU	31,570,000.00	2021 - 2027	Grant	Received	cross-cutting	Cross-cutting	Private Sector MSMES	0	1	Ongoing	European Union	
23	Community Markets for Conservation	COMACO is a social enterprise that supports wildlife conservation and small-scale farmers in Zambia	Bilateral	Zambia	COMACO	8,600,000.00		Grant	Received	Adaptation	Agriculture	Commerce and Trade	1	1	Ongoing	Finland	1. We work with illegal wildlife poachers, offering alternative livelihood skills 2. We train small-scale farmers in climate-smart, sustainable agriculture, increasing crop yields 3. We buy crops from our farmers at premium prices and produce high-value food products under the brand It's Wild! The result is increasing wildlife populations and food

																	secure small-scale farmers.
24	Improved Rural Connectivity	Improved Rural Connectivity is a project that aims to improve access to rural areas through better roads and transportation infrastructure. T he project also aims to strengthen the institutions that manage rural roads.	Multilateral	Zambia	MoFNP	200,000,000.00	2018 - 2025	Concessional Loan	Received	Adaptation	Cross-cutting	Infrastructure	0	1	Ongoing	World Bank	Key Results Expected: • Share of rural population with access to an all-season road increased from 18.7% to 25% in beneficiary provinces. • Increased proportion of Primary Feeder Roads in the country, that are in a good and fair condition, by 30% • Improved institutional oversight capacity in the roads sector, assessed by the development and application of a Road Development Agency performance framework by the ministry responsible for roads.

25	Zambia - Lusaka Sanitation Program– Climate Resilient Sustainable Infrastructure Project	The Lusaka Sanitation Program aims to increase access to sustainable sanitation services for residents of Lusaka, Zambia's capital city. The $127.83 million program will rehabilitate and construct climate-resilient sewerage infrastructure, promote decentralised sanitation and hygiene, and strengthen the Lusaka Water and Sewerage Company and other institutions	Multilateral	Zambia	ADF (AfDB)	47,541,089.09	2016 - 2025	Concessional Loan	Received	Adaptation	Cross-cutting	Water and Sanitation	1	1	Ongoing	African Development Bank	The intervention will have direct and indirect benefits to Lusaka City's population with improved sanitation to about 600,000 indirect beneficiaries and 473, 000 direct beneficiaries (52% women). Urban residents in the whole of Lusaka city will benefit from improved performance of Lusaka Water and Sewerage Company in delivering water and sanitation services.
26	Scaling Solar Project	Scaling Solar is designed for rapid implementation and offers a "one-stop- shop" package that includes advisory services, contracts, financing, guarantees, and political risk insurance.	Multilateral	Lusaka Province	Zambia - MoE,Zambia - MoFNP	250,000,000.00	2016 - 2020	Grant	Received	Mitigation	Energy	Renewable Energy, Electricity	1	1	Planned	World Bank	The Scaling Solar approach (i) was implemented quickly thanks to fully templated documents and processes and the offer of WBG debt financing and guarantees, (ii) de-risks projects to deliver lower tariffs, and (iii) achieves economies of scale via a standard approach across multiple projects/countries. The Zambian Scaling Solar project attracted top-tier global developers to the country's first competitive auction.

27	Africa CDC Regional Investment Project (ACDCP) Financing	The development objective of Africa Centres for Disease Control and Prevention Regional Investment Financing Project is to support Africa CDC to strengthen continental and regional infectious disease detection and response systems.	Multilateral	Zambia	Zambia - MoH	172,200,000.00	2020 - 2025	Concessional Loan	Received	Adaptation	Cross-cutting	Infrastructure	0	1	Ongoing	World Bank	For Zambia, construction of the biosafety level 3 (BSL- 3) laboratory and offices complex; development of a diverse skilled cadre in public health and livestock sector in line with the "One Health" approach; and ensure availability of critical public health assets. Additionally, the investments strengthen systems to serve Southern Africa's 174 million citizens, with extended benefits to the rest of the African continent. • Overall, the ACDCP will empower the 55-member states for strengthening of detection, prevention, and response to outbreaks.
28	Integrated small towns water and sanitation project	The main program outcomes include (i) increase in proportion of residents accessing improved water supply and sanitation, (ii) increased hours of water supply, (iii) increased revenue collection efficiency and (iv) reduction in Non-Revenue Water (NRW).	Multilateral	Zambia	Zambia - MLGRD	121,226,542.00	2016 - 2024	Concessional Loan	Received	Adaptation	Water	Infrastructure	1	1	Ongoing	African Development Bank	The main program outcomes include (i) increase in proportion of residents accessing improved water supply and sanitation, (ii) increased hours of water supply, (iii) increased revenue collection efficiency and (iv) reduction in Non-Revenue Water (NRW).
29	Enhanced sustainable and gender-sensitive agriculture	The objective of the project is to enhance climate-smart water resources	Bilateral	Zambia	Zambia - MWDS,Zambia - WARMA	15,600,000.00	2019 - 2023	Grant	Received	Adaptation	Water	Infrastructure	1	1	Ongoing	European Union	To achieve the objective, AWARE works on the national as well as decentralised level on water resources

	water management and irrigation systems for smallholder farmers in selected districts of the Lower Kafue sub catchment-AWARE	management and efficient agricultural water use for smallholders in the Lower Kafue Sub-Catchment, ensuring a gender sensitive approach.															management, and supports more than 11,000 smallholders in the sub-catchment to improve their agricultural water management practices.
30	Scaling Up Nutrition Phase II	The SUN II programme is a 4-year initiative supporting MCDP II led by UNICEF in partnership with the National Food and Nutrition Commission, line ministries, other UN agencies, and non-governmental organizations.	Bilateral	Countrywide	Government	57,000,000.00	2019 - 2024	Grant	Received	Adaptation	Cross-cutting	Nutrition.	0	1	Ongoing	European Union	Nutrition specific interventions in 17 districts conducted with 1520 radion spots, Agriculture, forestry, livestock and fisheries, water, sanitation and hygiene, economic empowerment for women reaching 138,593 women of reproductive age trained in saving groups, social protection provided to 12,904 cash transfers made.

	GET FiT	GET FiT Zambia is designed to assist the Zambian Government in the implementation of its REFiT Strategy and aims to procure and support Independent Power Producer (IPP) projects up to 20 MW	Bilateral	Country wide	KfW	45,223,000.00	2017 - 2027	Private Sector	Received	Mitigation	Energy	renewable Energy, Electricity	0	1	Ongoing	Germany	The procurement and support of 200 MW renewable energy capacity are at the core of the Programme, divided into a 100 MW solar PV round, and a 100 MW small hydro round
31	Enterprise Zambia Challenge Fund	To integrate agriculture SMEs and smallholder farmers into market-integrated environmentally sustainable, resilient, low carbon, circular and nutrition sensitive value chains	Bilateral	Countrywide	Zambia - MoA,Zambia - MGEE,MoFL	26,677,000.00	2020 - 2025	Grant	Received	cross - cutting	Agriculture	Livestock	0	1	Ongoing	European Union	Financial support amounting to Euro 26 million, supporting 40 Agri-enterprises, 8500 jobs created , 150,000 smallholder fish farmers and 105,000 using climate smart land management practices
32	ElectriFi - Zambia window	ElectriFI will mostly apply to projects leading to new and improved connections to electricity for populations living in under-served and remote areas.	Bilateral	Zambia	EDF	8,000,000.00	2018 - 2025	Grant	Received	Mitigation	Energy	Electricity	0	1	Ongoing	European Union	In an effort to increase the country's electrification rate, the government started investing in clean off-grid energy solutions to reach its target of 51% rural electricity access by 2030

33	Zambia Emergency Food Production Facility (ZEFPF)	The Zambia Emergency Food Production Facility (ZEFPF) is a stand-alone emergency project to mitigate the impacts of the Russia-Ukraine conflict on agriculture and food security in Zambia.	Multilateral	Zambia	Zambia - MoA	10,700,000.00	2022 - 2025	Concessional Loan	Received	Adaptation	Agriculture	Social Protection	0	1	Ongoing	African Development Bank	45,000 beneficiaries of whom 50% shall be women shall be targeted under Farmer Input Support Programme (FISP) Tier 2, located in all the sixteen (16) pilot districts in Lusaka and Central Provinces https://mapafrica.afdb.org/en/projects/46002-P-ZM-AA0-043
34	Zambia Aquaculture Project	Increased productivity, income and employment opportunities of emergent, small and medium scale aquapreneurs along the aquaculture value chain	Bilateral	Zambia	MoFL	5,300,000.00	2022 - 2026	Grant	Received	Adaptation	Fisheries	Water Infrastructure, capacity building	0	1	Ongoing	European Union	The project is expected to deliver technical assistance, capacity building and infrastructure development involving providing support to fish farmers to improve their technical skills and knowledge in areas such as fish breeding, feeding, and health management strengthening the capacity of local institutions and organizations to support the development of the aquaculture sector and improving infrastructure such as fish ponds, hatcheries, and processing facilities to support the growth of the aquaculture industry.

35	Zambia COVID-19 Emergence Response Health Systems Preparedness Project	(1) Emergency Public Health Response to COVID-19 (2) Resilient Health Service Delivery, (3) Project Management, Governance and Accountability.	Multilateral	Zambia	Zambia - MoH	49,000,000.00	2021 - 2025	Concessional Loan	Received	Adaptation	Health	Capacity Building	0	1	Ongoing	World Bank	(1) Percentage of identified close contacts of confirmed COVID-19 cases investigated based on national guidelines from 0 (2020) to 70 (2022) (2) Number of designated laboratories with SARSCoV-2 diagnostic capacity from 3 (2020) to 18 (2022) (3) Number of designated health facilities with COVID-19 case management capacity from 3 (2020) to 40 (2022)

36	Zambia Renewable Energy Financing Framework	The Green Climate Fund is supporting the Government of Zambia to catalyze private investment in the renewable energy sector to boost electricity generation and diversify the country's energy mix	Multilateral	Zambia	AfDB	52,500,000.00	2020 - 2025	Grant	Received	Mitigation	Energy	Renewable Energy, Electricity	0	1	Ongoing	Green Climate Fund	Activities under this component will catalyze the market for decentralised energy solutions and directly contribute to national energy access, translating the experience of small-scale IPP (GETFiT projects) into RE-based rural electrification. It is envisaged that local participation can be scaled up in the subsequent rounds of the GETFIT program as well as in other public RE tendering processes (including mini- and off-grid projects), building on the improved understanding and risk perception in the RE sector
37	Ecological Urban Development Lusaka	The ecological urban development project in Lusaka, Zambia, aims to improve sanitation service delivery by developing a pricing strategy. The project also seeks to separate water and sewerage costs.	Bilateral	Lusaka	LWSC	268,580,500.00	2018 - 2028	Concessional Loan,Grant	Received	Mitigation	Water	Waste Management	0	1	Ongoing	Germany	Develop a pricing strategy for sanitation services, improve the cost of service model to include capital investments and develop guidelines for separating water and sewerage costs.

38	Green Innovation Centres for the Agriculture and Food Sector (GIC)	The Project aims to promote and **invest** in the **green** recovery and sustainable growth **along** the **agriculture-forestry-biodiversity-water** and **climate nexus**.	Bilateral	Eastern and Southern Provinces	GIZ,Zambia - MoA,Zambia - MFL,COMACO	287,850,000.00	2015 - 2025	Grant,Equity,Private Sector	Received	Adaptation	Agriculture	Finance	0	1	Ongoing	Germany	The projects support the main outcome areas as follows: promotion of green partnership, supporting green economy diversification, strengthening public financial management and accountability
39	Zambia Health System Strengthening Programme	The Zambia Health Systems Strengthening programme aims improve the health of women and girls in Zambia across the continuum of care from birth, childhood and motherhood	Bilateral	Zambia	United Kingdom/UNFPA	45,213,939.00	2016 - 2021	Grant	Received	Adaptation	Health	Health	0	1	Ongoing	United Kingdom	This together with our other parallel interventions to strengthen the health system, will by 2021 result in a reduction in child and maternal deaths by 25% and 15% respectively and contribute towards attainment of the sustainable development goal for health. The nutrition status of 500,000 children, women and young girls will be improved and 270,000 girls and women gain access to family planning.

40	Economic, Nutrition and Technical support for increased Economic Returns and Profit In Sustainable agribusiness in Zambia ENTERPRISE Zambia	These projects address a selection of integrated issues: sustainable agriculture, food and nutrition security, research into and production of improved varieties of seed, rural enterprise development and income generation, environmental rehabilitation, and climate change adaptation	Bilateral	Countrywide	Self Help Africa	28,709,200.00	2020 - 2025	Grant	Received	Adaptation	Agriculture	Crop production	0	1	Ongoing	European Union	800 MSMEs, 6,000+ MSME employees, BDSPs, FSPs/investors and TVET providers. Household Members of MSME employees minimum 22,800 individuals. Final beneficiaries will be at least 22,800 household members of the MSME employees (this figure is likely to be higher as the assumption is that many of the 6,000 FTE positions will be part-time)
41	Climate Investor One	Climate Investor One (CIO) is a blended finance facility which provides loans in the early stage of a project life cycle and establishment of equity fund that ill meet up to 75 percent of total construction costs in tandem with the project sponsor	Multilateral	Multi-country Project	GCF	5,000,000.00	2018 - 2037	Grant	Received	Mitigation	Finance	Equity	0	1	Ongoing	Green Climate Fund	The first component of this programme is a development fund, which provides loans in the early stage of a project life cycle. The second component, a construction equity fund, will meet up to 75 percent of total construction costs in tandem with the project sponsor

42	Cashew Infrastucture Development Project	The Cashew Infrastructure Development Project (CIDP) is a stand-alone investment Project aimed at rejuvenating the cashew industry and enhancement of economic development in the Western Province of Zambia.	Multilateral	Western Province	Zambia - MoA	55,420,000.00	2015 - 2024	Concessional Loan	Received	Adaptation	Agriculture	Agro-forestry	0	1	Planned	African Development Bank	Target of roads completed and rehabilitated was reduced to 46.50km due to reduced GRZ contribution. Core nursery at Simulumbe was completed and is operational. The number of clone gardens established was more than double the target. All demonstration nurseries established as targeted.
43	Building the Basis for implementing the Save & Grow approach - Regional strategies on sustainable and climate-resilient intensification of cropping systems (climate resilient agriculture)	FAO's "Save and Grow" model of sustainable intensification of crop production aims to achieve the highest possible productivity by unit of production input within the ecosystem's carrying capacity. In other words, producing more with less.	Multilateral	Zambia	FAO	2,200,000.00	2016 - 2020	Grant	Received	Adaptation	Agriculture	Crop production	0	1	Ongoing	Food and Agriculture Organization	In Zambia, the project provided training to over 2 000 farmers, 20 policy-makers, 34 experts and 102 extension officers. Over 800 000 farmers have adopted agronomic practices promoted by the project. Protocols for climate-smart crop systems were developed and implemented in the target districts. The project also produced and distributed resource materials for farmers and the public, and training materials for extension officers nationwide. Communication material on sustainable intensification production systems and climate-smart crop production was presented at global platforms.

44	Social Protection Expansion Programme Phase II	To provide small grants to vulnerable households especially those with disabled and elderly persons in order for them to have regular monthly income to take care of their basic needs	Bilateral	Zambia	UK	43,955,747.00	2016 - 2023	Grant	Received	Adaptation	Social Protection	Social Cash Transfer	0	1	Ongoing	United Kingdom	The original expected outcome and primary goal of the programme was to support a national Social Cash Transfer (SCT) programme reaching 350,000 households. The SCT programme now has country wide coverage reaching more than 1.3 million households representing 39 percent of the population and 82 percent of the extreme poor
45	Zambia Energy Efficiency and Sustainable Transformation programme (ZE2ST)	The Zambia Energy Efficiency and Sustainable Transformation (ZE2ST) Program is a comprehensive initiative aimed at transforming Zambia's energy sector into a sustainable and energy-efficient one. The program's main objective is to unlock the country's potential for energy efficiency and sustainable transformation	Bilateral	Zambia	EU	37,800,000.00	2020 - 2027	Grant	Received	Mitigation	Energy	Energy Efficiency	0	1	Planned	European Union	Outcomes include Improved energy efficiency in various sectors, including industry, transport, and buildings, Increased use of renewable energy sources, such as solar and hydro power, Reduced greenhouse gas emissions and contribution to climate change mitigation and Enhanced capacity of Zambian authorities and stakeholders to implement energy efficiency and sustainable energy projects.

46	Private Enterprise Programme Zambia Phase II	To create investment in Zambia by building the capacity of micro, small and medium sized enterprises. The programme will aim to systematically transform the finance and investment environment for SMSEs in Zambia, by helping companies with potential to grow and become the engine of job creation in the economy	Bilateral	Countrywide	Private Sector	72,279,934.00	2020 - 2027	Grant	Received	cross-cutting	Commerce and Trade	Micro-finance	0	1	Ongoing	United Kingdom	The programme scored highly at both outcome and output level, including meeting crucial parameters set to invest in growth stage Zambian businesses (£15,446,700 facilitated) and successfully encourage financial stakeholders (Zambia Industrial Commercial Bank, Premier Credit and Bongo Hive) to develop impact investment facilities targeted at Zambian SMEs. 628 (117 for women) jobs were created, bringing the cumulative total to 1891 (673 for women) which is good progress towards the target for the 7-year programme.
47	Sustainable Access to Electricity in Southern Division	The project comprises the rehabilitation and reinforcement (R&R) measures of selected power transmission and distribution infrastructure (new lines and substations) in the Southern Division of Zambia	Bilateral	Southern Province	ZESCO,Zambia - MoF	51,730,700.00	2017 - 2026	Grant	Received	cross-cutting	Energy	Electricity	0	1	Planned	Germany	The project outcomes include the following: - Rehabilitation and Reinforcement: Upgrade existing power transmission and distribution infrastructure to improve electricity supply. - Access Component: Implement additional measures to increase access to electricity, including enabling works, connection subsidies, and prepaid meters.

48	Agriculture Value Chain Facility	The Agriculture Value Chain Facility Project in Zambia aims to enhance access to finance for businesses in Zambia's agriculture and aquaculture sectors, particularly small and medium-sized enterprises (SMEs). This project is a joint initiative of the European Investment Bank and the European Commission	Bilateral	countrywide	EIB	15,458,800.00	2020 - 2030	Concessional Loan	Received	Adaptation	Agriculture	Agribusiness	0	1	Ongoing	European Union	\the project will provide long-term funding to financial intermediaries, which will then on-lend to eligible SMEs in the agriculture and aquaculture sectors. By supporting SMEs, the project aims to increase Productivity and efficiency in the agriculture and aquaculture value chains. The project is expected to create jobs and stimulate economic growth in rural areas and will provide Capacity-Building and Technical Assistance to financial intermediaries and SMEs, enabling them to better manage their businesses and Access finance.
49	Health Ecosystems and Agriculture for Resilient Thriving Societies (HEARTH)	The Health Ecosystems and Agriculture for Resilient Thriving Societies (HEARTH) project is an innovative initiative that seeks to address the interconnected challenges of human health, agricultural productivity, and environmental sustainability.	Bilateral	Zambia	USAID	40,000,000.00	2021 - 2025	Private Sector,Grant,Equity	Received	cross-cutting	Agriculture	Ecosystems based Agriculture	0	1	Planned	United States	1. Improved Health Outcomes: Reduced morbidity and mortality rates, particularly among women and children. 2. Increased Agricultural Productivity: Improved crop yields, enhanced food security, and increased incomes for rural households. 3. Enhanced Ecosystem Services: Preserved and restored natural ecosystems, maintaining biodiversity and ecosystem services. 4. Strengthened Health Systems: Improved healthcare infrastructure, human resources, and supply chain management.

50	Improving the capacities of groundwater management and protection in Zambia	Improving the capacities of groundwater management and protection in Zambia is crucial, given the country's reliance on groundwater for drinking water and irrigation. The Bundesanstalt für Geowissenschaften und Rohstoffe (BGR) has been supporting the Zambian government in this endeavor.	Bilateral	Lusaka	Zambia - MWDS	2,206,000.00	2020 - 2022	Grant	Received	Adaptation	Water	Ground water management	0	1	Ongoing	Germany	Delineation of Groundwater Protection Zones: The BGR is supporting the delineation of groundwater protection zones for a new wellfield in Lusaka, which will help safeguard groundwater resources.[2] - Training and Capacity Building: Training programs are being developed for employees of drilling companies and authorities to improve well construction quality assurance and data collection. - Digital Information Platform: A web-based geo-information system is being established to provide easy access to spatial data and support evidence-based decision-making.

51	Lusaka Sanitation Project	(1) Sewerage improvements focus on upgrading and expanding the sewerage systems in the Ngwerere and Manchinchi sewersheds. (2) On-site sanitation investments focus on the development of a comprehensive response to the on-site sanitation challenges in Lusaka; and support on-site sanitation services and systems in priority areas. (3) Institutional strengthening focuses on providing technical assistance to enhance LWSC's capacity to implement the project, operate and maintain the facilities, and undertake reforms.	Multilateral	Zambia	LWSC	65,000,000.00	2015 - 2024	Concessional Loan	Received	Mitigation	Waste	Sanitation	0	1	Ongoing	World Bank	75,000 people are expected to gain access to improved sanitation services at project end. Thus far, the project has exceeded the target with 75,328 people have gained access to improved sanitation, of which 85% in poorest areas of the city. • 230,000 people are expected with access to improved fecal sludge management services. Thus far, 263,898 people have been reached, surpassing the project target. • 108km of sewer network will be rehabilitated and newly constructed by project end. Thus far,92.3km of sewer network has been laid along Kafue Road, Emmasdale, Chais, Industry and Kanyama areas. • 1,000 households are expected to connect to the new sewer network. Thus far, 1,581 household connections have been installed and 2,595 connection chambers have been installed to make it easier for households to connect. • 3,500 improved onsite-sanitation facilities have been constructed. • LWSC's capacity to manage the sanitation system will be enhanced. So far, LWSC is currently addressing 100% of sewer blockages within 48 hours.

52	Beyond the Grid Fund Zambia	The Beyond the Grid Fund Zambia (BGFZ) is a pioneering results-based financing facility that aims to provide energy access to underserved populations in Zambia. The program is part of the larger Beyond the Grid Fund for Africa (BGFA) initiative, which seeks to bring clean, affordable, off-grid energy access to millions of people across Sub-Saharan Africa	Bilateral	Country wide	REEEP,SM,FI,SupaMoto,Vitalite	12,800,000.00	2017 - 2021	Private Sector,Concessional Loan	Received	Mitigation	Energy	Electricity	0	1	Ongoing	Sweden	BGFZ's objective was to bring modern affordable energy services to at least 192,000 households – translating to one million Zambians – by 2021. This target was achieved in September 2021, and the results were acknowledged by public and private stakeholders at an acknowledgement event in Lusaka in March 2022. Building on the success of this pilot, the programme was expanded into the Beyond the Grid Fund for Africa (BGFA) in 2019, which brings the concept to five additional countries along with more financing to further improve energy access in Zambia.

53	Girls Education and Women Empowerment and Livelihoods (GEWEL)	The GEWEL project aims to support the Government of Republic of Zambia (a) to increase access to livelihood support for women and access to secondary education for disadvantaged adolescent girls in extremely poor households in selected districts, and (b) provide cash transfers for poor and vulnerable households.	Multilateral	Zambia	Government	347,000,000.00	2016 - 2024	Concessional Loan	Received	cross-cutting	Education	Social Protection	0	1	Ongoing	World Bank	116,891 women provided with the program's livelihoods package since inception. • Early results of the SWL impact assessment found positive impacts on household food security, profits, savings, productive activities, livelihood diversification, and happiness, whereby household consumption increased by 19 percent, business profits by 44 percent, agricultural income by 79 percent, savings by 50 percent, and assets by 21 percent. • 133,632 adolescent girls enrolled in secondary school, with 88 percent now progressing to the next grade. • 1,100,998 poor and vulnerable households receiving predictable and reliable unconditional cash transfers.

54	Reducing UPOPs and Mercury Releases from the Health Sector in Africa/Medical Waste Project	The Reducing UPOPs (Unintentional Persistent Organic Pollutants) and Mercury Releases from the Health Sector in Africa/Medical Waste Project is a critical initiative aimed at minimizing the environmental and health impacts of medical waste management in Africa	Multilateral		Zambia - MoH	6,453,195.00	2015 - 2020	Grant	Received	cross - cutting	Waste	Medical Waste	0	1	Planned	United Nations Development Programme	• Promote best practices and techniques for healthcare waste management. • Reduce emission of green -house gases resulting from low cost technology incineration of healthcare waste. • Minimizing or eliminating releases of Persistent Organic Pollutants (POPs) under the Stockholm Convention on POPs. • Phasing-down the use of mercury containing devices and products under the Minamata Convention.

55	Transforming Rural Livelihoods in Western Zambia - National Rural water Supply and Sanitation II	The program 'Transforming Rural Livelihoods in Western Zambia – NRWSSP Phase II' aims to provide sustainable access to water supply and sanitation in sixteen (16) rural districts of Western Province namely Kalabo, Mongu, Sesheke, Shangombo, Kaoma, Lukulu, Senanga, Mwandi, Mulobezi, Sioma, Nalolo, Mitete, Luampa, Nkeyema, Limulunga and Sikongo so as to contribute towards poverty alleviation of Zambia's rural population and also contribute towards achievement of National Vision targets of universal access to water and sanitation services.	Multilateral	Western Province	Zambia - MLGRD	14,606,089.00	2015 - 2024	Concessional Loan	Received	Adaptation	Agriculture	Irrigation	0	1	Ongoing	African Development Bank	• Provision of 1,200 new and rehabilitation of 750 existing water supply facilities and contribute to increase the proportion of rural population served • improved sanitation by constructing 600 communal sanitation facilities for public institutions, including schools, health centres and public places in addition to training in hygiene education.

56	Lake Tanganyika Development	The project will promote sustainable and equitable management and use of the Lake's natural resources; improving livelihoods of communities (within its catchment area) by supporting economic infrastructure, human resources development, market linkages and value chain development for natural resources products.	Multilateral	Northern Province	Zambia - MGEE	29,620,000.00	2014 - 2024	Concessional Loan	Received	Adaptation	Water	Natural resurces	0	1	Planned	African Development Bank	1. Improved Livelihoods: Enhance the livelihoods of communities surrounding Lake Tanganyika, promoting economic growth and poverty reduction. 2. Sustainable Fisheries: Ensure the long-term sustainability of Lake Tanganyika's fisheries, protecting the lake's ecosystem and biodiversity. 3. Enhanced Water Quality: Improve water quality, reducing pollution and protecting human health. 4. Increased Climate Resilience: Strengthen the resilience of communities and ecosystems to climate change impacts, promoting sustainable development. 5. Regional Cooperation: Foster regional cooperation and collaboration among countries bordering Lake Tanganyika, promoting sustainable development and resource management.

57	Community Water Management Improvement Project for traditional Farmers	The project will add significant value to the strategic up scaling of dam development and contribute to the attainment of the MDG goals and the ambitions of the Africa Water Vision. The Project will contribute to design planning and funds mobilisation to spur new and on-going water development programmes such as the Integrated Water Resources Management and Water Efficiency Implementation Plan (2007-30). The project also involves direct investments in connection with the field-testing of the guidelines that will include rehabilitation and rehabilitation of three existing dams and construction of one new small dam.	Multilateral		Zambia - MoA	1,209,864.00	2009 - 2013	Grant,Government Funds	Received	Adaptation	Water	Water Infrastructure	0	1	Planned	African Development Bank	1. Institutional capacity building: 2. Improving water access for enhanced productivity. 3. Credit Access and Investment facilitation, 4. Knowledge Dissemination 5. Project Coordination and Monitoring:

58	Support to Civil Society in Environmental Management phase 2	Establishment of a Civil Society Environmental Hub, a mechanism coordinating CSOs countrywide	Multilateral	National	Civil Society	5,040,000.00	2015 - 2019	Grant	Received	cross - cutting	Cross-cutting	Cross-cutting	0	1	Concluded	United Nations Environment Program	CEJ has implemented several projects and initiatives in environmental protection in Zambia mainly at the interface of dialogue with government institutions, local communities and private sector. It has worked with Civil Society Organizations (CSO) in Zambia in advocacy activities such as contributing to national budget submissions on environmental protection. CEJ has implemented on natural resource governance with traditional leaders, renewable energy for communities in Zambia and disability inclusion in climate action projects. It has convened high level national dialogue processes and symposiums.
59	Zambia for Agroforestry, Climate and Biodiversity	The overall objective: to contribute to the development of climate-relevant, productive, and sustainable transformation of agriculture, forestry, and food systems in Zambia to help to achieve the Nationally Determined Contributions (NDC).	Bilateral	Lower Zambezi-Luangwas - Nijka Corridors	ICRAF	4,482,706.00	2021 - 2026	Grant	Received	Adaptation	Agriculture	Agro-forestry	0	1	Ongoing	European Union	1. To improve livelihoods and climate change resilience of specific agricultural, agroforestry, forestry, and food systems, in the Lower Zambezi – Luangwa – Nyika (ZLN) corridor. Specific objective 2. To increase the climate relevance of Agriculture and Knowledge Innovation Systems (AKIS2) in the Lower Zambezi – Luangwa – Nyika (ZLN) corridor.

60	Beyond the Grid Fund Africa	Launched in July 2017, the Beyond the Grid Fund for Zambia (BGFZ) intends to bring clean, affordable off-grid energy services to 306,000 households, businesses and institutions, or 1.6 million people, by 2021.	Bilateral	Country wide	NEFCO	21,400,000.00	2019 - 2023	Private Sector	Received	Mitigation	Energy	Electricity	0	1	Ongoing	Sweden	As of September 2019, the contracted companies have connected over 145,000 households, translating to 750,000 people in all provinces of Zambia. They are on track to reach their goal of 1.6 million people well ahead of schedule. Beyond the Grid Fund for Zambia's (BGFZ) 145,000 connections represent 3.4MW of capacity and have led to a CO2 e emissions avoidance of 358 tonnes per year.

61	Preparation of the Third National Communication	The Third National Communication (TNC) aims to communicate Government's effort to address climate change in Zambia. The TNC was prepared through a consultative approach comprising various Government ministries, Cooperating Partners Civil Society Organisations (CSO), academia and the media, among others. The country received support in various forms and from different institutions and individuals during the process of preparing the TNC.	Multilateral	Zambia	Zambia - ZEMA,Zambia - MLNR	480,000.00	2016 - 2019	Grant	Received	cross - cutting	Cross-cutting	Capacity Building	0	1	Concluded	Global Environment Facility	• MOU's between ZEMA and GHG sectors institutions (Energy, Forestry and Agriculture) finalised. • GHG Inventory Preparation training conducted with the Energy, Industrial Processes and Waste sectors conducted • GHG data collection conducted (Energy and Industrial Processes • Adverts for consultancy to assess National Circumstances, Vulnerability and Adaptations (V&A) and Mitigation actions components of TNC placed in print media • Evaluation of proposals for consultancy conducted.

62	Country Enhancement Action Plan (CAEP)	1. Strengthen the MRV system's data collection and analysis for GHG projections and target setting and alignment of such to the respective sector policies, strategies and plans 2. Building capacity of data providers and establishing data sharing platforms for quality assurance. 3. Integrate the NDC MRV system to the Central Statistics Office for national reporting and communication of projection	Multilateral	Zambia	MoE	107,613.00	2020 - 2022	Grant	Received	Mitigation	Energy	Capacity Building	0	1	Concluded	International Renewable Energy Agency	1. Training on cost benefit analysis was undertaken for 14 of the Climate Change Unit in the Ministry of Lands and Natural Resources of Zambia. The training workshop was combined with a final validation of the bankable project proposals 2. Feedback received on Part 2 of the final report on energy related emissions data have been calculated at fuel and sector level from the energy balances 3. Held nine online energy statistics training sessions.

63	Climate Resilience through Risk Prevention and Innovative Climate Risk Insurance in Zambia	Agricultural actors have better access to private-sector climate risk insurance and information on climate risk.	Bilateral		Zambia - MoA	2,206,000.00	2020 - 2022	Grant	Received	Adaptation	Cross-cutting	Capacity Building	0	1	Planned	Germany	1. The capacities of intermediaries to offer climate risk insurance are strengthened. 2. The capacities of insurance companies to offer are strengthened. 3. Government institutions are better equipped to accompany the implementation climate risk insurance programmes. 4. The capacities of providers to supply climate risk information sustainably are strengthened.
64	Supporting Zambia to Integrate Agriculture Sectors into National Adaptation Plans	To tackle these vulnerabilities, the Government of Zambia, with support from the NAP-Ag Programme, are thinking ahead into the medium and long-term and advancing the processes by which adaptation strategies are integrated into national development plans and budgets.	Multilateral	Zambia	Zambia - MoA	700,000.00	2016 - 2018		Received	Adaptation	Agriculture	Capacity Building	0	1	Ongoing	United Nations Development Programme	• Strengthen capacities of policy and technical staff in key ministries and institutions to take climate change risks and opportunities in the agriculture sector into account in planning and budgeting processes • Strengthen and institutionalize processes for the formulation of NAP that address priorities of the agriculture sector. • Develop impact assessment framework for the agriculture sector that will generate evidence-based results of adaptation options • Promote Advocacy and knowledge-sharing on Agriculture Sector NAP

65	Strengthening Climate Resilience in the Kafue Sub – basin	The Strengthening Climate Resilience in the Kafue sub-basin (SCRIKA) project aims to strengthen the adaptive capacity of rural communities to better respond to the current climate variability and long-term consequence of climate change in the Kafue sub-basin.	Multilateral	Southern, Central, Lusaka	Zambia - MoFNP	38,000,000.00	2013 - 2019	Concessional Loan,Grant	Received	Adaptation	Infrastructure	Resilient Roads	0	1	Ongoing	African Development Bank	• Disbursement of funds to approved 320 community project proposals 26 Subproject proposals fully funded and fully implemented in 5 Districts. • 8 Matching Grant Proposals approved for funding. • 82Km climate resilient road completed in Itezhi-tezhi (up to Namwala pontoon) and Ngoma out of 237km. • Consultant to undertake midterm review has been engaged and about to commence works. • 11 districts trained in mainstreaming climate change into development planning
66	SNV INCREASE Climate Smart Agriculture and Biogas	The overall objective is to increase the social, economic and environmental resilience and equity in agriculture and energy systems, through strengthening the adaptive capacity of agricultural and energy systems.	Bilateral	Zambia	SNV	8,500,000.00	2020 - 2022	Grant	Received	cross-cutting	Cross-cutting	Energy, Agriculture	0	1	Ongoing	Sweden	1. Improve the income, food and energy security for men, women and youth farmers; 2. Increase business and value chain performance through climate smart investments in agriculture, water and renewable energy; 3. Improve performance of enabling environment for climate smart agriculture, water and renewable energy practices

67	Country Enhancement Action Plan (CAEP)	The Climate Action Enhancement Package (CAEP) is a new offering of the NDC Partnership. It is designed as a targeted, demand-driven and impact-focused fast-track initiative to deliver support for the development and implementation of enhanced and more ambitious NDCs. It allows countries to address the challenges of the first generation of NDCs by providing support for the development and implementation of evidence-based, high-quality NDCs with broad ownership from society and government.	Multilateral	Zambia	Zambia - MGEE	143,000.00	2020 - 2022	Grant	Received	cross-cutting	Cross-cutting	Capacity Building	0	1	Concluded	COMESA	1. Harmonization of project ideas identified from provincial consultations and aligning them to the respective sectors and NDC focus areas 2. Undertake a cost-benefit analysis and impact assessment of the longlist of NDC actions of the implementations plan to prioritize a shortlist of 10 ideas across adaptation and mitigation themes 3. Rank and prioritize 2 project ideas for preparation of bankable proposals 4. Submit full proposal documents to possible funders

68	Alternatives to Charcoal	The United States Agency for International Development (USAID's) Alternatives to Charcoal (A2C) activity is a five-year (2021-2026) project in Zambia whose aim to decrease urban charcoal demand and increase the use of Alternative Technologies and Fuels (ATFs) through innovation and increased private sector engagement to reduce charcoal production-driven deforestation and greenhouse gas emissions	Bilateral	National Leave and Provinces TBD	TETRATECH	25,000,000.00	2021 - 2026	Grant	Received	Mitigation	FOLU	Technology	1	1	Planned	United States	• Reduce deforestation through increased use of private sector led, low emissions charcoal alternative technologies and/or fuels; • Improve the business enabling environment for the charcoal alternative industry; • Enhance enforcement of laws and policies in the forestry and energy sectors; • Increase public perception of the negative impacts of charcoal on forests; and, • Support charcoal producers in transitioning to alternative sustainable livelihoods.

69	Strengthening Integrated Adaptation Planning and Implementation in Southern Africa Smallholder Agricultural Systems to Support Food Security	The overall expected outcome of this project therefore is to secure strengthened integrated adaptation planning and implementation of good practices in Zambia to support food security.	Multilateral	Zambia	Zambia - MoA	882,599.00	2015 - 2020	Grant	Received	Adaptation	Agriculture	Capacity Building	0	1	Ongoing	Food and Agriculture Organization	• Strengthened technical capacity for synthesis, analysis and transfer of climate and bio-physical data and information for assessment of vulnerabilities and risks and promoted climate information services • Strengthened capacities for developing, promoting and adopting Climate resilient agriculture practices, policies and financing. • Improved climate change adaptation practices prioritized and implemented in selected ecosystems and resilience to climate variability and change
70	Climate Smart Agriculture in Zambia	The climate-smart agriculture (CSA) concept reflects an ambition to improve the integration of agriculture development and climate responsiveness. It aims to achieve food security and broader development goals under a changing climate and increasing food demand.	Bilateral		World Bank	32,325,552.00	2016 - 2021	Concessional Loan	Received	Adaptation	Agriculture	Crop production	0	1	Ongoing	United Kingdom	• Farmers trained in conservation farming, climate smart agriculture and business/commercial skills to build their long-term resilience to droughts and improve their livelihoods. • Farmers supported to adopt conservation farming • Building the the evidence base of these techniques as adaptation strategies for with an aim on influencing national policy development and implementation • Improve linkages between farmers and input, services and output markets

71	Strengthening climate resilience of agricultural livelihoods in Agro-Ecological Regions I and II in Zambia	• Establishing or strengthening existing farmer field schools in each of the target camps across the 16 districts • Training of trainers (extension staff) to facilitate experiential learning by communities on adaptive practices • Establishing or rehabilitating learning centres of excellence in each of the 16 target districts	Multilateral	Eastern,Southern, Lusaka and western	Zambia - MoA	32,000,000.00	2018 - 2025	Grant	Received	Adaptation	Agriculture	Capacity Building	0	1	Ongoing	United Nations Development Programme	This project signals an important step to mobilize these funds in Zambia, scale-up pilot climate resilience projects, and work toward achieving Zambia's Nationally Determined Contribution to the Paris Agreement. In fulfilling its contribution to the Paris Agreement - and global goals to limit temperature increases to 2 degrees while ensuring no one is left behind in terms of economic and social development - the project will promote the conservation of water, improve the use of irrigation technologies, and strengthen climate information services
72	Climate Resilient Livestock Management Project	The Climate Resilient Livestock Management Project, implemented by the African Development Bank in Zambia between 2017 and 2022, has helped to equip small livestock farmers to adapt to climate change	Multilateral	Zambia	Zambia - MFL	6,210,000.00	2014 - 2019	Grant	Received	Adaptation	Agriculture	Livestock	0	1	Ongoing	African Development Bank	• Stock breeders acquire breeds resilientto climate change • Stockbreeders set up sustainable livestock pastures, fodder banks, rangeland and water harvesting systems • Restoration of degraded pasture and increased vegetation cover with different drought tolerant perennials • Country Technical staff of Government trained in climate risk assessment and adaptation skills for stockbreeders • Community level: Training artisans in manufacturing livestock-related material as a source of income diversification

73	Accelerated improvement of the regional management of the fisheries in Lake Tanganyika		Multilateral	Lake Tanganyika	Zambia - MGEE	15,595,982.00	2020 - 2023	Concessional Loan	Received	Adaptation	Fisheries	Capacity Building	0	1	Ongoing	African Development Bank	2. Enhance regional policies and institutional frameworks securing more sustainable fisheries management and 2) to develop regional action plans to deter and eliminate Illegal Unreported and Unregulated fishing.
74	Building the Resilience of Local Communities in Zambia through the Introduction of Ecosystem-based Adaptation (EbA) into Priority Ecosystems, including Wetlands and Forests	To strengthen the capacity of government and rural communities living around wetlands and forests to adapt to climate change using EbA		Zambia	Zambia - MLNR	6,185,000.00	2018 - 2022	Grant	Received	Adaptation	Cross-cutting	Forest, Agriculture	0	1	Planned	United Environment Program	The proposed project will address four NAPA priorities, namely Priorities: 2 – Promotion of alternative sources of livelihoods to reduce vulnerability to climate change/variability to communities living around GMAs; 5 – Promote natural regeneration of indigenous forests; 6 –Adaptation of land use practices (crops, fish, and livestock) in light of climate change; and 8 – Eradication of invasive Alien Species

75	UN CC:Learn: development of a National Climate Change Learning Strategy to strengthen learning and skills development to address climate change in Zambia	Zambia launched its National Climate Change Learning Strategy in March 2021.	Multilateral	Country-wide	Zambia - ZEMA,Zambia - MLNR	100,000.00	2019 - 2020	Grant	Received	cross-cutting	Cross-cutting	Capacity Building	0	1	Concluded	United Nations Institute for Training and Research	The Strategy has three main objectives: Raise awareness and strengthening climate change knowledge. Build individual and institutional capacity in climate change mitigation and adaptation
76	Promoting climate resilient, community based regeneration of indigenous forests in Zambia's Central Province	The project "Promoting Climate Resilient, Community-Based Regeneration of Indigenous Forests in Zambia's Central Province" aims to restore and conserve indigenous forests in Zambia's Central Province, while promoting climate resilience and community-led sustainable forest management.	Multilateral	Central Province	Zambia - MLNR,Zambia - MGEE	3,885,000.00	2015-2020	Grant	Received	Adaptation	FOLU	Energy Efficiency	0	1	Ongoing	United Nations Development Programme	• Strengthened technical and institutional capacity of foresters and communities in Central Province to implement appropriate climate-resilient agro-forestry and natural regeneration practices • Robust fire monitoring and management protection plans and measures in place in all districts in Central Province • to maintain desired regeneration targets and reduce fire frequency by 25-30% annually across the province • Energy efficient charcoal production and wood-saving technologies have successfully replaced inefficient systems in targeted areas of Central Province

77	Preparation of Zambia's Biennial Update Report	The BUR contains updates of the national GHG inventory, information on actions to reduce emissions/ enhance sinks and needs and support received, as continued in the Third National Report submitted in September 2020	Multilateral	Zambia	Zambia - ZEMA,Zambia - MLNR	352,000.00	2017 - 2018	Grant	Received	cross - cutting	Cross-cutting	Capacity Building	0	1	Concluded	Global Environment Facility	• GHG training conducted back to back with TNC • Data Collection for GHG conducted back to back with TNC • Procurement requisition for consultancy to assess Mitigation actions and their effects and develop a domestic Measuring Reporting and Verification (MRV) system proposal initiated

78	Transforming Landscapes for Resilience and Development in Zambia	The development objective of the Transforming Landscapes for Resilience and Development Project for Zambia is to improve natural resource management in select districts to support sustainable livelihoods, and in the event of an eligible crisis or emergency, to provide immediate and effective response to the eligible crisis or emergency	Multilateral	Zambia	Zambia - MoFNP	100,000,000.00	2019 - 2025	Concessional Loan	Received	cross - cutting	FOLU	Technology	1	1	Ongoing	World Bank	The project has supported a total of 28,965 against a target of 27,836 households with diversified livelihood activities and has supported activities that have brought 76,003.77 ha against 75,000 ha under sustainable landscape management practices. In addition, a total of 53,286 farmers have adopted improved agricultural technology (of which 55% female)

79	Enterprise Development and Growth Enhanced Zambia	EDGE is a **USAID-funded** five year project aimed at increasing the profitability and revenue for 450 agricultural MSMEs in Zambia by addressing their key constraints in access to finance, gaps in business management skills and technology, and limited access to markets.	Bilateral	Eastern, Lusaka and Central provinces	ACDI/VOCA	14,467,241.00	2020 - 2025	Private Sector,Grant	Received	cross - cutting	Agriculture	Cro[	0	1	Planned	United States	To date, the project has created 840 full-time jobs, and achieved an average of 80% increase in profits and a 72% growth in revenue for the 385 MSMEs. Additionally, $10 million worth of crops have been sold to markets through improved market linkages and $14 million in financing has been leveraged for 125 SMEs and individual producers.

80	Sustainable Agriculture for Forest Ecosystems (SAFE)	Overall aim: Conservation of forests and other ecosystems and sustainable management of agri-food systems 1. Strengthen selected supply chains and make them deforestation-free 2. Strengthen stakeholder capacities for transition towards sustainable and deforestation-free production 3. Improve capacities of smallholder producers to sustainably manage selected production systems 4. Share experiences and knowledge on deforestation-free supply chains regionally	Bilateral	Zambia and Lower Kafue Sub-Catchment	GIZ,Zambia - MGEE,Zambia - MoA	50,568,337.00	2022 - 2026	Grant	Received	cross - cutting	Agriculture	Agri-food systens	0	1	Ongoing	European Union	1. Reduced Deforestation: Reduce deforestation and forest degradation, conserving biodiversity and ecosystem services. 2. Improved Agricultural Productivity: Enhance agricultural productivity and incomes for smallholder farmers, improving food security and livelihoods. 3. Increased Climate Resilience: Promote climate-resilient agriculture practices, reducing vulnerability to climate change impacts. 4. Empowered Communities: Empower rural communities, particularly women and youth, to take ownership of their natural resources and livelihoods.

81	Increased Access to Electricity and Renewable Energy	Strategic Environmental Assessment for the Energy Sector in Zambia. Waste management from renewable and efficiency energy sources (WEEREE)	Bilateral	Zambia	Zambia - ZEMA	206,000.00	2018 - 2023	Grant	Received	Mitigation	Energy	Waste Management	0	1	Ongoing	European Union	Strengthening laws and regulations to promote renewable energy and energy efficiency, Providing training and capacity-building programs for stakeholders, including government officials, private sector companies, and local communities and Offering grant funding and other financial incentives to support the development of renewable energy projects.
82	Integrating climate change into water resources monitoring and planning	The project with support of the consulting GFA provides advisory services to the Water Resources Management Authority (WARMA), which was founded in 2012. This advice focuses on the establishment of the water resources information system (IWRMIS) and the use of this system to integrate climate change into water resource plans and allocation	Bilateral		Zambia - WARMA	4,412,000.00	2017 - 2019	Grant	Received	Adaptation	Water	Capacity Building	0	1	Concluded	Germany	The project has supported the process of dividing the country into water catchment areas and sub-catchment areas, and accompanied the planning of an information system for integrated water resources management. These activities have helped lay the foundations for improved water resources management.

83	Sustainable Intensificatin of Smallholder Farming Systems (SIFAZ)	The objective of the programme is to improve sustainable and climate smart crop production and land management practices, with a gender sensitive approach.	Bilateral	Zambia	Zambia - MoA	13,250,400.00	2019 - 2024	Grant	Received	Adaptation	Agriculture	Crop production	0	1	Ongoing	European Union	Main activities: Research and co-development of agricultural sustainable intensification practices by agro-ecological area; Training on conservation agriculture (CA), climate-smart agriculture (CSA) and sustainable intensification practices (SIPs); Adaptation of mechanisation equipment to smallholder farmers; Equipment and training to the National Agricultural Information Service (NAIS)
84	IAPRI	IAPRI's research and advocacy efforts are aimed to help policy makers and other agricultural stakeholders to make rational and informed policy decisions that creates a conducive environment for the poor to improve their living conditions and increase their resilience to climate change and other shocks.	Bilateral	Country wide	IAPRI	4,200,000.00	2018 - 2022	Grant	Received	cross - cutting	Agriculture	Capacity Building	0	1	Ongoing	Sweden	Research in the environment thematic area focuses on a) understanding the impact of climate change on rural livelihood, b) analysing the adoption of climate smart agricultural practices, c) understanding the role forest resources and d) analysing the drivers of deforestation land use change and options for mitigating climate change. The output puts will contribute towards the design of environmental policies and interventions that support climate mitigation and adaptation and sustainable natural resources management in Zambia.

85	Technical Assistance to the Climate Change and Natural Resource Management Department at Ministry of Lands and Natural Resources in Zambia	The project seeks to provide expertise in areas like developing climate change adaptation strategies, implementing sustainable land management practices, monitoring greenhouse gas emissions, capacity building for staff, integrating climate considerations into land use planning, and facilitating access to climate finance to effectively address the impacts of climate change on Zambia's natural resources and ecosystems.	Bilateral	Zambia	Zambia - MGEE	358,655.00	2020-2022	Grant	Received	Adaptation	Cross-cutting	Capacity Building	0	1	Ongoing	European Union	1. Develop concept papers addressing "green deal" focal areas relevant to Zambia that guide the EU-Zambia 2021-2027 National Indicative Programme (NIP) formulation, and cluster 33 NDC concept ideas for development of at least two bankable NDC actions. 2. Update GRZ communication and advocacy strategy on climate change and develop climate action communication tools. 3. Strengthen CCNRMD institutional capacity to develop bankable projects, monitor evaluate report and coordinate ongoing climate actions, and perform NDC gap analysis.
86	Country Enhancement Action Plan (CAEP)	The CAEP is designed to catalyze transformational change towards resilient, sustainable and low- emission development, supporting the objectives of the Paris Agreement	Bilateral	Zambia	Zambia - MGEE	87,737.00	2020 - 2022	Grant	Received	cross - cutting	Cross-cutting	Capacity Building	0	1	Concluded	United Kingdom	Through CAEP, 46 partners provided countries with technical and financial support, using a combination of their own resources and funding from the Technical Assistance Fund (TAF)

87	Promoting Production and Consumption of Nutritious Foods in Zambia	Increase resilience through climate-smart agricultural techniques, crop diversification, access to viable markets and post-harvest management amongst targeted smallholder farmers. Due to a severe drought in 2019, emergency food is also distributed Dec 2019-May 2020 to the most vulnerable to increase their resilience.	Bilateral	Central, Southern and Eastern Provinces	WFP	7,400,000.00	2018 - 2022	Grant	Received	Adaptation	Agriculture	Nutrition	0	1	Ongoing	Sweden	1. Improved Nutritional Status: Enhance the nutritional status of Zambians, particularly in rural areas, reducing malnutrition and related health problems. 2. Increased Productivity and Incomes: Improve crop and animal productivity, enhancing farmers' incomes and livelihoods. 3. Increased Access to Nutritious Foods: Improve access to nutritious foods, particularly for vulnerable groups, reducing malnutrition and related health problems.

88	Support to the Zambia Energy Sector: Increased Access to Electricity and Renewable Energy production (IAEREP)	The Increased Access to Electricity and Renewable Energy Production (IAEREP) program is a comprehensive initiative supporting Zambia's energy sector. Its primary goal is to increase access to clean, reliable, and affordable energy, while promoting renewable energy production and energy efficiency, especially in rural areas	Bilateral	Zambia	Zambia - MoE,Zambia - ZEMA	20,000,000.00	2017 - 2025	Grant	Received	cross - cutting	Energy	Electricity	0	1	Planned	European Union	1) Supporting public institutions to develop and/or revise the institutional and regulatory framework for renewable energy and energy efficiency in Zambia; 2) Capacity building of both public and private actors involved in deployment of renewable energy and energy efficiency solutions; 3) Support to renewable energy and energy efficiency projects, primarily off grid, in rural areas (EUR 25m): call for proposals for demo projects (investments) to (i) demonstrate sustainable business model(s) for minigrids and mini-grid management and viable PPP business models for rural electrification and for energy efficiency services to public bodies.

89	Digital Climate Information for Small holder farmers in Malawi and Zambia (E-PICSA)	An automated system for National Meteorological Services (NMS) that provides quality-checked, locally-specific, historical rainfall and temperature data, and location-specific season and short-term forecast; it does so by making best use of existing station data and state	Bilateral	Eastern Province	Zambia - MoA	4,500,000.00	2022 - 2024	Grant	Received	Adaptation	Agriculture	Early Warning	0	1	Ongoing	Germany	5,000 smallholder farmers as well as 50 agricultural extension officers benefit through access to and use of locally specific historical and forecast climate information and participatory farm management tools for improved decision making. Resulting in increased productivity and improved resilience to climate variability and change. Furthermore, 5 staff of the National Meteorological Service (NMS) benefit from training on app development and the skills to maintain a newly introduced automated software system and data base for site-specific historical climate information and forecasts.

90	Additional allocation for Food Production and Resilience of Food Systems in African, Caribbean and Pacific (ACP) countries	To address systemic productivity and sustainability challenges in Zambian smallholder farming systems and the requirement to adapt those to new threats (e.g., climate change, soil fertility decline, environmental off-site damage and biodiversity loss)	Bilateral	Zambia	FAO	22,084,000.00	2023 - 2027	Grant	Received	Adaptation	Agriculture	Crop production	0	1	Planned	European Union	1. Improved Climate Resilience: Enhance the resilience of smallholder farmers to climate change, reducing vulnerability to climate-related shocks and stresses. 2. Increased Agricultural Productivity: Improve agricultural productivity and incomes for smallholder farmers, promoting food security and poverty reduction. 3. Empowered Farmers: Empower farmers with actionable climate information, enabling them to make informed decisions about their agricultural practices and improving their overall well-being.

91	The Energy and Environment Partnership Trust Fund (EEP Africa)	EEP is a clean energy financing facility providing early stage and catalytic financing primarily for private-sector-led projects in Southern and East Africa (SEA). It was first established as a closed-end programme in 2010 with funding from the Ministry for Foreign Affairs of Finland (MFA Finland), the UK Department for International Development (DfID) and the Austrian Development Agency (ADA).	Bilateral	Southern and East Africa	Private Sector	10,400,000.00	2018 on going	Grant	Received	Mitigation	Energy		0	1	Ongoing	Finland	This project consists of (1) establishment of the Energy and Environment Partnership Trust Fund (EEP or Fund) as a multi-donor clean energy financing facility covering 15 countries in Southern and Eastern Africa (SEA) under direct management by NDF and (2) financing of EUR 10 million toward the Fund's first close.

5.2.6 Progress Made Towards Implementation

Despite notable progress in mobilising climate finance, a substantial gap remains between the financial resources required and those received. Zambia continues to face several challenges, including limited national capacity to prepare bankable project proposals that meet the technical and fiduciary standards of international climate finance institutions. Additionally, there are delays in the disbursement of approved funds and coordination challenges among implementing agencies, which affect timely execution and reporting.

Furthermore, the country faces difficulties in accessing private sector financing and blended finance mechanisms, largely due to perceived risks and lack of de-risking instruments. Long-term support for adaptation, particularly for rural and vulnerable communities, remains inadequate and often fragmented. Addressing these gaps is critical for Zambia to effectively implement its NDC commitments and build national climate resilience.

5.2.7 Planned and Pipeline Finance

Zambia is actively pursuing several climate finance opportunities to bridge the existing funding gap. A full project proposal has been submitted to the Green Climate Fund (GCF) for a Climate Resilient Agroforestry Programme targeting Eastern and Central Provinces, with an estimated value of approximately USD 10 million.

In addition, a concept note has been prepared for the Adaptation Fund to support community-based adaptation interventions in Western Zambia, with a proposed budget of USD 3.5 million. Zambia is also engaging with the NDC Partnership Technical Assistance Facility to mobilise private sector investment in clean energy solutions, particularly for off-grid mini-grids and clean cooking technologies.

At the national level, efforts are underway to enhance domestic resource mobilisation through targeted climate budget tagging and the development of public-private partnerships for sustainable infrastructure. These initiatives are intended to complement international support and strengthen Zambia’s overall climate finance architecture

5.3 Technology Development, Transfer and Support Needed and Received

5.3.1 Introduction

The Paris Agreement emphasizes technology development and transfer as crucial for achieving its goals of mitigating climate change and enhancing resilience. It establishes a framework to accelerate and enhance climate technology development and transfer, recognizing that widespread access to and deployment of clean technologies are essential for both mitigation and adaptation efforts. Article 10 highlights the critical role of technology development and transfer in achieving the Paris agreement's goals. It emphasizes the need for international cooperation to accelerate innovation and the deployment of technologies that can mitigate and adapt to climate change. This includes strengthening cooperative action on technology development and transfer, with a focus on supporting developing countries.

Zambia, recognizes technology as a critical enabler for achieving its Nationally Determined Contributions (NDCs) and Sustainable Development Goals (SDGs) goals. To facilitate effective access and transfer of climate technologies the country has put in place a supportive institutional and policy frameworks/ strategies.

The Ministry of Technology and Science in Zambia plays a pivotal role in empowering youth and women in innovation, technology transfer, commercialization, and human capacity development, initiatives that also contribute to climate change mitigation. Through its policy mandate, the Ministry promotes the development and transfer of climate-resilient technologies, coordinates research, and fosters innovation ecosystems that encourage sustainable solutions. Several targeted initiatives such as the Science and Technology Innovation Youth Fund (STIYF) and the HH Innovation Fund (HHIF) provide financial and technical support to young innovators, particularly women, enabling them to develop and commercialize technologies that enhance renewable energy use, waste management, and environmental protection.

Innovation hubs like UniPod at the Copperbelt University and the National Technology Business Centre (NTBC) offer incubation, mentorship, and prototyping support, allowing innovators to refine eco-friendly ideas into viable enterprises. Additionally, digital inclusion programs such as the Digital Zambia Acceleration Project (DZAP) enhance access to digital tools and platforms, empowering women and youth in rural and peri-urban areas to participate in green innovation and technology-driven climate solutions. By strengthening STEM education and vocational skills through the National Youth Skills Empowerment Programme and other work-based learning partnerships, the Ministry is building a generation of skilled Zambians capable of designing and implementing sustainable technologies, including renewable energy systems and circular economy practices. These collective efforts are directly contributing to climate change mitigation by promoting low-carbon technologies, supporting clean energy entrepreneurship, and enabling inclusive participation in the green economy—thereby reducing greenhouse gas emissions while improving livelihoods across the country

Collaboration among countries is cardinal in knowledge transfer. South-South and triangular cooperation (SSTC) plays a vital role in technology transfer and development by fostering collaboration among developing countries and facilitating the sharing of knowledge, expertise,

and resources. This approach promotes mutual benefit, collaborative problem- solving, and increased self-reliance among participating nations

Access to and implementation of low-emission and climate-resilient technologies will enhance the Zambia's capacity to reduce greenhouse gas emissions (GHGs) and strengthen resilience to the adverse impacts of climate change, while simultaneously promoting sustainable and inclusive development.

5.3.1.1 Technology Needs and Priorities

In 2013, Zambia conducted a Technology Needs Assessment (TNA) to identify and prioritize technologies that can contribute to both mitigation and adaptation goals. The TNA process also helped identify barriers to technology transfer and develop technology action plans to overcome these barriers. The TNA identified specific technologies for vulnerable sectors like water and agriculture, with action plans to enhance their resilience.

The scope and types of climate technologies identified in the TNA are those aligned to the key emitting sources and the country's NDC. Therefore, the support needed is in the following six (06) programmes identified in the NDC:

(i) Sustainable forest management;
(ii) Sustainable agriculture;
(iii) Renewable energy and energy efficiency;
(iv) Liquid waste;
(v) Transport; and
(vi) Coal (production, transportation, and consumption).

Some of the technology priorities include among others improved biomass commercial stoves, improved charcoal stoves, biomass gasification, retort kiln and metal kiln).

5.3.2 Technology Development, Transfer and Support Needed

Table 5.4 shows the details of Technology Development, Transfer and Support Needs for Zambia.

Table 5-4: Technology Development, Transfer and Support Needed

Year Support Needed	Support Type	Thematic Area	Description of Support Need	Recipient Institution	Estimated Cost (USD)	Potential/Target Source (s)	Expected Outcome/Use
2011-2026	Concessional Loan for Adaptation	Agriculture	The project aims at enhancing access to irrigation services in various locations of the country, through the establishment of several irrigation schemes and dams	Ministry of Agriculture	14,500,000.00	World Bank, African Development Bank	-Increased Agricultural Productivity -Improved Food Security -Enhanced Water Management: -Job Creation and Economic Growth -Functional Out-grower Clusters
2019-2028	Grant	Water	The primarily poor population living in small, peri-urban communities that form part of the programme towns and cities (around 20,000 residents during phase II at the time of the evaluation).	Eastern Water and Sewerage Company	4,708,000.00	Germany Government	Women and children in particular intended to benefit from the improved supply
2018-2026	Grant	Agriculture	The programme will stimulate an increase in regional food trade in sub–Saharan Africa (SSA), contributing to satisfying a growing food demand and to addressing food shortages through regional food production, processing and trade, and generating more rural jobs, climate resilience and income for farmers.	UK – FCDO	45,647,450.00	United Kingdom	The programme will: (i) work with companies that source, process, and trade food in the region, to maximise investment, coordination and benefits to smallholder farmers and (ii) contribute to improve the transparency and predictability of government policies to unlock regional food trade. It is expected that the programme will increase income for 1.8 million farming families.
2022 - 2032	Equity, Grant	Energy	The KawiSafi II project will create a USD 200 million venture equity fund aimed at closing the investment gap in three key areas where sub-Saharan countries struggle to find investors: energy transition, productivity, and mobility & logistics.	Acumen	6,562,500.00	Green Climate Fund	Investment gap closed in three areas of energy transition, productivity, and mobility and logistics
2022 - 2026	Concessional Loan	Agriculture	The objective of the operation is to promote agricultural diversification, sustainability and jobs in the agri-food sector of Zambia	Ministry of Agriculture	300,000,000.00	World Bank	▪ 5,000 jobs generated in areas benefitting from irrigation support

							▪ 605,000 hectares under climate-resilient technologies and practices for crop production ▪ 600,000 farmers who have received extension services and have completed training on CSA technologies ▪ 1,400 kilometers of farm feeder roads rehabilitated
2017 - 2030	Concessional Loan, Grant	Agriculture	The objective of Integrated Forest Landscape Project for Zambia is to improve landscape management and increase environmental and economic benefits for targeted rural communities in the Eastern Province and to improve the Recipient's capacity to respond promptly and effectively to an Eligible Crisis or Emergency	Ministry of Green Economy and Environment	32,800,000.00	World Bank	The following will be implemented (i) Create conditions that will allow livelihood investments (under Component (ii) Finance on-the-ground activities that improve rural livelihoods, conserve ecosystems, and reduce GHG emissions (iii) Finance activities related to national and provincial-level program coordination and management; and facilitate the use of International Development Association (IDA) funds in the event of a disaster
2015 – 2025	Bilateral Cooperation	Energy	Three new electric turbines, each rated at 5 MW will be installed, for a generation capacity calculated at 73 GWh annually. Two new switchyards one of 66 kV and the other of 33 kV will be constructed next to the powerhouse. High voltage transmission lines will connect these switchyards to the existing Kasama substation, where the power will integrate into the Zambian national grid.	ZESCO, Ministry of Finance	45,774,500.00	Germany Government	Contribute to energy security
2021 - 2027	Grant	Crosscutting	The project is aimed at supporting a climate-resilient transition towards green partnerships, sustainable growth and decent jobs in Zambia. The action intends to promote and invest in the	EU	47,174,000.00	EU	Enhance climate resilience in Zambia's agriculture, forestry, and biodiversity sectors, promote sustainable development and reduce poverty in rural communities, Biodiversity, Protect and

			green recovery and sustainable growth along the Zambian part of the Greater Kavango Zambezi (KAZA) Trans-Frontier Conservation Area (TFCA).				conserve Zambia's rich biodiversity, including endangered species and ecosystems
2018 - 2025	Concessional Loan	Infrastructure – Crosscutting	Improved Rural Connectivity is a project that aims to improve access to rural areas through better roads and transportation infrastructure. The project also aims to strengthen the institutions that manage rural roads.	Ministry of Finance	200,000,000.00	World Bank	▪ Share of rural population with access to an all-season road increased from 18.7% to 25% in beneficiary provinces. ▪ Increased proportion of Primary Feeder Roads in the country, that are in a good and fair condition, by 30% ▪ Improved institutional oversight capacity in the roads sector, assessed by the development and application of a Road Development Agency performance framework by the ministry responsible for roads.
2016 - 2025	Concessional Loan	Water &Sanitation	The Lusaka Sanitation Program aims to increase access to sustainable sanitation services for residents of Lusaka, Zambia's capital city. The program will rehabilitate and construct climate-resilient sewerage infrastructure, promote decentralised sanitation and hygiene, and strengthen the Lusaka Water and Sewerage Company and other institutions	LWSC	47,541,089.09	AfDB	The intervention will have direct and indirect benefits to Lusaka City's population with improved sanitation to about 600,000 indirect beneficiaries and 473, 000 direct beneficiaries (52% women). Urban residents in the whole of Lusaka city will benefit from improved performance of Lusaka Water and Sewerage Company in delivering water and sanitation services.
2017 - 2027	Private sector	Energy	GET FiT Zambia is designed to assist the Zambian Government in the implementation of its REFiT Strategy and aims to procure and support Independent Power Producer (IPP) projects up to 20 MW	KfW	45,223,000.00	Germany Government	The procurement and support of 200 MW renewable energy capacity are at the core of the Programme, divided into a 100 MW solar PV round, and a 100 MW small hydro round

2020 - 2025	Grant	Agriculture	To integrate agriculture SMEs and smallholder farmers into market-integrated environmentally sustainable, resilient, low carbon, circular and nutrition sensitive value chains	Zambia - MoA, Zambia - MGEE, MoFL	26,677,000.00	EU	Supporting 40 Agri-enterprises, 8500 jobs created, 150,000 smallholder fish farmers and 105,000 using climate smart land management practices
2018 - 2025	Grant	Energy	ElectriFI will mostly apply to projects leading to new and improved connections to electricity for populations living in under-served and remote areas.	EDF	8,000,000.00	EU	In an effort to increase the country's electrification rate, the government started investing in clean off-grid energy solutions to reach its target of 51% rural electricity access by 2030
2022 - 2026	Grant	Water Infrastructure, capacity building	Increased productivity, income and employment opportunities of emergent, small and medium scale aquapreneurs along the aquaculture value chain	Ministry of Fisheries and Livestock	5,300,000.00	EU	The project is expected to deliver technical assistance, capacity building and infrastructure development involving providing support to fish farmers to improve their technical skills and knowledge in areas such as fish breeding, feeding, and health management strengthening the capacity of local institutions and organizations to support the development of the aquaculture sector and improving infrastructure such as fish ponds, hatcheries, and processing facilities to support the growth of the aquaculture industry.
2020 - 2025	Grant	Energy	The Green Climate Fund is supporting the Government of Zambia to catalyze private investment in the renewable energy sector to boost electricity generation and diversify the country's energy mix	AfDB, MoE	52,500,000.00	Green Climate Fund	Activities under this component will catalyze the market for decentralised energy solutions and directly contribute to national energy access, translating the experience of small-scale IPP (GETFiT projects) into RE-based rural electrification. It is envisaged that local participation can be scaled up in the subsequent rounds of the GETFiT program as well as in other public RE tendering processes (including mini- and off-grid projects), building on the

							improved understanding and risk perception in the RE sector
2015 - 2025	Grant, Equity, Private Sector	Agriculture	The Project aims to promote and invest in the green recovery and sustainable growth along the agriculture-forestry-biodiversity-water and climate nexus.	GIZ, Zambia - MoA, Zambia - MFL, COMACO	287,850,000.00	Germany	The projects support three main outcome areas as follows: promotion of green partnership, supporting green economy diversification, strengthening public financial management and accountability
2020 - 2025	Grant	Agriculture	These projects address a selection of integrated issues: sustainable agriculture, food and nutrition security, research into and production of improved varieties of seed, rural enterprise development and income generation, environmental rehabilitation, and climate change adaptation	Self Help Africa	28,709,200.00	European Union	800 MSMEs, 6,000+ MSME employees, BDSPs, FSPs/investors and TVET providers. Household Members of MSME employees, minimum 22,800 individuals. Final beneficiaries will be at least 22,800 household members of the MSME employees (this figure is likely to be higher as the assumption is that many of the 6,000 FTE
2018 - 2037	Grant	-	Climate Investor One (CIO) is a blended finance facility which provides loans in the early stage of a project life cycle and establishment of equity fund that will meet up to 75 percent of total construction costs in tandem with the project sponsor Multilateral	GCF	5,000,000.00	GCF	The first component of this programme is a development fund, which provides loans in the early stage of a project life cycle. The second component, a construction equity fund, will meet up to 75 percent of total construction costs in tandem with the project sponsor
2020 - 2027	Grant	Energy	The Zambia Energy Efficiency and Sustainable Transformation (ZE2ST) Program is a comprehensive initiative aimed at transforming Zambia's energy sector into a sustainable and energy-efficient one. The program's main objective is to unlock the country's potential for energy efficiency and sustainable transformation	EU	37,800,000.00	EU	Outcomes include Improved energy efficiency in various sectors, including industry, transport, and buildings, Increased use of renewable energy sources, such as solar and hydro power, Reduced greenhouse gas emissions and contribution to climate change mitigation and Enhanced capacity of Zambian authorities and stakeholders to implement energy efficiency and sustainable energy projects
2017 - 2026	Grant	Energy	The project comprises the rehabilitation and reinforcement (R&R) measures of selected power transmission and distribution infrastructure (new lines	ZESCO, Zambia – MoF	51,730,700.00	Germany	The project outcomes include the following: □ Rehabilitation and Reinforcement: Upgrade existing power

			and substations) in the Southern Division of Zambia				transmission and distribution infrastructure to improve electricity supply. • Access Component: Implement additional measures to increase access to electricity, including enabling works, connection subsidies, and prepaid meters
2021 - 2026	Grant	Agriculture	The overall objective: to contribute to the development of climate-relevant, productive, and sustainable transformation of agriculture, forestry, and food systems in Zambia to help to achieve the Nationally Determined Contributions (NDC).	ICRAF	4,482,706.00	EU	1. To improve livelihoods and climate change resilience of specific agricultural, agroforestry, forestry, and food systems, in the Lower Zambezi – Luangwa – Nyika (ZLN) corridor. Specific objective 2. To increase the climate relevance of Agriculture and Knowledge Innovation Systems (AKIS2) in the Lower Zambezi – Luangwa – Nyika (ZLN) corridor.
2021 - 2026	Grant	AFOLU	The United States Agency for International Development (USAID's) Alternatives to Charcoal (A2C) activity is a five-year (2021-2026) project in Zambia whose aim to decrease urban charcoal demand and increase the use of Alternative Technologies and Fuels (ATFs) through innovation and increased private sector engagement to reduce charcoal production-driven deforestation and greenhouse gas emissions	TETRATECH	25,000,000.00	United States	• Reduce deforestation through increased use of private sector led, low emissions charcoal alternative technologies and/or fuels; • Improve the business enabling environment for the charcoal alternative industry; • Enhance enforcement of laws and policies in the forestry and energy sectors; • Increase public perception of the negative impacts of charcoal on forests; and, • Support charcoal producers in transitioning to alternative sustainable livelihoods.
2018 - 2025	Grant	Agriculture	• Establishing or strengthening existing farmer field schools in each of the target camps across the 16 districts	MoA	32,000,000.00	UNDP	This project signals an important step to mobilize these funds in Zambia, scale-up pilot climate resilience projects, and work toward achieving Zambia's Nationally Determined Contribution to

			□ Training of trainers (extension staff) to facilitate experiential learning by communities on adaptive practices □ Establishing or rehabilitating learning centres of excellence in each of the 16 target districts				the Paris Agreement. In fulfilling its contribution to the Paris Agreement - and global goals to limit temperature increases to 2 degrees while ensuring no one is left behind in terms of economic and social development - the project will promote the conservation of water, improve the use of irrigation technologies, and strengthen climate information services
2019 - 2025	Concessional Loan	AFOLU	The development objective of the Transforming Landscapes for Resilience and Development Project for Zambia is to improve natural resource management in select districts to support sustainable livelihoods, and in the event of an eligible crisis or emergency, to provide immediate and effective response to the eligible crisis or emergency	Zambia – MoFNP	100,000,000.00	World Bank	The project has supported a total of 28,965 against a target of 27,836 households with diversified livelihood activities and has supported activities that have brought 76,003.77 ha against 75,000 ha under sustainable landscape management practices. In addition, a total of 53,286 farmers have adopted improved agricultural technology (of which 55% female)
2020 - 2025	Private Sector, Grant	Agriculture	EDGE is a USAID-funded five year project aimed at increasing the profitability and revenue for 450 agricultural MSMEs in Zambia by addressing their key constraints in access to finance, gaps in business management skills and technology, and limited access to markets.	ACDI/VOCA	14,467,241.00	United States of America	To date, the project has created 840 full-time jobs, and achieved an average of 80% increase in profits and a 72% growth in revenue for the 385 MSMEs. Additionally, $10 million worth of crops have been sold to markets through improved market linkages and $14 million in financing has been leveraged for 125 SMEs and individual producers.
2022 - 2026	Grant	Agriculture	Overall aim: Conservation of forests and other ecosystems and sustainable management of agri-food systems 1. Strengthen selected supply chains and make them deforestation-free 2. Strengthen stakeholder capacities for transition towards sustainable and deforestation-free production 3. Improve capacities of smallholder producers to sustainably manage	GIZ, Zambia - MGEE, Zambia – MoA	50,568,337.00	EU	1. Reduced Deforestation: Reduce deforestation and forest degradation, conserving biodiversity and ecosystem services. 2. Improved Agricultural Productivity: Enhance agricultural productivity and incomes for smallholder farmers, improving food security and livelihoods. 3. Increased Climate Resilience: Promote climate-resilient agriculture practices,

			selected production systems 4. Share experiences and knowledge on deforestation-free supply chains regionally				reducing vulnerability to climate change impacts. 4. Empowered Communities: Empower rural communities, particularly women and youth, to take ownership of their natural resources and livelihoods.
2021 - 2027	Grant	Crosscutting	The project is aimed at supporting a climate-resilient transition towards green partnerships, sustainable growth and decent jobs in Zambia. The action intends to promote and invest in the green recovery and sustainable growth along the Zambian part of the Greater Kavango Zambezi (KAZA) Trans-Frontier Conservation Area (TFCA).	EU	47,174,000.00	EU	Enhance climate resilience in Zambia's agriculture, forestry, and biodiversity sectors, Promote sustainable development and reduce poverty in rural communities, Biodiversity, Protect and conserve Zambia's rich biodiversity, including endangered species and ecosystems
2017 - 2025	Grant	Energy	The Increased Access to Electricity and Renewable Energy Production (IAEREP) program is a comprehensive initiative supporting Zambia's energy sector. Its primary goal is to increase access to clean, reliable, and affordable energy, while promoting renewable energy production and energy efficiency, especially in rural areas	Zambia - MoE, Zambia – ZEMA	20,000,000.00	EU	1) Supporting public institutions to develop and/or revise the institutional and regulatory framework for renewable energy and energy efficiency in Zambia; 2) Capacity building of both public and private actors involved in deployment of renewable energy and energy efficiency solutions; 3) Support to renewable energy and energy efficiency projects, primarily off grid, in rural areas (EUR 25m): call for proposals for demo projects (investments) to (i) demonstrate sustainable business model(s) for minigrids and mini-grid management and viable PPP business models for rural electrification and for energy efficiency services to public bodies.
2023 - 2027	Grant	Agriculture	To address systemic productivity and sustainability challenges in Zambian smallholder farming systems and the requirement to adapt those to new threats (e.g., climate change, soil fertility decline, environmental off-site damage and biodiversity loss)	FAO	22,084,000.00	EU	1. Improved Climate Resilience: Enhance the resilience of smallholder farmers to climate change, reducing vulnerability to climate-related shocks and stresses. 2. Increased Agricultural Productivity: Improve agricultural productivity and

							incomes for smallholder farmers, promoting food security and poverty reduction. 3. Empowered Farmers: Empower farmers with actionable climate information, enabling them to make informed decisions about their agricultural practices and improving their overall well-being.
2011 - 2026	Concessional Loan and Grant	Agriculture	The project aims at enhancing access to irrigation services in various locations of the country, through the establishment of several irrigation schemes and dams	Zambia – MoA	14,500,000.00	World Bank	1. Increased Agricultural Productivity: The project has helped to increase agricultural productivity and incomes for smallholder farmers, particularly in rural areas. 2. Improved Food Security: By supporting the development of irrigation systems, the project has helped to improve food security by increasing the availability of crops and reducing reliance on rain-fed agriculture.3. Enhanced Water Management: The project has promoted sustainable water management practices, reducing the risk of water scarcity and improving the overall efficiency of irrigation systems.4. Job Creation and Economic Growth: The project has created jobs and stimulated economic growth in rural areas, contributing to Zambia's overall economic development.
2018 - 2026	Grant	Agriculture	The programme will stimulate an increase in regional food trade in sub Saharan Africa (SSA), contributing to satisfying a growing food demand and to addressing food shortages through regional food production, processing and trade, and generating more rural jobs, climate resilience and income for farmers.	UK - FCDO	45,647,450.00	United Kingdom	The programme will: (i) work with companies that source, process, and trade food in the region, to maximise investment, coordination and benefits to smallholder farmers and (ii) contribute to improve the transparency and predictability of government policies to unlock regional food trade. By 2023, we expect the programme will increase income for 1.8 million farming families.

5.3.3 Technology Development, Transfer and Support Received

Zambia has received various forms of support, including financial, technical, and capacity-building assistance, to drive technology development and deployment across different sectors. These initiatives are often linked to national development agendas and international cooperation frameworks. Table 5.5 shows some of the support received.

Table 5-5: Financial and technical support received

Source of Support	Type of Support received
United Nations Development Programme	The UNDP provides both technical and financial support through the Eight National Development Programme and the United Nations Sustainable Development Cooperation Framework, focusing on national development priorities.
Global Fund Support	The UNDP, as interim Principal Recipient of Global Fund grants, has strengthened national capacity in areas like programme management and financial systems for health
Financial Inclusion Project	The Financial Inclusion for Resilience and Innovation Project (FIRIP) aims to expand financial services for rural smallholders and MSMEs, improving their capacity to manage risks and invest in climate-resilient technologies
U.S. Climate Finance	The U.S. has provided financial support for climate change initiatives in Zambia, including innovative programs like the U.S.-Africa Clean Energy Finance initiative.
European Union Support	The EU supports various sectors, including energy, agriculture, and governance, providing technical and financial assistance to improve access to clean energy, enhance livelihoods, and promote democratic governance.
African Development Bank Support:	The African Development Bank has funded projects focused on strengthening financial systems and promoting renewable energy, including technical assistance for local financial institutions and capacity building.
UNICEF	UNICEF, in collaboration with the Zambian government, has supported the development of capacity building plans for rural water supply and sanitation.

5.3.4 Barriers and Challenges

Barriers and challenges to technology transfer in climate change include high initial costs, lack of infrastructure, policy and regulatory differences, and intellectual property rights. Additionally, challenges arise from the need for effective collaboration between research, industry, and government, as well as the absence of robust monitoring and evaluation mechanisms.

Depending on the maturity stage, different types of bottlenecks are slowing down the adoption of climate technologies. Traditional technologies that are already widely diffused require supporting non-financial aspects such as governance, knowledge, and behavioral factors. Meanwhile, modern or mature technologies require support related to the cost of finance and to equip developing countries with the adequate capacity to adopt these technologies.

Inadequate staff coupled with not- fit- for purpose infrastructure in R&D Institutions contributes to the low adaptation of imported technologies in the country. These constraints are also responsible for the low scale-up of local innovations.

5.3.5 Future Plans and Opportunities

In Zambia, priority areas for supporting and collaborating on climate technologies include enhancing access to climate information, promoting climate-smart agriculture, strengthening community resilience, and fostering enabling environments for Small and Medium Enterprises (SMEs). Specific focus areas include water resource management, early warning systems, and climate-resilient infrastructure, particularly in agriculture and water sectors.

Zambia has several planned climate projects and proposals in the pipeline, particularly within the framework of the Green Climate Fund (GCF), including initiatives focused on climate-resilient agriculture, renewable energy, and infrastructure. These projects aim to strengthen the country's resilience to climate change impacts, particularly in vulnerable sectors like agriculture and water resources.

To strengthen enabling environments for climate technology transfer in Zambia, a multi-faceted approach is needed, focusing on intellectual property, policy incentives, and standards. This includes developing robust intellectual property rights (IPR) frameworks to protect innovators, implementing targeted policy incentives to encourage technology adoption, and establishing clear standards to ensure technology quality and compatibility.

There's significant potential for regional technology collaboration in Africa, driven by a young, tech-savvy population, increasing internet access, and the African Continental Free Trade Area (AfCFTA). This collaboration can foster knowledge sharing, joint research, and cross-border investments, accelerating growth and creating a stronger, more inclusive tech ecosystem.

5.3.6 Conclusion

Zambia has made progress in climate technology transfer through initiatives like the Technology Needs Assessment (TNA) and the development of a National Climate Change Response Strategy. However, significant needs remain, particularly in the implementation of identified technologies and addressing barriers to their adoption. Further development of bankable project proposals, strengthening institutional frameworks, and securing adequate financing are crucial for scaling up climate technologies in Zambia.

Zambia is actively seeking enhanced international support and cooperation to bolster its climate change technology capabilities. This includes accessing climate finance, developing climate-smart agriculture practices, and participating in carbon markets. Various initiatives and partnerships are underway to help Zambia build resilience against climate change impacts, particularly in its agriculture sector.

5.4 Information on Capacity-Building Activities, Support Needed and Received

5.4.1 Introduction

Capacity-building is a critical enabler for Zambia to implement its climate change commitments under the Paris Agreement and to ensure the effective functioning of the Enhanced Transparency Framework (ETF). As a developing country Party with significant institutional, technical and financial constraints, Zambia continues to require targeted and sustained capacity support to strengthen national systems, institutions and human resources for climate action.

The government applies a multi sectoral approach, with each sector ministry being responsible for meeting their capacity building and training needs. Training and Research Institutions (TRIs) provide capacity building across sectors through training of professional staff, technology transfer, innovations including formal education training at tertiary level. Training also comes through several funded projects that have a capacity building component and the funding for such is channelled directly to the implementing entity.

Key institutions include the Ministry of Science Communication and Technology as well as through the National Science and Technology Council (NSTC) that sponsor graduate education across all sectors.
Domestic Funding is provided through Government budget allocations to support climate change adaptation and mitigation strategies. The National Science Technology Council (NSTC) superintends Strategic Research Fund (SRF) supporting R&D projects across various sectors. Grants are awarded to universities to promote academic research and nurturing the next generation of scientists and innovators.

External funding from cooperating partners such as World Bank, EU, BMZ, USAID, CSOs, NGOs, UNDP, NDA, GEF and Annex I countries have played a critical role in funding climate adaptation and mitigation capacity building. This has been thorough research projects that may have capacity building as one of the outputs and countries communicating/advertising through the ministry of foreign affairs.

5.4.2 Capacity building Support Needed

Table 5.6 highlights the costed needs per thematic/sectoral area.

Table 5-6: Costed Needs per Thematic/Sectoral area

Thematic area	Project/Programme Activity or Other	Institution Involved	Estimated Amount	Expected Timeframe
Banking and Finance	1.1. Development of the Climate Finance Resource Mobilization Strategy	Ministry of Finance and National Planning	$67,500	The MoFNP Strategic Plan approved and launched by December of 2023
	1.2. Establishment and launching of the Climate change Fund	Ministry of Finance and National Planning	$978,236	Climate Change Bill to establish Fund passed by the Parliament by December of 2023
	1.3. Mainstreaming of Climate change into socio-economic planning, budgeting and public financial management	Ministry of Finance and National Planning	$226,457	Final Guidelines produced by March of 2024
	1.4. Conduct Climate Change Public Expenditure Reviews	Ministry of Finance and National Planning	$135,305	Climate Change Public Expenditure Reviews final report by December of 2024
	1.5. Strengthen Budget Tracking Tool for climate change investments	Ministry of Finance and National Planning	$50,165	Budget Tracking System is operational by December of 2024
	1.6. Develop and Operationalise the Climate proofing manual for public financial management policies	Ministry of Finance and National Planning	$33,772	Climate Proofing final Manual by December of 2023
	1.7. Conduct Capacity Building for national and sector working groups	Ministry of Finance and National Planning	$100,145	100% sector working groups trained in Climate change by December of 2025
	1.8. Promote and Implement Private Public Partnership Infrastructure on Adaptation and Mitigation	Ministry of Finance and National Planning	$186,288	TBC projects under implementation phase by December of 2030
	2.1 Bank of Zambia Develop the Green Finance Guidelines and Green Loans Guidelines	Bank of Zambia	$60,000	Green Finance Guidelines Gazetted by April of 2024
	2.2 Capacity building program and virtual peer exchange for BoZ staff, selected Government officials, and financial institutions on green finance and the operationalization of the guidelines (covering TCFD, TNFD, and Basel recommendations on sustainable finance)	Bank of Zambia	$60,000	100% examiners/inspectors at BoZ, PIA and SEC trained; and 50% of the Financial Sector Policies and Management Unit at Ministry of Finance and National Planning by April of 2024
	2.3 Develop Regulatory and supervisory instruments to operationalize the guidelines (in line with the country context and international best practices such as nature related financial disclosures and climate related financial disclosures and the Basel recommendations on sustainable finance)	Bank of Zambia	$80,000	Regulatory and supervisory instruments for greening the banking sector developed (as guided by the consultant) by April of 2024
	2.4. Develop Climate Taxonomy for the financial sector	Bank of Zambia	$50,000	Green finance taxonomy developed by December of 2024

	2.5 Develop Incentives for Green Bonds	SEC	$50,000	Submission for incentives for green bonds made to Parliamentary Review Committee, and subsequently, the 2023 National Budget included a waiver on the 15% WHT on interest earned on green bonds by January of 2023
	2.6 Development of Green Bond Market	BoZ/SEC	$50,000	Green Bonds Guidelines reviewing by December of 2023
	2.7 Green Finance Policy and Implementation Plan for Zambia's financial sector	BoZ	$50,000	GFP Implementation Plan developed by June of 2024
	2.8 Green Finance Tagging and Reporting System (to report on financial flows related to climate change, biodiversity conservation and green finance) for Zambia's financial sector	BoZ	$50,000	Green finance tagging / reporting system developed under BoZ regulatory framework by June of 2024
AFOLU	3.1. Promotion of irrigation and efficient use of water resources.	MoA	$61,209,800	80,000 farmers. by December of 2026
	3.2. Increase the use of technologies for soil fertility improvement and moisture storage (including soil conservation measures).	MoA	$78,507,486	700,000 farming households by December of 2026
	3.3. Increase the use of indigenous and scientific knowledge on drought tolerant crop types	MoA	$173,765,470	750, 000 additional farming households adopting drought resilient crops by December of 2026
	3.5. Increase the use access of farming households to insurance against climate-induced risks related to agriculture and infrastructure	MoA	$103,008,759	
	3.6. Accelerate the implementation of Food Security Pack Programme	MoA	$975,659,927	
	3.7. Promote value addition in agriculture production and productivity	MoA	$347,616	150 enterprises by December of 2024
	3.8. Conservation and commercialization of indigenous crop varieties	MoA	$6,184,514	160 community seed banks established by December of 2026
	3.9. Implement Gender sensitive agriculture technologies	MoA	$29,154,171	400000 by December of 2026
	4.1. Strengthening of Legal Framework for Meteorological Services	ZMD	$120,208	Bill enactment by Parliament by December of 2025
	4.2. Increasing awareness and information about climate change risks and early warning systems	ZMD	$1,770,841	One product by sector (Water & Energy, DRM, Health & AFOLU) by December of 2025

	4.3. Strengthened coordination and information exchange processes to optimize and potentiate climate actions and build community resilience	DMMU/ZMD	$0	Monthly meeting by sector during rainy season by December of 2025
	4.4. Expand Internet bandwidth	ZMD	$113,383	30Mbps by December of 2025
	4.5. Develop Applications for accessing weather and climate products	ZMD	$211,636	One platform per sector (Water & Energy, DRM, Health & AFOLU) by December of 2025
	4.6. Digitization of paper records	ZMD	$4,018,727	2,250,000 hard copy records digitized by December of 2025
	4.7. Enhance access to modernised computing infrastructure	ZMD	$349,200	116 computers by December of 2024
	4.8. Strengthen linkages between ZMD and radio stations	ZMD	$207,701	100 by December of 2025
	4.9. Orient and train stakeholders on the development of a user-oriented weather and climate services.	ZMD	$130,228	450 agricultural extension officers trained by December of 2025
	4.10. Conduct the Mapping of sectors and locations specific areas receiving weather and climate products, services and early warning.	ZMD	$59,825	Report produced by December of 2024
	4.13. Establish Community-based workshops to enhance awareness and participation in voluntary rainfall observation.	ZMD	$706,345	116 by December of 2025
	4.14. Establish Research collaborations with learning institutions locally	ZMD	$80,363	10 by December of 2025
	4.15. Promote Joint international Resource Mobilization and implementation projects	ZMD	$3,967,830	6 by December of 2024
	4.16. Conduct staff training in project writing and resource mobilization proposals	ZMD	$17,032	25 by December of 2024
	4.17. Expansion and Modernisation of weather and climate observation infrastructure	ZMD	$15,297,548	Upper Air Monitoring Systems 5 by December of 2025
	5.1. Enhance the placement Forest under management of communities	Forestry Department	$103,364,438	2100000 Ha by December of 2026
	5.2. Increase natural forest regeneration	Forestry Department	$174,401,315	600000 Ha by December of 2030
	5.3. Upscale Tree planting	Forestry Department	$10,795,612	7500 Ha by December of 2026
	5.4. Increased capacities of forest professionals to enhance their ability in responding to climate change.	Forestry Department	$3,017,387	1160 by December of 2026
	5.5. Conduct Fire Management Training	ZEMA/Forestry Department	$1,821,837	185 by December of 2025
	5.6. Promote early forest burning clearing practice	Forestry Department		750000 Ha by December of 2026

	5.7. Promotion of alternative Sources of Livelihoods at Household level in forested areas	Forestry Department	$2,169,566	60% households report taking up alternative livelihoods in forest areas by December of 2026
	5.8. Conduct awareness campaigns on impacts of climate change on forests	Forestry Department	$454,121	185 by December of 2025
	5.10. Establish Forest Early warning and rapid response systems for fire using electronic channels	Forestry Department	$4,767,876	1 by December of 2025
	5.11. Conduct Research on vulnerable forest ecosystems in Zambia	Forestry Department	$263,794	10 by December of 2025
	5.12. Conduct law enforcement operations in gazetted forest and protected areas	Forestry Department	$469,003	15000 law enforcement operations conducted in gazetted forests and protected areas by December of 2026
	6.1. Develop and disseminate Policy Paper on gender, climate change and forestry	Forestry Department	$114,816	Policy Paper on gender, climate change and Forestry developed and disseminated by December of 2024
	6.2. Establish database on participation in forest management	Forestry Department	$109,949	Database disaggregated by gender established by December of 2024
	6.3. Increased participation of women in Community Forest Management Groups	Forestry Department	$48,037	100 additional annually trained female representatives by December of 2025
	6.4. Produce and publish lesson learnt materials	Forestry Department	$51,312	25 Materials on lessons learned developed by December of 2025
Energy	7.1. Increase solar energy contribution to the national installed electricity generation capacity	Energy	$923,599,661	Additional 720 MW under construction or commissioned by December of 2030
	7.2. Increase the supply of low carbon based hydro-electricity into the grid	Energy	$3,426,902,997	Additional 1400 MW of power generation by December of 2030
	7.3. Produce and supply wind electricity into the grid	Energy	$494,327,586	300MW of power generation by December of 2030
	7.4. Generate and supply geothermal electricity into the grid	Energy	$66,576,087	17,7MW of power generation by December of 2030
	7.5. Generate Biomass based electricity and supply into the grid	Energy	$307,071,125	100MW of power generation by December of 2030
	7.6. Assess the potential of Nuclear based electricity as future source of energy	Energy	$5,278,690	Feasibility study concluded by December of 2026
	7.7. Increase the generation in renewable energy for Off-grid supply	Energy	$3,604,698	15 by December of 2026
	7.8. Increase the number of businesses connected to mini grids	Energy	$740,892,423	77299 by December of 2026
	7.9. Connect Public and Private Entities to mini grids	Energy	$7,645,601	1217 by December of 2026

	7.12. Conduct mass replacement of Incandescent bulbs with LED/CFL	Energy	$9,425,644	3,500,000 LEDs distributed by December of 2027
	7.13. Update legal framework in renewable energy and energy efficiency	Energy	$168,954	Renewable Energy Act updated by December of 2026
	7.15. Training of personnel in data capture in energy efficiency and renewable energy technologies	Energy	$372,368	300 GRZ by December of 2026
Infrastructure	8.1. Capacity building among staff in design, setting building codes and standards for climate smart infrastructure	Infrastructure and housing	$150,377	150 by December of 2025
	8.2. Develop Climate sensitive land use planning guidelines (Urban and Rural)	Infrastructure and housing	$131,100	Climate sensitive land use planning guidelines finalized by December of 2024
	8.3. Revise existing National Construction codes and standards	Infrastructure and housing	$12,860,613	Revised National Construction codes and standards by December of 2028
	8.4. Undertake compliance visits on building codes and standards frequently (annually) in construction stage	Infrastructure and housing	$3,121,548	4 by December of 2030
	8.5. Construct demonstration Decent Climate Resilient Housing in Urban and Rural areas	Infrastructure and housing	$36,250,050	1000 by December of 2030
	8.6. Construction of Climate resilient roads	Infrastructure and housing	$480,114,928	2250 Km. constructed by December of 2030
	8.7 Construct climate proofed PPP (buildings, Bridges etc.) infrastructure	Infrastructure and housing	$94,145,271	500 by December of 2030
	8.8. Dredge Kilometres of Canals	Infrastructure and housing	$155,515,129	1500 by December of 2030
	8.9. Climate proof River/Canal Harbours climate	Infrastructure and housing	$49,314,997	10 by December of 2030
	8.10. Conduct maintenance and upgrade to climate resilience standard of public infrastructure (Roads, Bridges, Housing, Water, Drainage)	Infrastructure and housing		15% national budget to maintenance by December of 2027
Waste	9.1 Strengthen Waste Management regulatory and policy framework	Ministry of Local Government and Rural Development Local Authorities	$99,000	Policy approved and Implementation Plan reviewed by December of 2023
	9.2. Improve solid waste management and resource recovery	Water Development	$135,190,541	10 by December of 2030
	9.3. Establishment of Lusaka Waste Management Company	Water Development and Sanitation		Fully operational by June of 2024
	9.4. Conduct awareness campaign programmes at national and subnational levels	Water Development and Sanitation		2784 by December of 2026
	9.5. Increase waste disposal following sustainable guidelines	Water Development and Sanitation		15 by December of 2030

	9.6. Install power capacity (MW) of waste to energy projects	Energy/ZESCO	$242,081,764	MW produced TBC by December of 2030
	9.7. Install and make operational Commercial aerobic composting plants	Ministry of Local Government and Rural Development Local Authorities	$92,163	Pilot operational by December of 2026
	9.9. Increase capacities for data reporting on waste management	ZEMA	$352,789	15 by December of 2030
Health	10.1. Strengthen policies and institutional capacities to manage climate change risks in the health sector	MoH	$128,527,838	1 by December of 2026
	10.2. Availability of EH policy that clearly defines the strategies that include climate change for the Ministry of Health	MoH	$216,255	EH Strategy approved by December of 2025
	10.3. Availability of surveillance tools that aid in early warning against climate variability and extreme weather events with a focus on the health sector	MoH		1 by December of 2026
	10.4. Mainstream climate change across programmes to enhance resilience of the health sector	MoH		0.8 by December of 2026
Water	11.1. Increase Investment in climate resilient water sources infrastructure	Water Development and Sanitation	$363,827,182	25 Small dams & 1 Large Dam
	11.2. Map and protect Ground water aquifer resources mapped and protected	Water Development and Sanitation	$83,571,648	41 aquifers mapped and protected
	11.3. Capacity building in Aquifer mapping, groundwater exploration and protection	Water Development and Sanitation	$133,395	8 by December of 2026
	11.4. Implement relevant water technologies adopted based on the assessment results and potential	Water Development and Sanitation		29000 by December of 2026
	11.5. Establish Ground and surface water monitoring systems	Water Development and Sanitation	$14,914,745	96 by December of 2026
	11.6. Conduct water deficit/availability assessments in the three agro-ecological regions	Water Development and Sanitation	$1,735,004	6 by December of 2026
AFOLU	12.1 Strengthen the capacity of Livestock farmers to utilise breeds resilient to climate change	Ministry of Fisheries and Livestock	$1,983,677	10000 by December of 2026
	12.2 Establish water points (weirs, dams and boreholes) for livestock management	Ministry of Fisheries and Livestock	$12,667,175	65000 by December of 2026
	12.3 Promote the use of good animal husbandry practices among livestock farmers	Ministry of Fisheries and Livestock	$5,608,422	400000 new livestock farmers trained by December of 2026
	12.4 Enhance index-based livestock insurance (IBLI) scheme in the country	Ministry of Fisheries and Livestock	$29,471,485	600,000 registered farmers by December of 2026

	12.5 Operationalise Livestock Early Warning Information System (LEWIS)	Fisheries and Livestock/ZMD/DMMU	$528,596	1 LEWIS operational by December of 2026
	13.1 Increase degraded pasture and vegetation cover with different drought tolerant perennials	Ministry of Fisheries and Livestock	$21,564,843	45,100 Ha degraded restored land by December of 2026
	13.2. Sustainable forage seed production programme with private sector participation	Ministry of Fisheries and Livestock	$88,578,332	900,000 additional livestock farmers by December of 2026
	13.3. Diversification and strengthened livelihoods and source of incomes for rural populations.	Ministry of Fisheries and Livestock	$4,059,587	62000 by December of 2026
	13.4. Develop technical and business capacity for construction of biogas plants for livestock farmers	Ministry of Fisheries and Livestock	$33,268,208	19,900 livestock farmers trained
Industry	14.1. Reduce Clinker content in cement	ZEMA	$670,000	3 pilot projects reporting clinker reduction by December of 2026
	14.2. Reduce Use of fluorinated GHGs	Ministry of Transport and Logistics/ZEMA	$1,219,130,732	Programme under implementation by December of 2026
Transport	15.1 Develop the Lusaka Tramway System	Ministry of Transport and Logistics	$1,219,130,732	50 Km of Tramway built
	15.2. Develop Electrified Railway Systems	Ministry of Transport and Logistics	$2,104,712,143	30% over total railway lines by December of 2030
	15.3. Rehabilitation and Modernisation of railway transport Infrastructure.	Ministry of Transport and Logistics	$3,199,053,901	1248 KMs of railway rehabilitated under ZRL
	15.4 Development of the Urban Mobility Policy and strategy	Ministry of Transport and Logistics	$2,000,000	Electrical Mobility Policy, Strategy Implementation/Investment Framework by 2025 by December of 2025
Multi-sector	16.1. Development of the Green Growth Strategy	MGEE	$250,000	Green Growth Strategy Finalised and launched by December of 2023
	16.2. Development of the National Policy on Green Growth and Climate Change	MGEE	$150,000	NPGGCC Finalised and launched by December of 2023
	16.3. Revision of the NDC	MGEE	$125,000	NDC revised, finalised and submitted by December of 2025
	16.4. Development and Launching of the NDC Implementation Framework	MGEE	$235,000	NDC Implementation Plan launch by May of 2023
	16.5. Designing the NDC Investment Strategy and Plan	MGEE	$85,000	NDC Investment Strategy and Plan developed by May of 2023
	16.6. Develop the Climate Change Act	MGEE	$50,000	Climate Change Act enacted by December of 2023
	16.7. Production of the Biennial Transparency Report/4th National Communication report	MGEE	$1,030,000	BTR/NC4 PIP finalised and submitted by December of 2024

	16.8. Building the Capacity of key NDC sectors in Green Growth and Climate Change planning and program development	MGEE	$650,000	30 by December of 2023
	16.9. Development of the NDC Communication strategy	MGEE	$550,000	Communication and Learning Strategies developed by December of 2022
	16.10 Building the capacities of District Level Staff and communities in climate change actions	ZEMA	$3,655,397	1600 District Level staff trained by December of 2026
	16.11 Enhancing equal participation of women and men in the development of local area plans	Local government/Forestry	$1,404,313	2320 communities trained by December of 2026
	17.1 Develop and Operationalise National Enhanced Transparency Framework (ETF)/Measuring Reporting and Verification (MRV) systems	ZEMA	$5,492,799	MRV launched and operationalised by December of 2026
	17.2 Development of the National GHG Inventory	ZEMA		Final National GHG Inventory ready by March of 2025
	18.1 Development of Greening Environmental Tools and associated Processes	ZEMA	$500,000	Guidelines for greening ZEMA developed by 2024 by December of 2024
	18.2 Revision of the Waste Management Strategy	ZEMA	$645,000	Revised Waste Management Strategy developed by December 2023 by December of 2025
	18.3 Guidelines for Extended Producer Responsibility	ZEMA	$244,400	Producer Responsibility Guidelines developed by December 2024 by December of 2025
	18.4 Electrical and Electronic Waste management regulations and guidelines	ZEMA	$100,000	Hazardous Waste management regulations enacted by December of 2025
	18.5 Develop and build capacity on the National Carbon Registry	ZEMA	$600, 000	Operationalise National Carbon registry
	18.6 Build capacity of five ZEMA staff in Emission Accounting short to medium term courses)	ZEMA	2,000.000	Five ZEMA staff trained in Emission Accounting
	18.7 Develop a National Carbon Budget in preparation for Article Six implementation	ZEMA	$550,000	National Carbon Budget developed by December 2026

5.4.3 Capacity Building Support Received

Table 5.7 Highlights funds received and spent on capacity-building

Table 5-7: Funds Received and Spent on Capacity Building

Time frame	Source of support	Project Name	Programme Description	Total Budget (USD)	Sector	Sub sector	Implementing Entity
2016 - 2024	African Development Bank	Aquaculture Enterprise Development Project	The Aquaculture Enterprise Development Project is aimed at stimulating a viable aquaculture sub-sector in Zambia to promote economic diversification, food security, and sustainable employment generation, all of which are central priorities of the Government of Zambia	50,891,780.00	Agriculture	Fisheries, Water	Zambia - MoA, Zambia - MWDS
2015 - 2020	Food and Agriculture Organization	Supporting Developing Countries to Integrate the Agricultural Sectors into National Adaptation Plans (NAPs)	The NAP-Ag is focusing on: strengthening individual and institutional capacities of the agricultural sectors on NAPs, including on climate scenarios, cost-benefit analysis, and gender-sensitive adaptation options and value chains;	400,000.00	Agriculture	Gender, Finance	FAO,UNDP
2014 - 2018	Finland	Decentralised Forest and Natural Resources Management Programe Introduction Project	The Decentralised Forest and Other Natural Resources Programme is designed for a 12-year period to support the government and communities in implementing the Forest Act 2015. The project was linked to Zambia's ongoing decentralisation process and uses a multi-sector integrated	5,400,000.00	Cross-cutting	Forest	Subnational Government

			approach for planning and implementation of activities.				
2020 - 2022	International Renewable Energy Agency	Country Enhancement Action Plan (CAEP)	1. Strengthen the MRV system's data collection and analysis for GHG projections and target setting and alignment of such to the respective sector policies, strategies and plans 2. Building capacity of data providers and establishing data sharing platforms for quality assurance. 3. Integrate the NDC MRV system to the Central Statistics Office for national reporting and communication of projection	107,613.00	Energy	Capacity Building	MoE
2019 - 2020	United Nations Institute for Training and Research	UN CC:Learn: development of a National Climate Change Learning Strategy to strengthen learning and skills development to address climate change in Zambia	Zambia launched its National Climate Change Learning Strategy in March 2021.	100,000.00	Cross-cutting	Capacity Building	Zambia - ZEMA, Zambia - MLNR

2017 - 2019	Germany	Integrating climate change into water resources monitoring and planning	The project with support of the consulting GFA provides advisory services to the Water Resources Management Authority (WARMA), which was founded in 2012. This advice focuses on the establishment of the water resources information system (IWRMIS) and the use of this system to integrate climate change into water resource plans and allocation	4,412,000.00	Water	Capacity Building	Zambia - WARMA
2020 - 2022	United Kingdom	Country Enhancement Action Plan (CAEP)	The CAEP is designed to catalyze transformational change towards resilient, sustainable and low- emission development, supporting the objectives of the Paris Agreement	87,737.00	Cross-cutting	Capacity Building	Zambia - MGEE

Table 5.8 highlights planned and ongoing capacity-building activities

Table 5-8: Planned and ongoing capacity-building activities

Project Name	Programme Description	Status of Activity	Implementing Entity	Total Budget (USD)	Status (Committed or Received)	Time frame	Sector	Sub sector	Cooperating Partner
Environment and Natural Resources Management and Mainstreaming Programme	The project is a government initiative aimed at integrating environmental considerations into all aspects of development planning, ensuring that natural resource management is a central focus across different sectors,	Planned	Zambia – MLNR	10,800,000.00	Received	2010 - 2015	Cross-cutting	Mainstreaming	Finland
Zambia Growth Opportunities Project	The objective of the operation is to promote agricultural diversification, sustainability and jobs in the agri-food sector of Zambia	Ongoing	Zambia – MoA	300,000,000.00	Received	2022 - 2026	Agriculture	Agri-food	World Bank
Power Africa healthcare electrification grant	Through this new programme, Power Africa and SEforALL will equip target governments and their development partners with the necessary building blocks to identify, power, and sustainably maintain health facilities by 2030.	Planned	Muhanya Solar, Zambia – CHAZ	250,000.00	Received	2020 - 2021	Energy	Renewable Energy, Electricity	United States

Support to Civil Society in Environmental Management	The Civil Society Environment Fund, Phase 2 (CSEF2) is a capacity building and environmental grant fund managed by PMTC Ltd and Ecorys on behalf of Ministry of Foreign Affairs of Finland. The Fund is supporting civil society organisations (CSO's) in the Environment and Natural Resource sector, with a special focus on CSO capacity building, networking and coordination.	Planned	Civil Society	5,540,400.00	Received	2015 - 2019	Cross-cutting	CSOs	Finland
Sustainable Water Resources Management and Agricultural Water Use in Zambia AWARE - Accelerate Water and Agricultural Resources Efficiency	In line with Zambia's WRM Act, AWARE supports the development of catchment governance and planning structures, namely the Sub-Catchment Management Plan through the Lower Kafue Sub-Catchment Office (SCO) and the Sub-Catchment Council (SCC).	Ongoing	GIZ,Zambia - MoA,Zambia - MWDS,Zambia - WARMA	16,742,868.00	Received	2019 - 2023	Water	Infrastructure	Germany

Enterprise Zambia Challenge Fund	To integrate agriculture SMEs and smallholder farmers into market-integrated environmentally sustainable, resilient, low carbon, circular and nutrition sensitive value chains	Ongoing	Zambia - MoA,Zambia - MGEE,MoFL	26,677,000.00	Received	2020 - 2025	Agriculture	Livestock	European Union
ElectriFi - Zambia window	ElectriFI will mostly apply to projects leading to new and improved connections to electricity for populations living in under-served and remote areas.	Ongoing	EDF	8,000,000.00	Received	2018 - 2025	Energy	Electricity	European Union
Zambia Emergency Food Production Facility (ZEFPF)	The Zambia Emergency Food Production Facility (ZEFPF) is a stand-alone emergency project to mitigate the impacts of the Russia-Ukraine conflict on agriculture and food security in Zambia.	Ongoing	Zambia – MoA	10,700,000.00	Received	2022 - 2025	Agriculture	Social Protection	African Development Bank
Zambia Aquaculture Project	Increased productivity, income and employment opportunities of emergent, small and medium scale aquapreneurs along the aquaculture value chain	Ongoing	MoFL	5,300,000.00	Received	2022 - 2026	Fisheries	Water Infrastructure, capacity building	European Union

Zambia COVID-19 Emergence Response Health Systems Preparedness Project	(1) Emergency Public Health Response to COVID-19 (2) Resilient Health Service Delivery, (3) Project Management, Governance and Accountability.	Ongoing	Zambia - MoH	49,000,000.00	Received	2021 - 2025	Health	Capacity Building	World Bank
Zambia Renewable Energy Financing Framework	The Green Climate Fund is supporting the Government of Zambia to catalyze private investment in the renewable energy sector to boost electricity generation and diversify the country's energy mix	Ongoing	AfDB	52,500,000.00	Received	2020 - 2025	Energy	Renewable Energy, Electricity	Green Climate Fund
Ecological Urban Development Lusaka	The ecological urban development project in Lusaka, Zambia, aims to improve sanitation service delivery by developing a pricing strategy. The project also seeks to separate water and sewerage costs.	Ongoing	LWSC	268,580,500.00	Received	2018 - 2028	Water	Waste Management	Germany
Green Innovation Centres for the Agriculture and Food Sector (GIC)	The Project aims to promote and invest in the green recovery and sustainable growth along the agriculture -forestry-biodiversity-water and climate nexus.	Ongoing	GIZ,Zambia - MoA,Zambia - MFL,COMACO	287,850,000.00	Received	2015 - 2025	Agriculture	Finance	Germany

Zambia Health System Strengthening Programme	The Zambia Health Systems Strengthening programme aims improve the health of women and girls in Zambia across the continuum of care from birth, childhood and motherhood	Ongoing	United Kingdom/UNFPA	45,213,939.00	Received	2016 - 2021	Health	Health	United Kingdom
Economic, Nutrition and Technical support for increased Economic Returns and Profit In Sustainable agribusiness in Zambia ENTERPRISE Zambia	These projects address a selection of integrated issues: sustainable agriculture, food and nutrition security, research into and production of improved varieties of seed, rural enterprise development and income generation, environmental rehabilitation, and climate change adaptation	Ongoing	Self Help Africa	28,709,200.00	Received	2020 - 2025	Agriculture	Crop production	European Union
Climate Investor One	Climate Investor One (CIO) is a blended finance facility which provides loans in the early stage of a project life cycle and establishment of equity fund that will meet up to 75 percent of total construction costs in tandem with the project sponsor	Ongoing	GCF	5,000,000.00	Received	2018 - 2037	Finance	Equity	Green Climate Fund

Cashew Infrastructure Development Project	The Cashew Infrastructure Development Project (CIDP) is a stand-alone investment Project aimed at rejuvenating the cashew industry and enhancement of economic development in the Western Province of Zambia.	Planned	Zambia - MoA	55,420,000.00	Received	2015 - 2024	Agriculture	Agro-forestry	African Development Bank
Building the Basis for implementing the Save & Grow approach - Regional strategies on sustainable and climate-resilient intensification of cropping systems (climate resilient agriculture)	FAO's "Save and Grow" model of sustainable intensification of crop production aims to achieve the highest possible productivity by unit of production input within the ecosystem's carrying capacity. In other words, producing more with less.	Ongoing	FAO	2,200,000.00	Received	2016 - 2020	Agriculture	Crop production	Food and Agriculture Organization
Social Protection Expansion Programme Phase II	To provide small grants to vulnerable households especially those with disabled and elderly persons in order for them to have regular monthly income to take care of their basic needs	Ongoing	UK	43,955,747.00	Received	2016 - 2023	Social Protection	Social Cash Transfer	United Kingdom

Zambia Energy Efficiency and Sustainable Transformation programme (ZE2ST)	The Zambia Energy Efficiency and Sustainable Transformation (ZE2ST) Program is a comprehensive initiative aimed at transforming Zambia's energy sector into a sustainable and energy-efficient one. The program's main objective is to unlock the country's potential for energy efficiency and sustainable transformation	Planned	EU	37,800,000.00	Received	2020 - 2027	Energy	Energy Efficiency	European Union
Private Enterprise Programme Zambia Phase II	To create investment in Zambia by building the capacity of micro, small and medium sized enterprises. The programme will aim to systematically transform the finance and investment environment for SMSEs in Zambia, by helping companies with potential to grow and become the engine of job creation in the economy	Ongoing	Private Sector	72,279,934.00	Received	2020 - 2027	Commerce and Trade	Micro-finance	United Kingdom
Sustainable Access to Electricity in Southern Division	The project comprises the rehabilitation and reinforcement (R&R) measures of selected power transmission and distribution infrastructure (new lines and substations) in the Southern Division of Zambia	Planned	ZESCO, Zambia – MoF	51,730,700.00	Received	2017 - 2026	Energy	Electricity	Germany

Agriculture Value Chain Facility	The Agriculture Value Chain Facility Project in Zambia aims to enhance access to finance for businesses in Zambia's agriculture and aquaculture sectors, particularly small and medium-sized enterprises (SMEs). This project is a joint initiative of the European Investment Bank and the European Commission	Ongoing	EIB	15,458,800.00	Received	2020 - 2030	Agriculture	Agribusiness	European Union
Health Ecosystems and Agriculture for Resilient Thriving Societies (HEARTH)	The Health Ecosystems and Agriculture for Resilient Thriving Societies (HEARTH) project is an innovative initiative that seeks to address the interconnected challenges of human health, agricultural productivity, and environmental sustainability.	Planned	USAID	40,000,000.00	Received	2021 - 2025	Agriculture	Ecosystems based Agriculture	United States
Improving the capacities of groundwater management and protection in Zambia	Improving the capacities of groundwater management and protection in Zambia is crucial, given the country's reliance on groundwater for drinking water and irrigation. The Bundesanstalt für Geowissenschaften und Rohstoffe (BGR) has been supporting the Zambian government in this endeavor.	Ongoing	Zambia - MWDS	2,206,000.00	Received	2020 - 2022	Water	Ground water management	Germany

Lusaka Sanitation Project	(1) Sewerage improvements focus on upgrading and expanding the sewerage systems in the Ngwerere and Manchinchi sewer-sheds. (2) On-site sanitation investments focus on the development of a comprehensive response to the on-site sanitation challenges in Lusaka; and support on-site sanitation services and systems in priority areas. (3) Institutional strengthening focuses on providing technical assistance to enhance LWSC's capacity to implement the project, operate and maintain the facilities, and undertake reforms.	Ongoing	LWSC	65,000,000.00	Received	2015 - 2024	Waste	Sanitation	World Bank

Beyond the Grid Fund Zambia	The Beyond the Grid Fund Zambia (BGFZ) is a pioneering results-based financing facility that aims to provide energy access to underserved populations in Zambia. The program is part of the larger Beyond the Grid Fund for Africa (BGFA) initiative, which seeks to bring clean, affordable, off-grid energy access to millions of people across Sub-Saharan Africa	Ongoing	REEEP, SM, FI, SupaMoto, Vitalite	12,800,000.00	Received	2017 - 2021	Energy	Electricity	Sweden
Girls Education and Women Empowerment and Livelihoods (GEWEL)	The GEWEL project aims to support the Government of Republic of Zambia (a) to increase access to livelihood support for women and access to secondary education for disadvantaged adolescent girls in extremely poor households in selected districts, and (b) provide cash transfers for poor and vulnerable households.	Ongoing	Government	347,000,000.00	Received	2016 - 2024	Education	Social Protection	World Bank

Reducing UPOPs and Mercury Releases from the Health Sector in Africa/Medical Waste Project	The Reducing UPOPs (Unintentional Persistent Organic Pollutants) and Mercury Releases from the Health Sector in Africa/Medical Waste Project is a critical initiative aimed at minimizing the environmental and health impacts of medical waste management in Africa	Planned	Zambia – MoH	6,453,195.00	Received	2015 - 2020	Waste	Medical Waste	United Nations Development Programme
Transforming Rural Livelihoods in Western Zambia - National Rural water Supply and Sanitation II	The program 'Transforming Rural Livelihoods in Western Zambia – NRWSSP Phase II' aims to provide sustainable access to water supply and sanitation in sixteen (16) rural districts of Western Province namely Kalabo, Mongu, Sesheke, Shangombo, Kaoma, Lukulu, Senanga, Mwandi, Mulobezi, Sioma, Nalolo, Mitete, Luampa, Nkeyema, Limulunga and Sikongo so as to contribute towards poverty alleviation of Zambia's rural population and also contribute towards achievement of National Vision targets of universal access to water and sanitation services.	Ongoing	Zambia - MLGRD	14,606,089.00	Received	2015 - 2024	Agriculture	Irrigation	African Development Bank

Lake Tanganyika Development	The project will promote sustainable and equitable management and use of the Lake's natural resources; improving livelihoods of communities (within its catchment area) by supporting economic infrastructure, human resources development, market linkages and value chain development for natural resources products.	Planned	Zambia - MGEE	29,620,000.00	Received	2014 - 2024	Water	Natural resources	African Development Bank
Community Water Management Improvement Project for traditional Farmers	The project will add significant value to the strategic up scaling of dam development and contribute to the attainment of the MDG goals and the ambitions of the Africa Water Vision. The Project will contribute to design planning and funds mobilisation to spur new and on-going water development programmes such as the Integrated Water Resources Management and Water Efficiency Implementation Plan (2007-30). The project also involves direct investments in connection with the field-testing of the guidelines that will include rehabilitation and rehabilitation of three existing dams and construction of one new small dam.	Planned	Zambia - MoA	1,209,864.00	Received	2009 - 2013	Water	Water Infrastructure	African Development Bank

Zambia for Agroforestry, Climate and Biodiversity	The overall objective: to contribute to the development of climate-relevant, productive, and sustainable transformation of agriculture, forestry, and food systems in Zambia to help to achieve the Nationally Determined Contributions (NDC).	Ongoing	ICRAF	4,482,706.00	Received	2021 - 2026	Agriculture	Agro-forestry	European Union
Beyond the Grid Fund Africa	Launched in July 2017, the Beyond the Grid Fund for Zambia (BGFZ) intends to bring clean, affordable off-grid energy services to 306,000 households, businesses and institutions, or 1.6 million people, by 2021.	Ongoing	NEFCO	21,400,000.00	Received	2019 - 2023	Energy	Electricity	Sweden
Climate Resilience through Risk Prevention and Innovative Climate Risk Insurance in Zambia	Agricultural actors have better access to private-sector climate risk insurance and information on climate risk.	Planned	Zambia – MoA	2,206,000.00	Received	2020 - 2022	Cross-cutting	Capacity Building	Germany

Supporting Zambia to Integrate Agriculture Sectors into National Adaptation Plans	To tackle these vulnerabilities, the Government of Zambia, with support from the NAP-Ag Programme, are thinking ahead into the medium and long-term and advancing the processes by which adaptation strategies are integrated into national development plans and budgets.	Ongoing	Zambia - MoA	700,000.00	Received	2016 - 2018	Agriculture	Capacity Building	United Nations Development Programme
Strengthening Climate Resilience in the Kafue Sub – basin	The Strengthening Climate Resilience in the Kafue sub-basin (SCRIKA) project aims to strengthen the adaptive capacity of rural communities to better respond to the current climate variability and long-term consequence of climate change in the Kafue sub-basin.	Ongoing	Zambia - MoFNP	38,000,000.00	Received	2013 - 2019	Infrastructure	Resilient Roads	African Development Bank
SNV INCREASE Climate Smart Agriculture and Biogas	The overall objective is to increase the social, economic and environmental resilience and equity in agriculture and energy systems, through strengthening the adaptive capacity of agricultural and energy systems.	Ongoing	SNV	8,500,000.00	Received	2020 - 2022	Cross-cutting	Energy, Agriculture	Sweden

Alternatives to Charcoal	The United States Agency for International Development (USAID's) Alternatives to Charcoal (A2C) activity is a five-year (2021-2026) project in Zambia whose aim to decrease urban charcoal demand and increase the use of Alternative Technologies and Fuels (ATFs) through innovation and increased private sector engagement to reduce charcoal production-driven deforestation and greenhouse gas emissions	Planned	TETRATECH	25,000,000.00	Received	2021 - 2026	FOLU	Technology	United States
Strengthening Integrated Adaptation Planning and Implementation in Southern Africa Smallholder Agricultural Systems to Support Food Security	The overall expected outcome of this project therefore is to secure strengthened integrated adaptation planning and implementation of good practices in Zambia to support food security.	Ongoing	Zambia – MoA	882,599.00	Received	2015 - 2020	Agriculture	Capacity Building	Food and Agriculture Organization

Climate Smart Agriculture in Zambia	The climate-smart agriculture (CSA) concept reflects an ambition to improve the integration of agriculture development and climate responsiveness. It aims to achieve food security and broader development goals under a changing climate and increasing food demand.	Ongoing	World Bank	32,325,552.00	Received	2016 - 2021	Agriculture	Crop production	United Kingdom
Strengthening climate resilience of agricultural livelihoods in Agro-Ecological Regions I and II in Zambia	• Establishing or strengthening existing farmer field schools in each of the target camps across the 16 districts • Training of trainers (extension staff) to facilitate experiential learning by communities on adaptive practices • Establishing or rehabilitating learning centres of excellence in each of the 16 target districts	Ongoing	Zambia - MoA	32,000,000.00	Received	2018 - 2025	Agriculture	Capacity Building	United Nations Development Programme
Climate Resilient Livestock Management Project	The Climate Resilient Livestock Management Project, implemented by the African Development Bank in Zambia between 2017 and 2022, has helped to equip small livestock farmers to adapt to climate change	Ongoing	Zambia - MFL	6,210,000.00	Received	2014 - 2019	Agriculture	Livestock	African Development Bank

Accelerated improvement of the regional management of the fisheries in Lake Tanganyika		Ongoing	Zambia – MGEE	15,595,982.00	Received	2020 - 2023	Fisheries	Capacity Building	African Development Bank
Building the Resilience of Local Communities in Zambia through the Introduction of Ecosystem-based Adaptation (EbA) into Priority Ecosystems, including Wetlands and Forests	To strengthen the capacity of government and rural communities living around wetlands and forests to adapt to climate change using EbA	Planned	Zambia – MLNR	6,185,000.00	Received	2018 - 2022	Cross-cutting	Forest, Agriculture	United Nations Environment Program
Promoting climate resilient, community based regeneration of indigenous forests in Zambia's Central Province	The project "Promoting Climate Resilient, Community-Based Regeneration of Indigenous Forests in Zambia's Central Province" aims to restore and conserve indigenous forests in Zambia's Central Province, while promoting climate resilience and community-led sustainable forest management.	Ongoing	Zambia - MLNR, Zambia – MGEE	3,885,000.00	Received	2015-2020	FOLU	Energy Efficiency	United Nations Development Programme

Transforming Landscapes for Resilience and Development in Zambia	The development objective of the Transforming Landscapes for Resilience and Development Project for Zambia is to improve natural resource management in select districts to support sustainable livelihoods, and in the event of an eligible crisis or emergency, to provide immediate and effective response to the eligible crisis or emergency	Ongoing	Zambia - MoFNP	100,000,000.00	Received	2019 - 2025	FOLU	Technology	World Bank
Enterprise Development and Growth Enhanced Zambia	EDGE is a USAID-funded five year project aimed at increasing the profitability and revenue for 450 agricultural MSMEs in Zambia by addressing their key constraints in access to finance, gaps in business management skills and technology, and limited access to markets.	Planned	ACDI/VOCA	14,467,241.00	Received	2020 - 2025	Agriculture	Cro[	United States
Sustainable Agriculture for Forest Ecosystems (SAFE)	Overall aim: Conservation of forests and other ecosystems and sustainable management of agri-food systems 1. Strengthen selected supply chains and make them deforestation-free 2. Strengthen stakeholder capacities for transition towards sustainable and	Ongoing	GIZ, Zambia - MGEE, Zambia - MoA	50,568,337.00	Received	2022 - 2026	Agriculture	Agri-food systems	European Union

	deforestation-free production 3. Improve capacities of smallholder producers to sustainably manage selected production systems 4. Share experiences and knowledge on deforestation-free supply chains regionally								
Increased Access to Electricity and Renewable Energy	Strategic Environmental Assessment for the Energy Sector in Zambia. Waste management from renewable and efficiency energy sources (WEEREE)	Ongoing	Zambia – ZEMA	206,000.00	Received	2018 - 2023	Energy	Waste Management	European Union
Sustainable Intensification of Smallholder Farming Systems (SIFAZ)	The objective of the programme is to improve sustainable and climate smart crop production and land management practices, with a gender sensitive approach.	Ongoing	Zambia – MoA	13,250,400.00	Received	2019 - 2024	Agriculture	Crop production	European Union

IAPRI	IAPRI's research and advocacy efforts are aimed to help policy makers and other agricultural stakeholders to make rational and informed policy decisions that creates a conducive environment for the poor to improve their living conditions and increase their resilience to climate change and other shocks.	Ongoing	IAPRI	4,200,000.00	Received	2018 - 2022	Agriculture	Capacity Building	Sweden

Technical Assistance to the Climate Change and Natural Resource Management Department at Ministry of Lands and Natural Resources in Zambia	The project seeks to provide expertise in areas like developing climate change adaptation strategies, implementing sustainable land management practices, monitoring greenhouse gas emissions, capacity building for staff, integrating climate considerations into land use planning, and facilitating access to climate finance to effectively address the impacts of climate change on Zambia's natural resources and ecosystems.	Ongoing	Zambia – MGEE	358,655.00	Received	2020-2022	Cross-cutting	Capacity Building	European Union
Promoting Production and Consumption of Nutritious Foods in Zambia	Increase resilience through climate-smart agricultural techniques, crop diversification, access to viable markets and post-harvest management amongst targeted smallholder farmers. Due to a severe drought in 2019, emergency food is also distributed Dec 2019-May 2020 to the most vulnerable to increase their resilience.	Ongoing	WFP	7,400,000.00	Received	2018 - 2022	Agriculture	Nutrition	Sweden

Support to the Zambia Energy Sector: Increased Access to Electricity and Renewable Energy production (IAEREP)	The Increased Access to Electricity and Renewable Energy Production (IAEREP) program is a comprehensive initiative supporting Zambia's energy sector. Its primary goal is to increase access to clean, reliable, and affordable energy, while promoting renewable energy production and energy efficiency, especially in rural areas	Planned	Zambia - MoE, Zambia - ZEMA	20,000,000.00	Received	2017 - 2025	Energy	Electricity	European Union
Digital Climate Information for Small holder farmers in Malawi and Zambia (E-PICSA)	An automated system for National Meteorological Services (NMS) that provides quality-checked, locally-specific, historical rainfall and temperature data, and location-specific season and short-term forecast; it does so by making best use of existing station data and state	Ongoing	Zambia - MoA	4,500,000.00	Received	2022 - 2024	Agriculture	Early Warning	Germany
Additional allocation for Food Production and Resilience of Food	To address systemic productivity and sustainability challenges in Zambian smallholder	Planned	FAO	22,084,000.00	Received	2023 - 2027	Agriculture	Crop production	European Union

Systems in African, Caribbean and Pacific (ACP) countries	farming systems and the requirement to adapt those to new threats (e.g., climate change, soil fertility decline, environmental off-site damage and biodiversity loss)								
The Energy and Environment Partnership Trust Fund (EEP Africa)	EEP is a clean energy financing facility providing early stage and catalytic financing primarily for private-sector-led projects in Southern and East Africa (SEA). It was first established as a closed-end programme in 2010 with funding from the Ministry for Foreign Affairs of Finland (MFA Finland), the UK Department for International Development (DfID) and the Austrian Development Agency (ADA).	Ongoing	Private Sector	10,400,000.00	Received	2018 on going	Energy		Finland

5.5 Support Needed and Received for Transparency-Related Activities

5.5.1 Introduction

In line with Article 13 of the Paris Agreement, this section outlines the support received and needed for the Enhanced Transparency Framework (ETF). The ETF provides a common framework for reporting climate action to ensure that all Parties provide clear, consistent and comparable information on greenhouse gas (GHG) emissions, mitigation actions, adaptation efforts, and climate support received and provided.

5.5.2 Enhanced Transparency Framework Support Received

Zambia's capacity needs and support provided for ETF reporting focusses on strengthening in country capacities on preparing and updating greenhouse gas inventories, tracking progress in implementing and achieving the NDC; assessing and reporting on adaptation actions, mobilizing and monitoring climate finance, and facilitating the development and transfer of climate technologies. It also highlights cross-cutting needs, including data management, gender responsiveness, and stakeholder engagement.

The assessment of capacity needs was informed by national consultations, sectoral reviews, and lessons from previous National Communications and Biennial Update Reports, as well as ongoing projects supported by the GEF, bilateral and multilateral partners. The analysis provides a basis for prioritizing short, medium and long term actions and for mobilizing resources to strengthen Zambia's institutional and technical capacities for effective and transparent climate change reporting.

Zambia has benefited from a few transparency-related support provided through the Global Environment Facility and bilateral and multilateral international partners. Details of the ETF related support projects are presented in Table 5.9.

Table 5-9: Support Received for Enhanced Transparency related activities

	Name of Donor	Project Name	Project Objective & Duration	Project Duration	Status	Support provided
1	GEF/UNEP	"Zambia: Enabling Activities for the Preparation of Initial Biennial Transparency Report and Fourth National Communication to the United Nations Framework Convention on Climate Change (UNFCCC)"	To prepare Zambia's first Biennial Transparency Report and Fourth National Communication (BTR1/NC4) to the UNFCCC	3 Years September 2022 to November 2025	Ongoing	Financial Support to prepare Zambia's BTR1/NC4
2	GEF Trust Fund/ Conservation International	CBIT Regional Project "Capacity building of COMESA member states in Eastern and Southern Africa for enhanced transparency in climate change monitoring, reporting and verification as defined in the Paris Agreement"	Objective: To strengthen the capacity of COMESA member States to comply with the Transparency Requirements of the Paris Agreement through the establishment of an Eastern and Southern Africa Regional CBIT transparency framework for Monitoring, Reporting, and Verification (MRV) of climate actions, reporting on NDCs, and knowledge dissemination.	Duration: 5 years 2021-2025	Ongoing	Targeted capacity building in MPGS, , IPPC guidelines and GHG Inventories
3	Germany through the Federal Ministry for Economic Affairs and Climate Action	Supporting Preparedness for Article 6 Cooperation Project (SPARC6)	Objective: Regional project to support preparedness of four countries including Zambia, Colombia, Thailand, Pakistan to fully engage in Article six transactions with high environmental integrity that create sustainable development co-benefits.	Duration: 5 years 2023 -2028	Ongoing	 Development of a National Carbon Registry
4	Agence Française de Dévelopement (AFD)	GHG Capacity Building in Greenhouse Gas Emissions Inventory and Measurement, Reporting and Verification Systems in Zambia	To build ZEMA and GRZ Sector institutions GHG Inventory Capacities to: i) More effectively and efficiently compile future inventories in-house using Tier 2 methodologies; ii) Support relational cross-sectoral analysis and reporting;	2 years March 2022 to October 2024	Closed	Targeted capacity in cross sectorial GHG emission accounting
5				1 Week	Closed	

	UNFCCC/ Transparency Division of the UNFCCC Secretariat	In-Country in-person Quality Assurance Programme of Green House Gas Inventory Management Systems (IMS) and BUR National Inventory Report (NIR)	To build in country capacities on quality assurance of sectorial GHG Inventories	24 to 28 July 2023		Quality control and quality assurance processes on GHG management systems
6	UNFCCC/ Transparency Division of the UNFCCC Secretariat	In country-In person capacity building workshop on Quality Assurance of the National Energy Information Management System and Energy Statistics of Zambia	To build in country capacities on quality assurance of energy sectorial GHG Inventories	1 week 12 – 15 February 2024,	Closed	Energy sectorial GHG quality control and quality assurance processes
7	UNFCCC/ Transparency Division of the UNFCCC Secretariat	Development of the national GHG Improvement Plan	Develop a national GHG Improvement Plan	August 2024 to June 2025	Closed	Gap analysis and development national GHG Improvement Plan
8	UNOPS/ UNEP Copenhagen Climate Centre/ Initiative for Climate Action Transparency (ICAT)	Capacity building Initiative to establish an integrated data management Framework for GHG Projections, Mitigation Policy Analysis, and NDC Tracking	Capacity building Initiative to establish an integrated data management Framework for GHG Projections, Mitigation Policy Analysis, and NDC Tracking	18 months	Initiated	Targeted training in emission projections, mitigation scenario analysis, and monitoring progress towards NDC targets, and for transparency and reporting across sectors.
9	European Union/GGI	EU Global Support Facility for Nationally Determined Contributions Roadmap for the Operationalisation of IMRV In Zambia	Develop a roadmap for developing an Integrated Measurement and Reporting Framework for ETF in Zambia	6 months	closed	IMRV road map development

5.5.3 National Capacity-Building Initiatives

Zambia capacity-building ETF priorities focusses on strengthening institutional arrangements, enhancing technical competencies, and improving systemic frameworks that enable effective implementation and reporting of the country's climate actions. Three notable examples of planned initiatives to support effective ETF implementation include the establishment of a National iMRV and Transparency System, NDC Implementation and Tracking Framework and the strengthening of Adaptation Monitoring and Evaluation Capacities

Establishment of the National MRV and Transparency System

The first national capacity-building initiative relates to the establishment of a National MRV and Transparency System. The overall objective of this initiative is to strengthen Zambia's institutional and technical capacities to meet its reporting obligations under the Enhanced Transparency Framework. The initiative will focus on the development of standardized templates for data collection, the establishment of national data-sharing agreements among ministries, the creation of a central database for greenhouse gas inventories and mitigation actions, and the training of technical staff in IPCC methodologies, including quality assurance, quality control, and uncertainty analysis.

Progress to some extent has been made through projects such as the Capacity-Building Initiative for Transparency (CBIT), AFD and other GEF-funded readiness programmes, which have supported the Zambia Environmental Management Agency, and sector ministries.

This initiative therefore strengthens capacity at the systemic level through legal frameworks and coordination mechanisms, at the institutional level through improved data systems and protocols, and at the individual level through the training of national experts in inventory preparation and MRV tools. The web based IMRV system is under development

National Capacity Development for NDC Implementation and Tracking

The second initiative is the National Capacity Development for NDC Implementation and Tracking, which aims to build the country's capacities for planning, implementing, monitoring, and reporting on its mitigation and adaptation commitments under the Nationally Determined Contribution. The initiative involves training of sectoral focal points on NDC tracking indicators, the development of monitoring and evaluation frameworks for mitigation, adaptation, strengthening financial tracking systems for climate-related expenditures, and integrating gender-responsive approaches into sectoral implementation.

Strengthening Adaptation Monitoring and Evaluation Capacity

The third national initiative focuses on strengthening adaptation monitoring and evaluation (M&E) capacity. Its objective is to equip Zambia with the tools and expertise necessary to systematically assess climate risks, monitor the effectiveness of adaptation measures, and report on progress towards resilience-building objectives. The initiative includes the development of sector-specific adaptation indicators, the design of data collection and reporting frameworks for priority sectors such as agriculture, water, forestry and health, and the training of government officials and stakeholders in the use of M&E tools and methodologies.

This initiative aims to strengthens capacity at the systemic level by embedding adaptation M&E into national development and sectoral planning, at the institutional level by equipping line ministries and sub-national authorities with tools and frameworks, and at the individual level by enhancing the technical skills of planners, statisticians, and field officers who are directly involved in monitoring adaptation

5.5.4 Enhanced Transparency Framework Support Needed

Despite the progress achieved, Zambia still faces challenges that require sustained financial and technical support to fully operationalize a robust transparency system. Key needs include:

- Continued capacity building for emission accounting and applying of higher-tier methodologies for key emission sectors.
- Development of robust regulations for ETF data collection
- strengthening national systems and tools for tracking the implementation of its Nationally Determined Contributions (NDCs), such as NDC data management and policy impact assessment by establishing robust data management frameworks for greenhouse gas projections and NDC tracking
- Long-term funding for maintenance and expansion of the MRV system for greenhouse gas Inventory, mitigation actions, adaptation actions and climate Finance, capacity Building, and technology transfer.
- Sustainable financing mechanisms to ensure continuity of transparency activities beyond project-based funding cycles.
- Enhancement of the MRV and National Carbon registry within ZEMA and sectors.
- Development of a national MRV and article 6 strategy.
- Continuous training of national experts on IPCC guidelines, mitigation assessment tools, Carbon trading, and transparency reporting.

Table 5-10: ETF Support Needs

No		
1	**GHG and MRV Systems**	Continued cross sectorial capacity building in emission accounting and application of higher-tier methodologies for key emission sectors.
		Development of a national MRV and article 6 strategy to enhance GHG Annual information and Regular information reporting for implementation of Article 6.
		Enhancement of the MRV systems within ZEMA and among the sectors
2	**NDC Tracking and Mitigation Assessment**	Continuous training of national experts on IPCC guidelines, mitigation assessment tools, Carbon trading, and transparency reporting.
		Strengthening national systems and tools for tracking the implementation of its Nationally Determined Contributions (NDCs), such as NDC data management and policy impact assessment by establishing robust data management frameworks for greenhouse gas projections and NDC tracking
		Development of National Carbon registry within ZEMA to support implementation of Article 6 .
3	**Adaptation and Climate Risks**	Mainstreaming adaptation into development planning and budgeting
		Need for more predictable financial resources dedicated to adaptation, including through innovative instruments and private-sector engagement.
		Strengthen training programmes for sector ministries (agriculture, water, health, environment) on adaptation planning, monitoring, reporting

4	Climate Finance	Long-term funding for maintenance and expansion of the MRV system for greenhouse gas Inventory, mitigation actions, adaptation actions and climate Finance, capacity Building, and technology transfer.
		Sustainable financing mechanisms to ensure continuity of transparency activities beyond project-based funding cycles.
		Long-term funding for maintenance and expansion of the MRV system for greenhouse gas Inventory, mitigation actions, adaptation actions and climate Finance, capacity Building, and technology transfer.

5.5.5 Challenges and Lessons Learned

Despite significant progress under national initiatives to strengthen capacities for climate action, Zambia continues to face several challenges that have informed lessons for future capacity-building efforts. First, limited technical and human resource capacity in areas such as GHG inventory preparation, adaptation monitoring and evaluation, and climate finance tracking has affected timely reporting under the Enhanced Transparency Framework. Second, fragmented institutional coordination across ministries, agencies, and local government bodies has sometimes resulted in duplication of efforts and inconsistent data management. Third, inadequate availability and quality of sectoral data, particularly for adaptation indicators and emissions, remains a barrier to effective planning and reporting. Fourth, the reliance on short-term donor funding for many capacity-building programs has limited continuity and sustainability. Finally, the integration of gender and social inclusion considerations into capacity-building activities has been insufficient, reducing equitable access to training and participation.

Lessons learned from these challenges highlight the importance of targeted and sustained training, mentorship, and retention strategies for national experts; establishment of clear roles, formal data-sharing agreements, and inter-ministerial coordination platforms; investment in reliable data systems, centralised databases, and standard procedures for data collection and verification; integration of capacity-building into national planning and budgeting to ensure long-term sustainability; and deliberate incorporation of gender-responsive approaches and the inclusion of marginalized groups to strengthen equity and effectiveness in climate action.

5.5.6 Future Plans

Zambia plans to strengthen capacities across systemic, institutional, and individual levels to support effective climate action and reporting under the Enhanced Transparency Framework. At the systemic level, the focus will be on formalizing inter-ministerial coordination, embedding climate considerations into sectoral and sub-national planning, and improving data management and archiving protocols. At the institutional level, efforts will target strengthening sector ministries and agencies to collect, analyse, and report climate data, scale up MRV systems, and track climate finance. At the individual level, Zambia will expand targeted training in GHG inventories, mitigation modelling, adaptation M&E, climate finance, and gender-responsive approaches, complemented by mentorship and regional collaboration.

Cross-cutting priorities include promoting gender and social inclusion, leveraging digital tools, and fostering partnerships with regional and international institutions. Short-term plans will focus on immediate trainings and system improvements, medium-term plans on institutionalization and scaling, and long-term plans on establishing sustainable national expertise and centres of excellence

5.6 Gender and Climate Change

5.6.1 Introduction

Gender equality and the empowerment of women are central to Zambia's approach to climate change. recognising that climate impacts are often differentiated by gender due to social, economic, and cultural factors; the country has committed to integrating gender considerations into all climate policies, strategies, and actions. Gender mainstreaming ensures that both women and men benefit equitably from climate initiatives and that vulnerable group are not disproportionately affected by climate impacts.

This section outlines Zambia's efforts to mainstream gender in climate action, highlights the support needed and received (including estimated and actual funding), identifies challenges and lessons learned, and presents future plans to strengthen gender-responsive climate policies and practices.

5.6.2 Gender Mainstreaming in Climate Actions

Zambia has undertaken several measures to integrate gender considerations into climate adaptation, mitigation, and policy frameworks. Gender perspectives have been incorporated into the National Climate Change Policy, the Nationally Determined Contributions (NDCs), and sectoral climate strategies to ensure equitable participation and benefits. Training programs have been conducted to raise awareness and build capacity among government officials, sectoral planners, and local authorities on gender-responsive approaches in climate planning and implementation.

Efforts have also been made to promote women's participation in local climate adaptation initiatives, including water management, agroforestry, and renewable energy projects, to ensure inclusive decision-making. In addition, Zambia has worked to collect and use sex-disaggregated data in climate reporting, including in vulnerability assessments, adaptation monitoring, and project implementation reviews. Through these measures, the country seeks to enhance the resilience of vulnerable populations while promoting equitable access to climate finance, technology, and resources.

5.6.4 Support Received

Zambia has received technical and financial support from a variety of partners to advance gender mainstreaming in climate change. Bilateral and multilateral support, including from UNDP, UN Women, and the Green Climate Fund (GCF), has strengthened institutional capacity, facilitated the development of gender-sensitive policies, and supported the implementation of pilot initiatives. Zambia has also benefited from regional cooperation through platforms such as SADC and COMESA, which provide knowledge exchange on gender-responsive climate strategies. Workshops and training sessions for government officials and sector stakeholders have enhanced skills in integrating gender into climate policies and project design.

At the community level, development partners have supported initiatives that promote women's participation in renewable energy, agroforestry, and climate-smart agriculture. These combined efforts have contributed to increased awareness, greater women's participation in

climate decision-making, and improved integration of gender perspectives into policy and planning.

The actual funds received and support sources are summarized in Table 5.10

Table 5-11: Funds Received and Support Sources

Support Source	Description	Funds Received (USD)	Duration	Implementing Partner
UNDP	Capacity-building workshops for sector officials	120,000	2023–2024	Ministry of Green Economy and Environment
UN Women	Development of gender-sensitive policy guidelines	80,000	2022–2023	Sector ministries
GCF Readiness	Pilot gender-responsive adaptation initiatives	200,000	2023–2025	Ministry of Green Economy and Environment
Regional programs (SADC/WISER)	Knowledge exchange and training on gender in climate	50,000	2022–2023	Various regional bodies
Community projects (bilateral support)	Renewable energy and agroforestry participation initiatives	100,000	2023–2025	Local authorities & NGOs

5.6.3 Support Needed for Gender Mainstreaming

To further strengthen gender integration in climate action, Zambia requires support in several areas. There is a need for technical assistance and training for government institutions and local authorities on gender-responsive planning, budgeting, and monitoring. Development of comprehensive gender-sensitive climate data and reporting systems are also needed to inform planning, tracking, and evaluation of interventions.

Support is required to access domestic and international climate finance that explicitly incorporates gender considerations. Assistance is also necessary in developing guidelines, frameworks, and tools to ensure effective mainstreaming of gender across sectors and programs. Finally, Zambia requires programs to engage communities, civil society, and private sector actors on the importance of gender equality in building climate resilience.

The estimated funding required for these support areas is summarized in Table 5.9:

Table 5-12: Funding Required for the Supported Needed

Support Area	Description	Estimated Funds (USD)	Timeframe	Notes

Capacity-building	Training government officials and sector planners on gender-responsive climate strategies	300,000	0–2 yrs	Based on GCF Readiness project estimates
Data systems	Development of gender-sensitive climate data collection and reporting	250,000	3–5 yrs	Includes database development and indicator design
Policy guidance	Development of guidelines and mainstreaming frameworks	100,000	0–2 yrs	Consultancy support and stakeholder workshops
Community engagement	Awareness programs and local-level participation initiatives	150,000	0–5 yrs	Includes outreach and materials for marginalized groups
Resource mobilization support	Assistance to access domestic and international climate finance	50,000	3–5 yrs	Technical assistance and proposal preparation

5.6.5 Challenges and Lessons Learned

Despite progress, Zambia faces several challenges in fully mainstreaming gender in climate action. Many institutions still lack sufficient technical expertise to integrate gender systematically into climate policies and programs. There is also a shortage of sex-disaggregated data and indicators for monitoring the gender dimensions of climate impacts and interventions. Limited financial resources restrict the scale and sustainability of gender-responsive initiatives. Cultural and social norms sometimes limit women's participation in decision-making and access to climate resources. Furthermore, efforts across sectors and ministries are often uncoordinated, reducing the overall effectiveness of gender mainstreaming.

Lessons learned from these challenges highlight the importance of building institutional and human capacity, establishing clear coordination mechanisms, investing in gender-sensitive data systems, promoting community awareness, and ensuring dedicated funding for gender-responsive climate initiatives.

5.6.6 Future Plans

Zambia plans to further strengthen gender mainstreaming in climate action through a series of strategic measures. The country will enhance coordination across ministries and agencies to systematically integrate gender into climate policies, programs, and reporting. It will expand training and technical assistance for government officials, sectoral planners, and local authorities on gender-responsive climate strategies. Zambia also plans to develop comprehensive gender-sensitive indicators and integrate sex-disaggregated data collection into national climate information systems.

Efforts will be made to increase domestic and international funding for gender-responsive climate actions and pilot initiatives. Greater participation of women and marginalized groups in climate decision-making, adaptation projects, and renewable energy initiatives will be

promoted. Finally, Zambia will update guidelines and frameworks to ensure that gender considerations are consistently embedded across all climate interventions and sector plans. Through these measures, the country aims to achieve equitable and inclusive climate resilience, ensuring that climate policies, strategies, and projects benefit all segments of society while reducing gender-based disparities.

Chapter 6: Flexibility

This chapter focuses on the application of flexibility provisions in reporting climate-related information, in line with the Enhanced Transparency Framework under the Paris Agreement. recognising the varying capacities of countries, the framework allows developing nations like Zambia to exercise flexibility in certain reporting areas, ensuring that national circumstances and capabilities are adequately considered.

In Greenhouse Gas (GHG) inventories, Zambia may report emissions using Tier 1 methods, relying on default emission factors and simplified approaches where detailed data are unavailable. This ensures that reporting remains compliant while accommodating limitations in sectoral data availability. Similarly, for mitigation actions and their effects, Zambia can provide qualitative descriptions when quantitative data are difficult to obtain, explaining the objectives, implementation status, and anticipated outcomes of each action. Where feasible, simplified methodologies may be applied to estimate the effects of mitigation measures, balancing accuracy with practical data constraints.

For reporting on support received, Zambia has the option to present information in aggregate terms rather than disaggregated by individual projects or funding sources. This provides a broad overview of international assistance while reducing the reporting burden. The country's application of these flexibility provisions is guided by its national circumstances, including data availability, institutional capacity, and resource constraints. Zambia has also developed a Carbon Market Framework to enhance its climate reporting capabilities, aligning with international standards while reflecting local realities.

By judiciously applying flexibility provisions, Zambia ensures that its BTR accurately reflects both its climate actions and the practical realities of its reporting environment. This approach not only meets international obligations but also fosters transparency, credibility, and trust in Zambia's climate governance.

Chapter 7: Other Relevant Information

7.1 Research and Systematic Observation

7.1.1 Introduction

Zambia is highly vulnerable to the adverse impacts of climate change, experiencing an increased frequency of extreme weather events such as erratic rainfall patterns, prolonged droughts, and severe floods. These climatic shifts pose significant threats to the nation's agriculture-dependent economy, impacting food security, livelihoods, and causing substantial economic losses to its Gross Domestic Product (GDP). The critical importance of water resources to Zambia's climate resilience is underscored by their explicit recognition as a key vulnerability in the country's Second National Communication to the UNFCCC. Furthermore, water is explicitly designated as a priority sector within Zambia's National Adaptation Plan (NAP).

In this context, robust research and systematic observations (RSO) are of paramount importance. They provide the foundational data and scientific understanding necessary to inform national climate policies, develop effective adaptation measures, and guide mitigation strategies. This strategic alignment supports Zambia's long-term development aspirations as articulated in Vision 2030, which seeks to transform Zambia into a prosperous middle-income country, and its subsequent National Development Plans. Zambia demonstrates its commitment to the global climate agenda through its active engagement with the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement. This commitment is evidenced by its history of submitting National Communications (NC1, NC2, NC3) and Biennial Update Reports (BUR1). This Biennial Transparency Report (BTR) serves as a key mechanism for enhanced transparency and reporting on Zambia's RSO activities, reflecting its continuous efforts to strengthen its climate action framework.

7.1.2 National Framework for Research and Observation

Zambia Meteorological Department (ZMD)

Operating under the Ministry of Green Economy and Environment, the ZMD is the national authority responsible for weather forecasting, climate monitoring, and the provision of essential meteorological services across Zambia. Its core functions encompass generating and disseminating meteorological information and warnings critical for various sectors; establishing and maintaining a countrywide network of surface meteorological stations (with upper-air and maritime observation points planned for future development), thereby ensuring comprehensive data collection; undertaking applied and fundamental research on Zambian weather and climate patterns, including historical analysis and future projections; coordinating surface observations; and processing, archiving, and managing climatic data to ensure its accessibility and long-term preservation. The ZMD also collaborates extensively with international organizations and research institutions, aligning its practices with global standards.

Water Resources Management Authority (WARMA)

Established by the Water Resources Management Act No. 21 of 2011, WARMA, under the Ministry of Water Development and Sanitation, serves as the principal regulatory body for the comprehensive management and development of Zambia's water resources, ensuring equitable access and sustainable utilization. Its core functions include promoting the sustainable utilization and development of water resources; establishing and maintaining an integrated water resources management (IWRM) information system; ensuring access to acceptable quality and quantity of water for all users; setting standards and guidelines for water resources management; monitoring and regulating water use across all sectors, including hydropower generation; and regulating water infrastructure construction and operation. WARMA operates based on IWRM principles, explicitly incorporating gender equality and climate change considerations into its mandate, and holds control over all water resources in Zambia.

Department of Water Resources Development (DWRD)

Also, under the Ministry of Water Development and Sanitation, the DWRD plays a crucial role in water infrastructure and resource planning. Its core functions include providing policy guidance on water resources development; overseeing the construction, rehabilitation, and maintenance of water infrastructure; conducting exploratory research and surveys on water availability across different regions; maintaining a geo-spatial database on dams and boreholes; and managing transboundary waters in collaboration with regional entities. While DWRD conducts exploratory research, WARMA often contributes to or utilizes such research for its regulatory and management roles.

Forestry Department

The Forestry Department, under the Ministry of Green Economy and Environment, is responsible for the sustainable management of Zambia's forest resources. Its roles include enhancing forest data collection for improved decision-making; implementing policies and legal frameworks for sustainable forest management; and collaborating with international partners like the FAO and UN-REDD programmes to strengthen forest monitoring and REDD+ initiatives.

Ministry of Agriculture, Ministry of Fisheries and Livestock, and Disaster Management and Mitigation Unit (DMMU)

These institutions are critical partners in the application of climate information services for national planning and response. The Ministry of Agriculture utilizes climate information for agricultural planning, promoting climate-smart agriculture, and enhancing food security. The Ministry of Fisheries and Livestock applies climate data for sustainable livestock management and aquaculture development, adapting to changing environmental conditions. The Disaster Management and Mitigation Unit (DMMU) is a key beneficiary and collaborator in early warning systems, utilizing climate and hydrological forecasts for disaster preparedness and response.

Academic and Research Institutions

Zambia’s academic and research landscape significantly contributes to climate-related RSO. Institutions such as the University of Zambia, Copperbelt University, Mulungushi University, and National Institute of Public Administration conduct diverse climate-related research, offer

specialized programs, and contribute to human capacity building. The Zambia Agriculture Research Institute (ZARI) and Golden Valley Agricultural Research Trust (GART) lead agricultural research, including adaptive research on climate-resilient crops and sustainable farming practices. The Zambia Institute for Policy Analysis and Research (ZIPAR) provides policy-relevant research and analysis on climate change impacts and responses. The National Institute for Scientific and Industrial Research (NISIR) conducts scientific and industrial research, including aspects relevant to climate change adaptation and mitigation technologies. Finally, the Ministry of Technology and Science supports and promotes science and technology research across various sectors, including climate change. Many of these institutions are involved in the Zambia SPAR6C Climate Change Research Network, fostering inter-institutional collaboration.

Coordination Mechanisms

Coordination among these institutions is vital for effective RSO efforts at national and sub-national levels. Zambia emphasizes a "one government" approach, as highlighted in its NDC Implementation Framework, to foster greater stakeholder collaboration. Multi-institutional collaborations, such as AICCRA Zambia, actively work with the ZMD, Ministry of Agriculture, and other relevant entities to build a national data ecosystem that integrates climate science and agricultural practices, ensuring climate information is tailored and delivered to support agricultural resilience. Furthermore, WARMA actively collaborates with key partners like the Disaster Management and Mitigation Unit (DMMU), the Red-Cross Society of Zambia, and the ZMD on crucial flood preparedness and early warning initiatives, ensuring timely dissemination of advisories and coordinated responses to hydrological hazards. Efforts are also ongoing to establish and strengthen platforms for seamless data exchange, harmonizing methodologies, and standardizing data formats across institutions like WARMA, ZMD, and DWRD, which is crucial for creating a comprehensive and integrated national RSO system.

7.1.3 Research Activities

Zambia conducts diverse climate research to enhance understanding, inform policy, and develop targeted interventions.

National Research Priorities and Focus Areas

Research activities are aligned with national development goals and climate change strategies. The ZMD undertakes ongoing research on Zambian weather and climate patterns, including historical trend analysis and future projections to inform national policies and services. The DWRD conducts exploratory research on water resource availability, supporting strategic water planning and infrastructure development. Academic institutions like the University of Zambia and Copperbelt University lead various climate-related research initiatives, contributing to scientific knowledge and human capacity. Research also focuses on Climate-Smart Agriculture (CSA) practices and climate information services, with significant support from AICCRA Zambia, aiming to enhance agricultural resilience and food security. Furthermore, research is undertaken into climate-sensitive diseases, as identified in the National Adaptation Plan, to develop effective public health responses.

Research on Climate Change Impacts and Vulnerability

Research extensively covers the impacts of climate change and national vulnerabilities. Studies build upon key vulnerabilities identified in previous National Communications, particularly focusing on water resources, public health, and biodiversity. Research directly informs the National Adaptation Plan (NAP) and its objectives, identifying specific vulnerabilities across sectors and guiding the development of appropriate adaptation actions. Detailed studies also analyze the impacts of increased temperatures and decreased rainfall on agricultural livelihoods, providing insights for adaptation strategies to protect rural communities.

Research on Mitigation Options

Zambia conducts research to identify and assess viable mitigation options across key sectors. In the energy sector, research focuses on promoting efficient cookstoves, increasing electrification rates, and exploring energy substitution in industry to reduce reliance on fossil fuels and traditional biomass. For the forest sector, research supports afforestation and reforestation programs, improved natural vegetation management practices, and the development of sustainable charcoal production methods to reduce deforestation and enhance carbon sequestration. Overall, research findings contribute to the National Green Growth Strategy and inform broader low-carbon development pathways, promoting a transition to a more sustainable and resilient economy.

Research Case Studies/Success Stories

Concrete examples demonstrate the impact of research efforts:

i. **Mutation Breeding for Enhanced Crop Resilience (Cowpeas and Common Beans)**

The University of Zambia (UNZA), in collaboration with Zambia Agriculture Research Institute (ZARI), National Institute for Scientific and Industrial Research (NISIR), and the International Atomic Energy Agency (IAEA), developed and released two mutation-derived cowpea varieties: Lukusuzi and Lunkhwakwa (registered in 2018 in FAO/IAEA Mutated Varieties Database). These varieties show remarkable tolerance to abiotic stresses (soil acidity, drought, heat) and resistance to biotic stresses (pests, diseases), significantly reducing production costs and expanding cultivation zones. Their high vegetative growth also offers potential for forage and nutritious leaves. This success, recognized and funded by the VACS Project through CIMMYT and USAID, highlights nuclear science's role in sustainable agriculture. Zambia is a success story for the 60th anniversary of the FAO/IAEA Centre of Nuclear Techniques. Additional cowpea mutants are undergoing testing for release.

UNZA also developed improved common bean genotypes: Kundalila, Kilimanjaro, and Serengeti, offering higher yields, disease resistance, higher iron bioavailability, and faster cooking times (within 30 minutes). The fast-cooking varieties, Kundalila and Serengeti, significantly contribute to saving electricity and reducing charcoal use, leading to reduced deforestation and mitigating climate change impacts.

ii. Southern African Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL)

SASSCAL, a joint initiative of Angola, Botswana, Namibia, South Africa, Zambia, and Germany, addresses global change challenges. From 2012 to 2018, SASSCAL supported numerous research projects in Zambia, contributing to improved data infrastructure, scientific publications, and policy uptake, thereby enhancing Zambia's capacity for climate change research and sustainable land management. These projects included: land use assessment, seed testing, beekeeping capacity, forest management, soil analysis, sediment burden, water database, and biodiversity monitoring, all funded by BMBF.

iii. Government-Funded Climate-Related Projects through the Strategic Research Fund (SRF)

The Government of Zambia, through the NSTC's Strategic Research Fund (SRF), has funded critical climate change-related research projects across sectors, demonstrating domestic commitment. In the Energy Sector, projects like "Spatial Analysis of Geothermal Resource Occurrence Controls and Prospectivity" (2019-2022, USD 39,000) contribute to energy diversification and resilience. Other initiatives focus on solar drying technology for post-harvest loss reduction (2021-2022, USD 22,300), biogas generation for clean cooking (2021-2023, USD 22,300), and utilizing invasive plants for eco-friendly energy (2021-2022, USD 22,300). For the Water Sector, projects include "Biochar Briquetting from Biosolids..." (2021-2024, USD 40,000) addressing water quality and waste management, and "Interactive effects of climate and land-use on soil organic carbon..." (2019-2022, USD 3,000) enhancing understanding of climate impacts on soil nutrients. In the Agriculture Sector, research covers sustainable insect larvae production for animal feed (2021-2024, USD 40,000), local Mycorrhizae and Bacillus use in maize-legume intercropping (2022-2025, USD 39,980), common bean breeding for blight resistance (2022-2025, USD 38,600), plant-derived bio-pesticides (2022-2025, USD 39,000), and biochar in faecal sludge management (2019-2022, USD 11,250). These projects collectively aim to enhance crop resilience, promote sustainable practices, and improve food

7.1.4 Systematic Observation Networks

Systematic observation efforts provide the continuous flow of data necessary to monitor climate variability and change, assess impacts, and develop informed responses.

Atmospheric Observations

The ZMD maintains Zambia's national meteorological station network, comprising about 250 Automatic Weather Stations (AWS), 200 Automatic Rainfall Stations (ARS), and 600 rain gauges. Zambia has made significant strides in expanding its ground meteorological stations to cover all 116 districts across the country, greatly enhancing local data collection. However, despite this progress, critical gaps remain. Currently, there are no upper-air stations or weather radars, and other necessary hydro-meteorological stations required for comprehensive climate services are still lacking. These gaps significantly hinder the provision of robust climate services for adaptation and limit the availability of detailed data needed to assess hazards and vulnerabilities, accurately understand and characterize climate change impacts, and issue timely and effective early warnings. Addressing these critical observational gaps is paramount, as it would provide a complete and more accurate picture of Zambia's climate system, allowing

for the development of more precise adaptation and mitigation strategies, ultimately safeguarding lives, livelihoods, and economic development.

Data is collected through direct measurements from instruments at these stations, with methodologies adhering to World Meteorological Organization (WMO) guidelines and standards. The ZMD implements rigorous quality control and assurance procedures to ensure data reliability, and weather and climate information is disseminated through various channels, including daily and weekly forecasts, specialized advisories, and mobile applications. Key Essential Climate Variables (ECVs) systematically observed in the atmospheric domain include temperature (surface and upper air), precipitation, humidity, wind speed and direction, atmospheric pressure, and cloud cover.

ZMD leverages the Meteosat series of geostationary meteorological satellites (operated by EUMETSAT) and integrates validated reanalysis and satellite-observed gridded datasets like Tropical Applications of Meteorology using Satellite (TAMSAT) and the Japanese 55-year Reanalysis (JRA-55). These offer high spatial and temporal resolution, particularly vital given Zambia's sparse ground network, for real-time monitoring and detailed climate studies. ZMD employs advanced climate modelling techniques, integrating data from global forecasting centres (ECMWF, NCEP, UK Met Office, Meteo-France, JMA) for Numerical Weather Prediction (NWP). It participates in regional seasonal forecasting initiatives (SARCOF) and explores Artificial Intelligence (AI) for enhanced predictions, including downscaling global model outputs (GCMs and RCMs) to regional scales for adaptation/mitigation strategies. Ensemble forecasting (e.g., NMME, C3S) and improved parameterizations further enhance reliability.

Zambia's commitment to global meteorological data exchange is further reinforced through its engagement with the Global Basic Observing Network (GBON) and the WMO Information System 2.0 (WIS 2.0). GBON aims to ensure that all WMO Members have access to the most essential meteorological observations, which are crucial for underpinning weather forecasts and climate analyses. WIS 2.0 facilitates the seamless exchange of all weather, climate, and water information, enabling National Meteorological and Hydrological Services (NMHSs) to share and access data efficiently.

Hydrological and Water Resources Observations

Water resources are extensively monitored through a dedicated network and advanced systems. The Water Resources Management Authority (WARMA) is actively involved in monitoring crucial hydrological parameters, including water levels and quality across the country. It operates a network of 27 hydrometric stations strategically located nationwide, which are integrated with the Global Flood Awareness System (GloFAS) to provide real-time data for flood forecasting. WARMA has also developed and operationalized a customized Flood Early Warning System (FEWS) to enhance flood preparedness by generating and disseminating timely and reliable flood-related advisories. WARMA plays a key role as part of the national taskforce on floods, actively collaborating with partners such as the Disaster Management and Mitigation Unit (DMMU), the Red-Cross Society of Zambia, and the Zambia Meteorological Department (ZMD) to improve preparedness. Furthermore, WARMA has implemented a web-based Water Quality Management Information System for proactive monitoring of both surface and groundwater quality, providing easy access to vital water quality data. Studies have revealed significant groundwater contamination in areas like Mufuchani, underscoring the importance of WARMA's monitoring efforts. Nitrate and microbiological indicators are major water quality concerns, often linked to anthropogenic influences.

The Department of Water Resources Development (DWRD) monitors surface water and groundwater resources and maintains a comprehensive geo-spatial database on dams and boreholes across the country, which is critical for water infrastructure planning and management. The Zambia Drought Monitoring System (ZADMS), a satellite-based online weather-monitoring system developed by the International Water Management Institute (IWMI) for the Ministry of Agriculture, serves as a single portal for drought monitoring data, providing seasonal, sub-seasonal, and 7-day weather forecasts. It incorporates national- to district-level datasets from multiple satellites and other sources and facilitates collaborative working across institutions and sectors for integrated drought management, including meteorology and water resources.

Terrestrial and Forest Observations

Monitoring of terrestrial ecosystems, particularly forests, is crucial for assessing land use change and its climate implications. The Forestry Department is responsible for the status of forest monitoring and inventory systems in Zambia. The Food and Agriculture Organization (FAO) collaborates with the Forestry Department to enhance forest data collection and decision-making, including recent efforts like the 2024 forest inventory in Manyinga District, which provides updated information on forest cover and carbon stocks. The Open Foris Arena platform is used for processing forest inventory data and developing sustainable forest management plans, aiding in systematic data management and analysis for the forestry sector. These forest observations are highly relevant for Zambia's REDD+ (Reducing Emissions from Deforestation and Forest Degradation) initiatives and broader sustainable forest management efforts, contributing to both mitigation and adaptation goals.

Climate Trends and the 2023/2024 Drought in Zambia

Systematic observations reveal significant climate trends in Zambia and provide critical data for understanding extreme events. Zambia's Agro-ecological Zones (AEZs) are critical for understanding agricultural potential and for planning. These zones are categorized as AER I (least rainfall, drought-prone), AER II (moderate rainfall, variable patterns), and AER III (high rainfall, higher temperatures), and are vital for climate analysis (Figure 7.1).

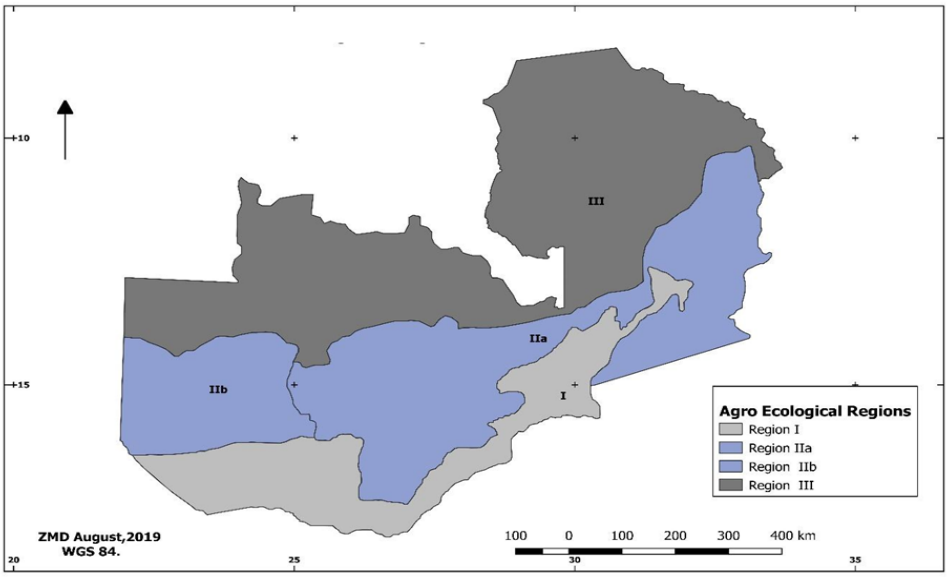


Figure 7.1: Zambia's Agro-ecological Zones

Regarding temperature, Zambia has experienced a significant increase, with the mean annual temperature rising by 1.3°C since 1960 (an average of 0.29°C per decade). Historical data shows increase in maximum temperatures and hotter days/warm nights. For precipitation, rainfall records indicate historical variability, with a 6% decline in annual precipitation from 1971 to 2005 in some regions, particularly the south-western part. Future projections suggest decreased precipitation in AER II and AER III, and increased inter-annual variability, leading to more intense droughts and floods.

The 2023/2024 drought in Zambia, exacerbated by both climate change and natural variability, severely impacted 9.8 million people and 1.1 million households across 84 districts, leading to a Presidential declaration of a National Disaster and Emergency. The impacts were significant, including a drastic crop yield decline (affecting 6 million people), widespread water scarcity, reduced hydropower generation (resulting in a 700MW deficit), increased water-borne diseases, reduced economic growth, and severe environmental degradation (such as fires, land degradation, and biodiversity loss). Addressing these challenges requires increased investment in research and systematic observations to improve understanding of drought patterns, develop early warning systems, and implement targeted, sector-specific strategies to enhance resilience. Climate modelling, supported by robust data, is paramount for accurate predictions and informed decision-making.

7.1.5 Data Management, Archiving, and Accessibility

Effective data management, archiving, and accessibility are fundamental to robust RSO.

Data Management Systems

Zambia utilizes various systems for collecting, processing, and archiving climate and environmental data. For Meteorological Data, the ZMD employs specialized systems including the Climsoft Climate Data Management System, an internally developed Climate Data Management System, and the ENACTS Data Platform & Library. In Water Resources, the DWRD maintains a geo-spatial database for dams and boreholes, while WARMA maintains an integrated water resources management information system and a web-based Water Quality Management Information System for proactive monitoring and easy access to water quality data. For Forestry Data, platforms like Open Foris Arena are used for processing forest inventory data and developing forest management plans. The Zambia Drought Monitoring System (ZADMS) serves as a single portal for drought monitoring data, integrating datasets from multiple satellites and other sources.

Data Quality and Standards

Ensuring high-quality observational data is a continuous effort. This involves regular calibration and maintenance of instruments across meteorological and hydrological networks to ensure accuracy and reliability. Zambia adheres to national and international standards for data collection and reporting, particularly those set by the WMO for meteorological and hydrological observations. Rigorous quality assurance and quality control (QA/QC) procedures are implemented across all data streams to identify and correct errors.

Data Accessibility and Sharing

Policies and practices promote the availability of climate data to various stakeholders. Emphasis is placed on open access to climate and environmental data, with efforts to make data available in machine-readable formats where possible, facilitating wider use and analysis. Collaboration among institutions aims to build a comprehensive national data ecosystem for seamlessly blending climate science and agriculture, ensuring that relevant data reaches policymakers, researchers, and end-users like farmers.

7.1.6 Gaps and Constraints

Despite progress, significant challenges remain in Zambia's RSO system, highlighting critical capacity building needs.

Identified Gaps and Constraints

Challenges persist in data collection and information, particularly for detailed and disaggregated data at local and regional scales, which is crucial for targeted interventions. The need for a robust Measuring, Reporting, and Verification (MRV) system remains a key constraint for enhanced transparency under the UNFCCC. Constraints related to technical and human capacities across various RSO institutions limit the full potential of data generation, analysis, and application. Furthermore, ensuring seamless data exchange, harmonizing methodologies, and standardizing data formats across multiple institutions, including WARMA, ZMD, and DWRD, remains a significant challenge.

7.1.7 Needs and Priorities

Addressing these gaps requires sustained and targeted support. Ongoing initiatives include AICCRA Zambia's Internship and Innovation Grant program and training on platforms like Open Foris Arena, which build practical skills in climate science and data management. There is a crucial need for continued international cooperation, technology transfer, and adequate climate finance to strengthen Zambia's RSO capabilities comprehensively. Support is also needed for developing endogenous capacities in data collection, advanced analysis, and the application of climate information for decision-making.

Specific needs include improving climate change monitoring systems through integrating satellite observations, ground-based data, and forecast models, particularly in the water sector. Support for innovative approaches like decentralised monitoring and early-warning systems leveraging Artificial Intelligence (AI) and drone sensors is also critical to enhance real-time data collection and early warning dissemination. The Systematic Observations Financing Facility (SOFF), established to provide financial and technical assistance, will be crucial in addressing these gaps and ensuring sustained observations.

7.1.8 International and Regional Cooperation

Zambia will continue its active engagement with international partners and participation in global RSO initiatives. Continued engagement with partners such as the United Nations Development Programme (UNDP), Global Environment Facility (GEF), Food and Agriculture Organization (FAO), International Water Management Institute (IWMI), and the NDC Partnership is crucial for securing technical expertise and financial support. Zambia's

participation in and alignment with initiatives like the Global Basic Observing Network (GBON) and the WMO Information System 2.0 (WIS 2.0) will be key to enhancing data exchange and ensuring that essential observations are available for global weather and climate services. The Systematic Observations Financing Facility (SOFF) will also be a vital mechanism for facilitating sustained investment in Zambia's observing systems. Zambia will also maintain its active participation in global and regional RSO initiatives, contributing to international data exchange and knowledge sharing.

7.1.9 Future Outlook and Conclusions

Zambia is committed to continuously strengthening its RSO system to support its climate and development agendas.

Strategic Directions

RSO efforts will continue to be aligned with key national development priorities and climate change strategies, including the National Climate Change Response Strategy, National Policy on Climate Change, National Adaptation Plan, and the National Green Growth Strategy. There will be a continued focus on strengthening climate information services for key vulnerable sectors such as agriculture, water, and health, ensuring that climate data translates into actionable information for stakeholders.

Planned Enhancements to Observing Systems

Plans include upgrading and expanding meteorological and hydrological networks, including WARMA's hydrometric stations and water quality monitoring systems, to improve spatial coverage and data resolution. Further development and institutionalization of drought monitoring systems like ZADMS will be pursued to enhance early warning and response capabilities. Continued efforts will also focus on enhancing forest monitoring and management planning, including updated inventories and the use of advanced remote sensing technologies.

Future Research Agenda

Future climate research priorities include investing in more detailed regional climate modelling to provide localized climate projections and impact assessments. There is also a focus on conducting comprehensive studies on the socio-economic impacts of climate change to inform vulnerable communities and develop resilience strategies. Furthermore, the agenda includes further integrating indigenous knowledge with scientific research to develop culturally relevant and effective adaptation solutions.

Chapter 8: Conclusions

Summary of Progress and Contributions

Zambia has demonstrated significant commitment and made tangible progress in strengthening its Research and Systematic Observations (RSO) capabilities. These efforts are crucial for understanding the evolving climate landscape and its impacts on key sectors. The RSO system provides the essential data and scientific insights that contribute directly to national climate action, informing the development and implementation of adaptation and mitigation strategies. This systematic approach also underpins Zambia's adherence to international reporting obligations under the UNFCCC. The Water Resources Management Authority (WARMA) plays an indispensable role in this national effort, specifically in hydrological monitoring, the development and operation of early warning systems for floods and droughts, and comprehensive water quality assessment, ensuring the sustainable management of this vital resource.

Call for Continued Support

Despite the progress achieved, the ongoing challenges posed by climate change necessitate sustained effort and investment. Zambia emphasizes the critical need for continued international support, including consistent financial investment, robust technology transfer, and targeted capacity building initiatives. Such support is vital to further enhance Zambia's RSO system, improve its accuracy and coverage, and ensure its full contribution to both national climate resilience and global climate efforts.

POLICY RECOMMENDATIONS

1. **Strengthen forest conservation, restoration and sustainable management**

- To integrate mandatory compensatory reforestation and forest restoration obligations into the Environmental Impact Assessment (EIA) process for projects involving large-scale land clearing, in order to mitigate greenhouse gas emissions and biodiversity loss.
- Implement and enforce land-use zoning that protects high-carbon forest ecosystems (including intact natural forests) and limits conversion of forest to agriculture or other uses.
- Adopt scalable afforestation and reforestation programmes across degraded forest landscapes, with clear targets and monitoring systems.
- Upgrade charcoal production technology: promote efficient charcoal kilns, sustainable harvest systems (e.g., coupe system) and improved cook-stoves to reduce biomass demand.
- Strengthen community forest management: incentivise local/traditional communities with benefit-sharing models, jobs in forest restoration, guardrails and capacity building.
- Improve forest monitoring, reporting and verification (MRV): deploy satellite, drone and field data systems to track tree-cover loss, illegal logging, and carbon stocks.

2. **Transition to climate-smart agriculture and sustainable land use**

- Promote agroforestry (trees integrated into cropland/pasture) to enhance carbon sequestration, improve yields, diversify income and reduce land-conversion pressure.
- Encourage sustainable land-management practices including minimum tillage, cover cropping, integrated soil fertility management, manure management and better grazing management.
- Upgrade livestock systems: improve animal health, feed quality, pasture management, herd productivity to reduce methane and nitrous oxide emissions per unit of output.
- Incorporate climate-smart agriculture (CSA) training for smallholder farmers: provide extension services, demonstration plots, financial incentives/subsidies for CSA adoption.
- Integrate land-use planning to avoid conversion of natural/semi-natural ecosystems to agriculture, and support intensification rather than expansion of agricultural area.
- Facilitate access to finance for smallholders to invest in sustainable practices (e.g., credit schemes, blended finance, risk-sharing).

3. **Improve energy access and reduce biomass dependency in rural areas**

- Expand rural electrification (especially renewable energy technologies: solar, mini-grids, biomass gasification) so that households shift away from fuelwood/charcoal.
- Promote and subsidise improved cook-stoves and alternative fuels (e.g., biogas, LPG) to reduce wood consumption and emissions from inefficient burning.
- Support sustainable charcoal value chains: ensure that charcoal producers use sustainable wood sources (e.g., plantation wood) and efficient kilns, while consumers shift to cleaner options.
- Integrate energy policy with land/forest policies

4. **Enhance MRV systems, data collection and institutional capacity**

- Establish a centralised MRV database, with annual reporting on deforestation rates, carbon stocks, emissions by sub-sector (forests, agriculture, livestock).
- Build capacity at provincial and district levels for data collection: livestock counts, feed intake/quality, pasture condition, soil carbo
- Use advanced remote sensing, GIS, drones and field verification to monitor land-cover change and validate carbon stock estimates.
- Create institutional coordination across ministries (Agriculture, Forestry/Environment, Energy, Livestock) and agencies (statistical service, environment agency) to ensure aligned policies and data flows.
- Integrate MRV into national-level planning (NDC, Green Growth Strategy 2024-2030) so that mitigation actions can be tracked and adjusted based on results.

5. **Mobilise finance and create incentive mechanisms**

- Develop and deploy payment-for-ecosystem-services (PES) schemes: e.g., communities rewarded for maintaining/enhancing forest carbon stocks.
- Leverage international climate finance, green bonds, private sector investment for AFOLU mitigation projects (forest projects, agroforestry, sustainable land management).

- Create fiscal incentives (tax breaks, subsidies, grants) for private investment in sustainable land use, low-carbon agriculture, efficient charcoal production and rural energy access.
- Integrate carbon crediting mechanisms: define national guidelines for carbon projects in AFOLU and other sectors, support smallholders' participation in carbon markets.
- Ensure benefit sharing and local participation so that incentives reach communities and create local ownership of mitigation actions.

ANNEXES

Annex I - Base year for Assessment of uncertainty in trend: 1990, Year T: 2022

2006 IPCC Categories	Gas	Base Year emissions or removals (Gg CO2 equivalent)	Year T emissions or removals (Gg CO2 equivalent)	Activity Data Uncertainty (%)	Emission Factor Uncertainty (%)	Combined Uncertainty (%)	Contribution to Variance by Category in Year T	Inventory trend in national emissions for year t increase with respect to base year (% of base year)	Uncertainty introduced into the trend in total national emissions (%)
1 – Energy									
1.A.1 - Energy Industries - Liquid Fuels	CO2	152.72208	23.228127	7.071067812	9.899494937	12.16552506	1.31254E-05	15.2094098	0.000153792
1.A.1 - Energy Industries - Liquid Fuels	CH4	0.0030051	0.00094041	7.071067812	141.4213562	141.5980226	2.91456E-12	31.29380054	1.061E-11
1.A.1 - Energy Industries - Liquid Fuels	N2O	0.00036243	0.000188082	7.071067812	141.4213562	141.5980226	1.16582E-13	51.8947107	2.20043E-13
1.A.1 - Energy Industries - Solid Fuels	CO2	0	3517.02763	5	7	8.602325267	0.300910366	0	0.284859895
1.A.1 - Energy Industries - Solid Fuels	CH4	0	0.036597582	5	100	100.124922	4.41411E-09	0	3.13123E-09
1.A.1 - Energy Industries - Solid Fuels	N2O	0	0.054896373	5	100	100.124922	9.93174E-09	0	7.04527E-09
1.A.1 - Energy Industries - Biomass – solid	CO2	0	0	5	7	8.602325267	0	100	0
1.A.1 - Energy Industries - Biomass – solid	CH4	0	0.35721156	5	100	100.124922	4.20523E-07	0	2.98306E-07
1.A.1 - Energy Industries - Biomass – solid	N2O	0	0.047628208	5	100	100.124922	7.47596E-09	0	5.30321E-09
1.A.1 - Energy Industries	CO2	0	0	5	5	7.071067812	0	100	0
1.A.1 - Energy Industries	CH4	0	0	5	5	7.071067812	0	100	0
1.A.1 - Energy Industries	N2O	0	0	5	5	7.071067812	0	100	0
1.A.2 - Manufacturing Industries and Construction - Liquid Fuels	CO2	303.6742949	1806.548629	25.98076211	12.12435565	28.67054237	0.155047151	594.8967891	0.178229352
1.A.2 - Manufacturing Industries and Construction - Liquid Fuels	CH4	0.011914514	0.073510937	25.98076211	173.2050808	175.1427989	9.50516E-09	616.9864683	8.0557E-09
1.A.2 - Manufacturing Industries and Construction - Liquid Fuels	N2O	0.002381076	0.014696086	25.98076211	173.2050808	175.1427989	3.79841E-10	617.2035338	3.21925E-10

1.A.2 - Manufacturing Industries and Construction - Solid Fuels	CO2	915.1359873	1685.324381	21.21320344	9.899494937	23.40939982	0.130778973	184.161087	0.14021241
1.A.2 - Manufacturing Industries and Construction - Solid Fuels	CH4	0.09596193	0.17738064	21.21320344	141.4213562	143.0034965	5.41066E-08	184.8448025	6.5638E-08
1.A.2 - Manufacturing Industries and Construction - Solid Fuels	N2O	0.01439429	0.026607096	21.21320344	141.4213562	143.0034965	1.2174E-09	184.8448025	1.47685E-09
1.A.2 - Manufacturing Industries and Construction - Biomass – solid	CO2	0	0	15.8113883	18.91441519	24.65268955	0	100	0
1.A.2 - Manufacturing Industries and Construction - Biomass – solid	CH4	1.3747712	1.3026176	15.8113883	243.6856911	244.1981082	2.34095E-05	94.75159212	5.42574E-05
1.A.2 - Manufacturing Industries and Construction - Biomass – solid	N2O	0.05565436	0.04900276	15.8113883	388.9087297	389.2300091	3.56376E-08	88.04837572	6.38864E-08
1.A.3.a - Civil Aviation - Liquid Fuels	CO2	117.4418	104.1066856	21.21320344	7.071067812	22.36067977	0.000649039	88.64534225	0.0009861
1.A.3.a - Civil Aviation - Liquid Fuels	CH4	0.000821388	0.000728898	21.21320344	141.4213562	143.0034965	1.29884E-12	88.73978482	3.72877E-12
1.A.3.a - Civil Aviation - Liquid Fuels	N2O	0.00328555	0.00291559	21.21320344	212.1320344	213.1900561	4.61866E-11	88.73978482	1.33456E-10
1.A.3.b - Road Transportation - Liquid Fuels	CO2	424.2347883	3091.164892	15	5	15.8113883	0.785304745	728.6448394	1.06938197
1.A.3.b - Road Transportation - Liquid Fuels	CH4	0.085614798	0.562732584	15	100	101.1187421	1.06444E-06	657.2842513	9.7039E-07
1.A.3.b - Road Transportation - Liquid Fuels	N2O	0.021363584	0.244239063	15	150	150.7481343	4.45644E-07	1143.249469	3.66098E-07
1.A.3.b - Road Transportation	CO2	0	0	0	0	0	0	100	0
1.A.3.c - Railways - Liquid Fuels	CO2	15.262377	31.0823565	5	2.024291498	5.394233594	9.24147E-06	203.6534447	1.30756E-05
1.A.3.c - Railways - Liquid Fuels	CH4	0.000854776	0.00174078	5	150.6024096	150.6853868	2.26195E-11	203.6534447	3.19588E-11
1.A.3.c - Railways - Liquid Fuels	N2O	0.005890742	0.011996699	5	200	200.0624902	1.89369E-09	203.6534447	2.67556E-09
1.A.3.e - Other Transportation - Liquid Fuels	CO2	4.43586	0	15	5	15.8113883	0	0	8.09714E-08
1.A.3.e - Other Transportation - Liquid Fuels	CH4	0	0	15	100	101.1187421	0	100	0
1.A.3.e - Other Transportation - Liquid Fuels	N2O	0	0	15	150	150.7481343	0	100	0
1.A.4 - Other Sectors - Liquid Fuels	CO2	275.8160408	618.0440151	25.98076211	11.09053651	28.24889378	0.021012055	224.0783434	0.027750657
1.A.4 - Other Sectors - Liquid Fuels	CH4	0.035450822	0.073690643	25.98076211	206.1552813	207.7859476	1.36196E-08	207.8672366	1.73064E-08
1.A.4 - Other Sectors - Liquid Fuels	N2O	0.012902019	0.04555234	25.98076211	206.1552813	207.7859476	1.30286E-08	353.0636653	1.37187E-08
1.A.4 - Other Sectors - Biomass – solid	CO2	0	0	15.8113883	18.91441519	24.65268955	0	100	0
1.A.4 - Other Sectors - Biomass – solid	CH4	32.909938	58.57515026	15.8113883	223.6067977	224.1651177	0.010767	177.9862067	0.016152203
1.A.4 - Other Sectors - Biomass – solid	N2O	0.40974659	0.676815034	15.8113883	269.2582404	269.7220792	1.42955E-06	165.1789303	2.23694E-06

1.A.5 - Non-Specified - Liquid Fuels	CO2	10.29760582	25.65895952	5	5	7.071067812	1.08219E-05	249.1740311	1.45079E-05
1.A.5 - Non-Specified - Liquid Fuels	CH4	0.000346736	0.000545289	5	5	7.071067812	4.88739E-15	157.2633193	7.53209E-15
1.A.5 - Non-Specified - Liquid Fuels	N2O	6.93472E-05	0.000109058	5	5	7.071067812	1.95496E-16	157.2633193	3.01283E-16
1.B.1.a - Coal mining and handling	CO2	0.002794482	0.034849048	0	0	0	0	1247.066647	0
1.B.1.a - Coal mining and handling	CH4	0.854746872	10.65926316	5	0	5	0	1247.066647	0
1.B.1.c - Fuel transformation	CO2	0	0	0	0	0	0	100	0
1.B.1.c - Fuel transformation	CH4	699.15664	2516.10632	0	0	0	0	359.8773402	0
1.B.1.c - Fuel transformation	N2O	13.13552	47.27176	0	0	0	0	359.8773402	0
1.B.2.a – Oil	CO2	3.78729	0	0	0	0	0	0	0
1.B.2.a – Oil	CH4	0.543816	0	0	0	0	0	0	0
1.B.2.a – Oil	N2O	0.0150459	0	0	0	0	0	0	0
1.B.2.b - Natural Gas	CO2	0	0	0	0	0	0	100	0
1.B.2.b - Natural Gas	CH4	0	0	0	0	0	0	100	0
1.B.2.b - Natural Gas	N2O	0	0	0	0	0	0	100	0
1.B.3 - Other emissions from Energy Production	CO2	0	0	0	0	0	0	100	0
1.B.3 - Other emissions from Energy Production	CH4	0	0	0	0	0	0	100	0
1.B.3 - Other emissions from Energy Production	N2O	0	0	0	0	0	0	100	0
1.C - Carbon dioxide Transport and Storage	CO2	0	0	0	0	0	0	100	0
2 - Industrial Processes and Product Use									
2.A.1 - Cement production	CO2	149.03512	512.93476	70.17834424	5	70.3562364	0.42813756	344.1703942	0.605213645
2.A.2 - Lime production	CO2	880.894395	1123.036505	51.96152423	5	52.20153254	1.129817044	127.488211	1.604470632
2.A.3 - Glass Production	CO2	0	0	35.35533906	0	35.35533906	0	100	0
2.A.4 - Other Process Uses of Carbonates	CO2	0	0	0	0	0	0	100	0
2.A.5 - Other (please specify)	CO2	0	0	0	0	0	0	100	0
2.A.5 - Other (please specify)	CH4	0	0	0	0	0	0	100	0
2.A.5 - Other (please specify)	N2O	0	0	0	0	0	0	100	0
2.B.1 - Ammonia Production	CO2	43.5219125	0	5	0	5	0	0	0

2.B.2 - Nitric Acid Production	N2O	56.436255	0	2	0	2	0	0	0
2.B.3 - Adipic Acid Production	N2O	0	0	2	0	2	0	100	0
2.B.4 - Caprolactam, Glyoxal and Glyoxylic Acid Production	N2O	0	0	10	0	10	0	100	0
2.B.5 - Carbide Production	CO2	0	0	0	0	0	0	100	0
2.B.5 - Carbide Production	CH4	0	0	0	0	0	0	100	0
2.B.6 - Titanium Dioxide Production	CO2	0	0	7.071067812	0	7.071067812	0	100	0
2.B.7 - Soda Ash Production	CO2	0	0	5	0	5	0	100	0
2.B.8 - Petrochemical and Carbon Black Production	CO2	0	0	34.64101615	0	34.64101615	0	100	0
2.B.8 - Petrochemical and Carbon Black Production	CH4	0	0	24.49489743	0	24.49489743	0	100	0
2.B.9 - Fluorochemical Production	CHF3	0	0	14.14213562	0	14.14213562	0	100	0
2.B.10 - Hydrogen Production	CO2	0	0	0	0	0	0	100	0
2.B.10 - Hydrogen Production	CH4	0	0	0	0	0	0	100	0
2.B.10 - Hydrogen Production	N2O	0	0	0	0	0	0	100	0
2.C.1 - Iron and Steel Production	CO2	0.8716776	19.2342004	26.45751311	25	36.40054945	0.000161145	2206.572751	0.000178447
2.C.1 - Iron and Steel Production	CH4	0	0	14.14213562	0	14.14213562	0	100	0
2.C.2 - Ferroalloys Production	CO2	0	0	26.45751311	0	26.45751311	0	100	0
2.C.2 - Ferroalloys Production	CH4	0	0	10	0	10	0	100	0
2.C.3 - Aluminium production	CO2	0	0	22.36067977	0	22.36067977	0	100	0
2.C.3 - Aluminium production	CF4	0	0	10.39230485	0	10.39230485	0	100	0
2.C.3 - Aluminium production	C2F6	0	0	10.39230485	0	10.39230485	0	100	0
2.C.4 - Magnesium production	CO2	0	0	14.14213562	0	14.14213562	0	100	0
2.C.5 - Lead Production	CO2	5.512	0.0183	10	0	10	1.10092E-11	0.332002903	1.55803E-11
2.C.6 - Zinc Production	CO2	7.052	0	10	0	10	0	0	0
2.C.7 - Rare Earths Production	CO2	0	0	0	0	0	0	100	0
2.D - Non-Energy Products from Fuels and Solvent Use	CO2	17.74197333	18.84344	14.14213562	0	14.14213562	1.16728E-05	106.2082534	1.65194E-05
2.D - Non-Energy Products from Fuels and Solvent Use	CH4	0	0	0	0	0	0	100	0
2.D - Non-Energy Products from Fuels and Solvent Use	N2O	0	0	0	0	0	0	100	0

2.E - Electronics Industry	N2O	0	0	0	0	0	0	100	0
2.E - Electronics Industry	CF4	0	0	0	0	0	0	100	0
2.E - Electronics Industry	SF6	0	0	0	0	0	0	100	0
2.F.1 - Refrigeration and Air Conditioning	CH2 FCF3	0.234	69.28104105	50	0	50	0.003944779	29607.2825	0.005582688
2.F.1 - Refrigeration and Air Conditioning	SF6	0	0	0	0	0	0	100	0
2.G - Other Product Manufacture and Use	SF6	0.0004935	0.915936	30	30	42.42640687	4.96428E-07	185600	5.27072E-07
2.G - Other Product Manufacture and Use	N2O	0	0	0	0	0	0	100	0
2.H - Other	CO2	0	0	0	0	0	0	100	0
2.H - Other	CH4	0	0	0	0	0	0	100	0
2.H - Other	N2O	0	0	0	0	0	0	100	0
3 - Agriculture, Forestry, and Other Land Use									
3.A.1 - Enteric Fermentation	CH4	5960.384339	13021.61731	0	0	0	0	218.4694235	0
3.A.2 - Manure Management	CH4	212.2263151	501.71212	0	0	0	0	236.4042931	0
3.A.2 - Manure Management	N2O	24.97810292	63.43046346	0	0	0	0	253.9442794	0
3.B.1.a - Forest land Remaining Forest land	CO2	-84325.6527	-9976.514419	10	10	14.14213562	6.54397352	0	153.0721564
3.B.1.b - Land Converted to Forest land	CO2	-670.5569374	-1966.449959	12.24744871	12.24744871	17.32050808	0.381365078	0	0.493246685
3.B.2.a - Cropland Remaining Cropland	CO2	0	0	0	0	0	0	100	0
3.B.2.b - Land Converted to Cropland	CO2	4458.993069	8505.389243	12.24744871	12.24744871	17.32050808	4.513231855	190.7468595	6.499584795
3.B.3.a - Grassland Remaining Grassland	CO2	0	0	0	0	0	0	100	0
3.B.3.b - Land Converted to Grassland	CO2	2207.324648	20522.53528	13.22875656	13.22875656	18.70828693	12.47096119	929.7470264	13.45720836
3.B.4.a.i - Peat Extraction remaining Peat Extraction	CO2	0	0	0	0	0	0	100	0
3.B.4.a.iii - Other Wetlands Remaining Other Wetlands	CO2	0	0	0	0	0	0	100	0
3.B.4.b.i - Land converted for Peat Extraction	CO2	0	0	0	0	0	0	100	0
3.B.4.b.ii - Land converted to Flooded Land	CO2	41.57970432	41.57970432	0	0	0	0	100	0
3.B.4.b.iii - Land converted to Other Wetlands	CO2	0	0	0	0	0	0	100	0

3.B.5.a - Settlements Remaining Settlements	CO2	0	0	0	0	0	0	100	0
3.B.5.b - Land Converted to Settlements	CO2	362.0246464	362.0246464	11.18033989	11.18033989	15.8113883	0.002270124	100	0.004259694
3.B.6.b - Land Converted to Other land	CO2	0	0	0	0	0	0	100	0
3.C.1 - Burning	CO2	0	0	21.79449472	161.7096163	163.1716887	0	100	0
3.C.1 - Burning	CH4	715.4862074	3261.510904	21.79449472	20.14000993	29.67524221	0.116778224	455.8453915	0.137181438
3.C.1 - Burning	N2O	280.783044	2018.699457	21.79449472	0.173205081	21.79518295	0.025569067	718.953477	0.032423351
3.C.2 - Liming	CO2	1.2151315	8.18191	10	5	11.18033989	2.75089E-06	673.3353551	3.60713E-06
3.C.3 - Urea application	CO2	30.8966834	112.6319452	10	5	11.18033989	0.000521299	364.5438048	0.000701949
3.C.4 - Direct N2O Emissions from managed soils	N2O	100.0360012	989.0631752	11.18033989	14.14213562	18.02775638	0.104516605	988.7072284	0.110476563
3.C.5 - Indirect N2O Emissions from managed soils	N2O	19.00697783	131.3649728	18.02775638	15.00033333	23.452292	0.003120208	691.1407694	0.003745759
3.C.6 - Indirect N2O Emissions from manure management	N2O	0	0.320514266	0	0	0	0	0	0
3.C.7 - Rice cultivation	CH4	27.56361289	178.9520179	15	30	33.54101966	0.011843487	649.2328077	0.011906572
3.C.8 - CH4 from Drained Organic Soils	CH4	0	0	0	0	0	0	100	0
3.C.9 - CH4 from Drainage Ditches on Organic Soils	CH4	0	0	0	0	0	0	100	0
3.C.10 - CH4 from Rewetting of Organic Soils	CH4	0	0	0	0	0	0	100	0
3.C.11 - CH4 Emissions from Rewetting of Mangroves and Tidal Marshes	CH4	0	0	0	0	0	0	100	0
3.C.12 - N2O Emissions from Aquaculture	N2O	0	0	0	0	0	0	100	0
3.C.13 - CH4 Emissions from Rewetted and Created Wetlands on Inland Wetland Mineral Soils	CH4	0	0	0	0	0	0	100	0
3.C.14 - Other (please specify)	CO2	0	0	0	0	0	0	100	0
3.C.14 - Other (please specify)	CH4	0	0	0	0	0	0	100	0
3.C.14 - Other (please specify)	N2O	0	0	0	0	0	0	100	0
3.D.1 - Harvested Wood Products	CO2	0	0	0	0	0	0	100	0
3.D.2 - Other (please specify)	CO2	0	0	0	0	0	0	100	0
3.D.2 - Other (please specify)	CH4	0	0	0	0	0	0	100	0
3.D.2 - Other (please specify)	N2O	0	0	0	0	0	0	100	0

4 – Waste									
4.A - Solid Waste Disposal	CH4	563.1304177	1474.350632	0	0	0	0	261.8133537	0
4.B - Biological Treatment of Solid Waste	CH4	0	0	0	0	0	0	100	0
4.B - Biological Treatment of Solid Waste	N2O	0	0	0	0	0	0	100	0
4.C - Incineration and Open Burning of Waste	CO2	0.161211277	0.419842129	0	0	0	0	260.4297517	0
4.C - Incineration and Open Burning of Waste	CH4	2.01947866	5.259323261	0	0	0	0	260.4297517	0
4.C - Incineration and Open Burning of Waste	N2O	0.234471459	0.610633438	0	0	0	0	260.4297517	0
4.D - Wastewater Treatment and Discharge	CH4	289.4503032	613.9492266	0	0	0	0	212.1086832	0
4.D - Wastewater Treatment and Discharge	N2O	0	0	0	0	0	0	100	0
4.E - Other (please specify)	CO2	0	0	0	0	0	0	100	0
4.E - Other (please specify)	CH4	0	0	0	0	0	0	100	0
4.E - Other (please specify)	N2O	0	0	0	0	0	0	100	0
5 – Other									
5.A - Indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3	N2O	0	0	0	0	0	0	100	0
5.B - Indirect CO2 emissions from the atmospheric oxidation of CH4, CO and NMVOC	CO2	0	0	0	0	0	0	100	0
Total									
		Sum(C): -65565.854	Sum(D): 55153.498			Sum(H): 27.141		Sum(M): 177.756	
						Uncertainty in total inventory: 5.210		Trend uncertainty: 13.333	

Annex II: Key Category Analysis – Approach 1 Level Assessment

A	B	C	D	E	F	G
IPCC Category code	**IPCC Category**	**Greenhouse gas**	**2022 Ex,t (Gg CO2 Eq)**	**|Ex,t| (Gg CO2 Eq)**	**Lx,t**	Cumulative Total of Column F
3.B.1.a	Forest land Remaining Forest land	CARBON DIOXIDE (CO2)	-9976.51	306923.14	0.81	0.81
3.B.3.b	Land Converted to Grassland	CARBON DIOXIDE (CO2)	20522.54	21129.04	0.06	0.87
3.A.1	Enteric Fermentation	METHANE (CH4)	13021.62	13021.62	0.03	0.90
3.B.2.b	Land Converted to Cropland	CARBON DIOXIDE (CO2)	8505.39	8516.85	0.02	0.92
1.A.1	Energy Industries - Solid Fuels	CARBON DIOXIDE (CO2)	3517.03	3517.03	0.01	0.93
3.C.1	Burning	METHANE (CH4)	3261.51	3261.51	0.01	0.94
1.A.3.b	Road Transportation - Liquid Fuels	CARBON DIOXIDE (CO2)	3091.16	3091.16	0.01	0.95
1.B.1.c	Fuel transformation	METHANE (CH4)	2516.11	2516.11	0.01	0.96
3.C.1	Burning	NITROUS OXIDE (N2O)	2018.70	2018.70	0.01	0.96
3.B.1.b	Land Converted to Forest land	CARBON DIOXIDE (CO2)	-1966.45	1976.99	0.01	0.97
1.A.2	Manufacturing Industries and Construction - Liquid Fuels	CARBON DIOXIDE (CO2)	1806.55	1806.55	0.00	0.97
1.A.2	Manufacturing Industries and Construction - Solid Fuels	CARBON DIOXIDE (CO2)	1685.32	1685.32	0.00	0.98
1.A.4	Other Sectors - Biomass - solid	METHANE (CH4)	1640.10	1640.10	0.00	0.98
4.A	Solid Waste Disposal	METHANE (CH4)	1474.35	1474.35	0.00	0.98
2.A.2	Lime production	CARBON DIOXIDE (CO2)	1123.04	1123.04	0.00	0.99
3.C.4	Direct N2O Emissions from managed soils	NITROUS OXIDE (N2O)	989.06	989.06	0.00	0.99
1.A.4	Other Sectors - Liquid Fuels	CARBON DIOXIDE (CO2)	618.04	618.04	0.00	0.99
4.D	Wastewater Treatment and Discharge	METHANE (CH4)	613.95	613.95	0.00	0.99
3.B.5.b	Land Converted to Settlements	CARBON DIOXIDE (CO2)	362.02	548.70	0.00	0.99
2.A.1	Cement production	CARBON DIOXIDE (CO2)	512.93	512.93	0.00	1.00
3.A.2	Manure Management	METHANE (CH4)	501.71	501.71	0.00	1.00
1.A.4	Other Sectors - Biomass - solid	NITROUS OXIDE (N2O)	179.36	179.36	0.00	1.00

3.C.7	Rice cultivation	METHANE (CH4)	178.95	178.95	0.00	1.00
3.C.5	Indirect N2O Emissions from managed soils	NITROUS OXIDE (N2O)	131.36	131.36	0.00	1.00
3.C.3	Urea application	CARBON DIOXIDE (CO2)	112.63	112.63	0.00	1.00
2.F.1	Refrigeration and Air Conditioning	HFCs, PFCs	69.28	69.28	0.00	1.00
1.A.3.b	Road Transportation - Liquid Fuels	NITROUS OXIDE (N2O)	64.72	64.72	0.00	1.00
3.A.2	Manure Management	NITROUS OXIDE (N2O)	63.43	63.43	0.00	1.00
1.B.1.c	Fuel transformation	NITROUS OXIDE (N2O)	47.27	47.27	0.00	1.00
3.B.4.b.ii	Land converted to Flooded Land	CARBON DIOXIDE (CO2)	41.58	41.58	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Biomass - solid	METHANE (CH4)	36.47	36.47	0.00	1.00
1.A.3.c	Railways - Liquid Fuels	CARBON DIOXIDE (CO2)	31.08	31.08	0.00	1.00
1.A.5	Non-Specified - Liquid Fuels	CARBON DIOXIDE (CO2)	25.66	25.66	0.00	1.00
1.A.1	Energy Industries - Liquid Fuels	CARBON DIOXIDE (CO2)	23.23	23.23	0.00	1.00
2.C.1	Iron and Steel Production	CARBON DIOXIDE (CO2)	19.23	19.23	0.00	1.00
2.D	Non-Energy Products from Fuels and Solvent Use	CARBON DIOXIDE (CO2)	18.84	18.84	0.00	1.00
1.A.3.a	Civil Aviation - Liquid Fuels	CARBON DIOXIDE (CO2)	16.85	16.85	0.00	1.00
1.A.3.b	Road Transportation - Liquid Fuels	METHANE (CH4)	15.76	15.76	0.00	1.00
1.A.1	Energy Industries - Solid Fuels	NITROUS OXIDE (N2O)	14.55	14.55	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Biomass - solid	NITROUS OXIDE (N2O)	12.99	12.99	0.00	1.00
1.A.1	Energy Industries - Biomass - solid	NITROUS OXIDE (N2O)	12.62	12.62	0.00	1.00
1.A.4	Other Sectors - Liquid Fuels	NITROUS OXIDE (N2O)	12.07	12.07	0.00	1.00
1.B.1.a	Coal mining and handling	METHANE (CH4)	10.66	10.66	0.00	1.00
1.A.1	Energy Industries - Biomass - solid	METHANE (CH4)	10.00	10.00	0.00	1.00
3.C.2	Liming	CARBON DIOXIDE (CO2)	8.18	8.18	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Solid Fuels	NITROUS OXIDE (N2O)	7.05	7.05	0.00	1.00
4.C	Incineration and Open Burning of Waste	METHANE (CH4)	5.26	5.26	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Solid Fuels	METHANE (CH4)	4.97	4.97	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Liquid Fuels	NITROUS OXIDE (N2O)	3.89	3.89	0.00	1.00

1.A.3.c	Railways - Liquid Fuels	NITROUS OXIDE (N2O)	3.18	3.18	0.00	1.00
1.A.4	Other Sectors - Liquid Fuels	METHANE (CH4)	2.06	2.06	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Liquid Fuels	METHANE (CH4)	2.06	2.06	0.00	1.00
1.A.1	Energy Industries - Solid Fuels	METHANE (CH4)	1.02	1.02	0.00	1.00
2.G	Other Product Manufacture and Use	SF6, PFCs	0.92	0.92	0.00	1.00
4.C	Incineration and Open Burning of Waste	NITROUS OXIDE (N2O)	0.61	0.61	0.00	1.00
4.C	Incineration and Open Burning of Waste	CARBON DIOXIDE (CO2)	0.42	0.42	0.00	1.00
3.C.6	Indirect N2O Emissions from manure management	NITROUS OXIDE (N2O)	0.32	0.32	0.00	1.00
1.A.3.a	Civil Aviation - Liquid Fuels	NITROUS OXIDE (N2O)	0.13	0.13	0.00	1.00
1.A.1	Energy Industries - Liquid Fuels	NITROUS OXIDE (N2O)	0.05	0.05	0.00	1.00
1.A.3.c	Railways - Liquid Fuels	METHANE (CH4)	0.05	0.05	0.00	1.00
1.B.1.a	Coal mining and handling	CARBON DIOXIDE (CO2)	0.03	0.03	0.00	1.00
1.A.5	Non-Specified - Liquid Fuels	NITROUS OXIDE (N2O)	0.03	0.03	0.00	1.00
1.A.1	Energy Industries - Liquid Fuels	METHANE (CH4)	0.03	0.03	0.00	1.00
2.C.5	Lead Production	CARBON DIOXIDE (CO2)	0.02	0.02	0.00	1.00
1.A.5	Non-Specified - Liquid Fuels	METHANE (CH4)	0.02	0.02	0.00	1.00
1.A.3.a	Civil Aviation - Liquid Fuels	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Gaseous Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Peat	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Biomass - solid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Biomass - liquid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Biomass - gas	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Biomass - other	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Gaseous Fuels	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Other Fossil Fuels	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Peat	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Biomass - liquid	METHANE (CH4)	0.00	0.00	0.00	1.00

1.A.1	Energy Industries - Biomass - gas	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Biomass - other	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Gaseous Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Other Fossil Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.1	Energy Industries – Peat	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Biomass - liquid	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Biomass - gas	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Biomass - other	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.1	Energy Industries	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.1	Energy Industries	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Peat	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Biomass - solid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Biomass - liquid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Biomass - gas	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Biomass - other	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Other Fossil Fuels	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Peat	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Biomass - liquid	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Biomass - gas	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Biomass - other	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Other Fossil Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Peat	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00

1.A.2	Manufacturing Industries and Construction - Biomass - liquid	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Biomass - gas	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Biomass - other	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Solid Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Gaseous Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Biomass - solid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Biomass - liquid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Biomass - gas	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Biomass - other	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Solid Fuels	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Gaseous Fuels	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Other Fossil Fuels	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Biomass - solid	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Biomass - liquid	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Biomass - gas	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Biomass - other	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Solid Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Gaseous Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Other Fossil Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Biomass - solid	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Biomass - liquid	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Biomass - gas	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Biomass - other	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Solid Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Gaseous Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Biomass - solid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00

1.A.3.b	Road Transportation - Biomass - liquid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Biomass - gas	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Biomass - other	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Solid Fuels	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Gaseous Fuels	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Other Fossil Fuels	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Biomass - solid	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Biomass - liquid	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Biomass - gas	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Biomass - other	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Solid Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Gaseous Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Other Fossil Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Biomass - solid	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Biomass - liquid	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Biomass - gas	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Biomass - other	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Solid Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Gaseous Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Biomass - solid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Biomass - liquid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Biomass - gas	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Biomass - other	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Solid Fuels	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Gaseous Fuels	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Other Fossil Fuels	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Biomass - solid	METHANE (CH4)	0.00	0.00	0.00	1.00

1.A.3.c	Railways - Biomass - liquid	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Biomass - gas	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Biomass - other	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Solid Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Gaseous Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Other Fossil Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Biomass - solid	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Biomass - liquid	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Biomass - gas	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Biomass - other	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Liquid Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Solid Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Gaseous Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Biomass - solid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Biomass - liquid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Biomass - gas	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Biomass - other	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Liquid Fuels	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Solid Fuels	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Gaseous Fuels	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Other Fossil Fuels	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Biomass - solid	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Biomass - liquid	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Biomass - gas	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Biomass - other	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Liquid Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Solid Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Gaseous Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00

1.A.3.d	Water-borne Navigation - Other Fossil Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Biomass - solid	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Biomass - liquid	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Biomass - gas	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Biomass - other	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Liquid Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Solid Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Gaseous Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Biomass - solid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Biomass - liquid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Biomass - gas	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Biomass - other	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Liquid Fuels	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Solid Fuels	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Gaseous Fuels	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Other Fossil Fuels	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Biomass - solid	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Biomass - liquid	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Biomass - gas	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Biomass - other	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Liquid Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Solid Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Gaseous Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Other Fossil Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Biomass - solid	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Biomass - liquid	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Biomass - gas	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Biomass - other	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00

1.A.4	Other Sectors - Solid Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Gaseous Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.4	Other Sectors – Peat	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Biomass - solid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Biomass - liquid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Biomass - gas	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Biomass - other	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Solid Fuels	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Gaseous Fuels	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Other Fossil Fuels	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Peat	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Biomass - liquid	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Biomass - gas	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Biomass - other	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Solid Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Gaseous Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Other Fossil Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Peat	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Biomass - liquid	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Biomass - gas	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Biomass - other	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Solid Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Gaseous Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Peat	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Biomass - solid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Biomass - liquid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Biomass - gas	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00

1.A.5	Non-Specified - Biomass - other	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Solid Fuels	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Gaseous Fuels	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Other Fossil Fuels	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.5	Non-Specified – Peat	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Biomass - solid	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Biomass - liquid	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Biomass - gas	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Biomass - other	METHANE (CH4)	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Solid Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Gaseous Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Other Fossil Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.5	Non-Specified – Peat	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Biomass - solid	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Biomass - liquid	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Biomass - gas	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Biomass - other	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.B.2.a	Oil	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.B.2.a	Oil	METHANE (CH4)	0.00	0.00	0.00	1.00
1.B.2.a	Oil	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.B.2.b	Natural Gas	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.B.2.b	Natural Gas	METHANE (CH4)	0.00	0.00	0.00	1.00
1.B.2.b	Natural Gas	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.B.3	Other emissions from Energy Production	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.B.3	Other emissions from Energy Production	METHANE (CH4)	0.00	0.00	0.00	1.00
1.B.3	Other emissions from Energy Production	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.C	Carbon dioxide Transport and Storage	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
2.A.3	Glass Production	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
2.A.4	Other Process Uses of Carbonates	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00

2.A.5	Other (please specify)	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
2.A.5	Other (please specify)	METHANE (CH4)	0.00	0.00	0.00	1.00
2.A.5	Other (please specify)	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
2.B.1	Ammonia Production	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
2.B.2	Nitric Acid Production	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
2.B.3	Adipic Acid Production	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
2.B.4	Caprolactam, Glyoxal and Glyoxylic Acid Production	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
2.B.5	Carbide Production	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
2.B.5	Carbide Production	METHANE (CH4)	0.00	0.00	0.00	1.00
2.B.6	Titanium Dioxide Production	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
2.B.7	Soda Ash Production	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
2.B.8	Petrochemical and Carbon Black Production	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
2.B.8	Petrochemical and Carbon Black Production	METHANE (CH4)	0.00	0.00	0.00	1.00
2.B.9	Fluorochemical Production	SF6, PFCs, HFCs and other halogenated gases	0.00	0.00	0.00	1.00
2.C.1	Iron and Steel Production - Solid Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
2.C.1	Iron and Steel Production - Solid Fuels	METHANE (CH4)	0.00	0.00	0.00	1.00
2.C.1	Iron and Steel Production	METHANE (CH4)	0.00	0.00	0.00	1.00
2.C.2	Ferroalloys Production	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
2.C.2	Ferroalloys Production	METHANE (CH4)	0.00	0.00	0.00	1.00
2.C.3	Aluminium production	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
2.C.3	Aluminium production	PFCs (PFCs)	0.00	0.00	0.00	1.00
2.C.4	Magnesium production	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
2.C.6	Zinc Production	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
2.D	Non-Energy Products from Fuels and Solvent Use	METHANE (CH4)	0.00	0.00	0.00	1.00
2.D	Non-Energy Products from Fuels and Solvent Use	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
2.E	Electronics Industry	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
2.E	Electronics Industry	SF6, PFCs, HFCs and other halogenated gases	0.00	0.00	0.00	1.00
2.G	Other Product Manufacture and Use	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00

2.H	Other	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
2.H	Other	METHANE (CH4)	0.00	0.00	0.00	1.00
2.H	Other	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
3.B.2.a	Cropland Remaining Cropland	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
3.B.3.a	Grassland Remaining Grassland	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
3.B.4.a.i	Peat Extraction remaining Peat Extraction	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
3.B.4.a.iii	Other Wetlands Remaining Other Wetlands	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
3.B.4.b.i	Land converted for Peat Extraction	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
3.B.4.b.iii	Land converted to Other Wetlands	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
3.B.5.a	Settlements Remaining Settlements	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
3.B.6.b	Land Converted to Other land	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
3.C.1	Burning	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
3.C.10	CH4 from Rewetting of Organic Soils	METHANE (CH4)	0.00	0.00	0.00	1.00
3.C.11	CH4 Emissions from Rewetting of Mangroves and Tidal Marshes	METHANE (CH4)	0.00	0.00	0.00	1.00
3.C.12	N2O Emissions from Aquaculture	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
3.C.13	CH4 Emissions from Rewetted and Created Wetlands on Inland Wetland Mineral Soils	METHANE (CH4)	0.00	0.00	0.00	1.00
3.C.14	Other (please specify)	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
3.C.14	Other (please specify)	METHANE (CH4)	0.00	0.00	0.00	1.00
3.C.14	Other (please specify)	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
3.C.8	CH4 from Drained Organic Soils	METHANE (CH4)	0.00	0.00	0.00	1.00
3.C.9	CH4 from Drainage Ditches on Organic Soils	METHANE (CH4)	0.00	0.00	0.00	1.00
3.D.1	Harvested Wood Products	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
3.D.2	Other (please specify)	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
3.D.2	Other (please specify)	METHANE (CH4)	0.00	0.00	0.00	1.00
3.D.2	Other (please specify)	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
4.B	Biological Treatment of Solid Waste	METHANE (CH4)	0.00	0.00	0.00	1.00
4.B	Biological Treatment of Solid Waste	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
4.D	Wastewater Treatment and Discharge	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00

4.E	Other (please specify)	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
4.E	Other (please specify)	METHANE (CH4)	0.00	0.00	0.00	1.00
4.E	Other (please specify)	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
5.A	Indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
5.B	Indirect CO2 emissions from the atmospheric oxidation of CH4, CO and NMVOC	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.B.1.b	Uncontrolled combustion and burning coal dumps - Solid Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
1.B.1.b	Uncontrolled combustion and burning coal dumps - Solid Fuels	METHANE (CH4)	0.00	0.00	0.00	1.00
1.B.1.b	Uncontrolled combustion and burning coal dumps - Solid Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
1.B.1.c	Fuel transformation	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
2.B.10	Hydrogen Production	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
2.B.10	Hydrogen Production	METHANE (CH4)	0.00	0.00	0.00	1.00
2.B.10	Hydrogen Production	NITROUS OXIDE (N2O)	0.00	0.00	0.00	1.00
2.C.7	Rare Earths Production	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	1.00
Total						
			57027.08418	378674.82211	1	

Annex III: Key Category Analysis – Approach 1 Trend Assessment

A	B	C	D	E	F	G	H
IPCC Category code	**IPCC Category**	**Greenhouse gas**	**1990 Year Estimate Ex0 (Gg CO2 Eq)**	**2022 Year Estimate Ext (Gg CO2 Eq)**	**Trend Assessment (Txt)**	**% Contribution to Trend**	**Cumulative Total of Column G**
3.B.1.a	Forest land Remaining Forest land	CARBON DIOXIDE (CO2)	-84325.65	-9976.51	0.80	0.67	0.67
3.B.3.b	Land Converted to Grassland	CARBON DIOXIDE (CO2)	2207.32	20522.54	0.13	0.11	0.78
3.B.2.b	Land Converted to Cropland	CARBON DIOXIDE (CO2)	4458.99	8505.39	0.04	0.03	0.82
3.A.1	Enteric Fermentation	METHANE (CH4)	5960.38	13021.62	0.04	0.03	0.85
1.A.1	Energy Industries - Solid Fuels	CARBON DIOXIDE (CO2)	0.00	3517.03	0.03	0.03	0.88
3.B.1.b	Land Converted to Forest land	CARBON DIOXIDE (CO2)	-670.56	-1966.45	0.02	0.02	0.90
1.A.3.b	Road Transportation - Liquid Fuels	CARBON DIOXIDE (CO2)	424.23	3091.16	0.02	0.01	0.91
2.A.2	Lime production	CARBON DIOXIDE (CO2)	880.89	1123.04	0.01	0.01	0.92
3.C.1	Burning	NITROUS OXIDE (N2O)	280.78	2018.70	0.01	0.01	0.93
3.C.1	Burning	METHANE (CH4)	715.49	3261.51	0.01	0.01	0.94
1.A.4	Other Sectors - Biomass - solid	METHANE (CH4)	921.48	1640.10	0.01	0.01	0.95
1.A.2	Manufacturing Industries and Construction - Solid Fuels	CARBON DIOXIDE (CO2)	915.14	1685.32	0.01	0.01	0.96
1.A.2	Manufacturing Industries and Construction - Liquid Fuels	CARBON DIOXIDE (CO2)	303.67	1806.55	0.01	0.01	0.97
3.C.4	Direct N2O Emissions from managed soils	NITROUS OXIDE (N2O)	100.04	989.06	0.01	0.01	0.97
3.B.5.b	Land Converted to Settlements	CARBON DIOXIDE (CO2)	362.02	362.02	0.01	0.01	0.98
1.B.1.c	Fuel transformation	METHANE (CH4)	699.16	2516.11	0.00	0.00	0.98
1.A.1	Energy Industries - Liquid Fuels	CARBON DIOXIDE (CO2)	152.72	23.23	0.00	0.00	0.99
4.D	Wastewater Treatment and Discharge	METHANE (CH4)	289.45	613.95	0.00	0.00	0.99
1.A.4	Other Sectors - Liquid Fuels	CARBON DIOXIDE (CO2)	275.82	618.04	0.00	0.00	0.99
2.B.2	Nitric Acid Production	NITROUS OXIDE (N2O)	56.44	0.00	0.00	0.00	0.99

4.A	Solid Waste Disposal	METHANE (CH4)	563.13	1474.35	0.00	0.00	0.99
1.A.4	Other Sectors - Biomass - solid	NITROUS OXIDE (N2O)	108.58	179.36	0.00	0.00	0.99
2.B.1	Ammonia Production	CARBON DIOXIDE (CO2)	43.52	0.00	0.00	0.00	0.99
3.A.2	Manure Management	METHANE (CH4)	212.23	501.71	0.00	0.00	0.99
3.C.7	Rice cultivation	METHANE (CH4)	27.56	178.95	0.00	0.00	0.99
2.A.1	Cement production	CARBON DIOXIDE (CO2)	149.04	512.93	0.00	0.00	1.00
3.B.4.b.ii	Land converted to Flooded Land	CARBON DIOXIDE (CO2)	41.58	41.58	0.00	0.00	1.00
3.C.5	Indirect N2O Emissions from managed soils	NITROUS OXIDE (N2O)	19.01	131.36	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Biomass - solid	METHANE (CH4)	38.49	36.47	0.00	0.00	1.00
2.F.1	Refrigeration and Air Conditioning	HFCs, PFCs	0.23	69.28	0.00	0.00	1.00
1.A.3.b	Road Transportation - Liquid Fuels	NITROUS OXIDE (N2O)	5.66	64.72	0.00	0.00	1.00
2.D	Non-Energy Products from Fuels and Solvent Use	CARBON DIOXIDE (CO2)	17.74	18.84	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Biomass - solid	NITROUS OXIDE (N2O)	14.75	12.99	0.00	0.00	1.00
3.C.3	Urea application	CARBON DIOXIDE (CO2)	30.90	112.63	0.00	0.00	1.00
2.C.6	Zinc Production	CARBON DIOXIDE (CO2)	7.05	0.00	0.00	0.00	1.00
2.C.1	Iron and Steel Production	CARBON DIOXIDE (CO2)	0.87	19.23	0.00	0.00	1.00
2.C.5	Lead Production	CARBON DIOXIDE (CO2)	5.51	0.02	0.00	0.00	1.00
1.A.1	Energy Industries - Solid Fuels	NITROUS OXIDE (N2O)	0.00	14.55	0.00	0.00	1.00
1.A.3.c	Railways - Liquid Fuels	CARBON DIOXIDE (CO2)	15.26	31.08	0.00	0.00	1.00
1.A.3.e	Other Transportation - Liquid Fuels	CARBON DIOXIDE (CO2)	4.44	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Biomass - solid	NITROUS OXIDE (N2O)	0.00	12.62	0.00	0.00	1.00
1.B.2.a	Oil	CARBON DIOXIDE (CO2)	3.79	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Biomass - solid	METHANE (CH4)	0.00	10.00	0.00	0.00	1.00
1.B.1.c	Fuel transformation	NITROUS OXIDE (N2O)	13.14	47.27	0.00	0.00	1.00

1.A.3.b	Road Transportation - Liquid Fuels	METHANE (CH4)	2.40	15.76	0.00	0.00	1.00
3.A.2	Manure Management	NITROUS OXIDE (N2O)	24.98	63.43	0.00	0.00	1.00
1.B.1.a	Coal mining and handling	METHANE (CH4)	0.85	10.66	0.00	0.00	1.00
3.C.2	Liming	CARBON DIOXIDE (CO2)	1.22	8.18	0.00	0.00	1.00
1.A.5	Non-Specified - Liquid Fuels	CARBON DIOXIDE (CO2)	10.30	25.66	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Solid Fuels	NITROUS OXIDE (N2O)	3.81	7.05	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Liquid Fuels	CARBON DIOXIDE (CO2)	7.08	16.85	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Solid Fuels	METHANE (CH4)	2.69	4.97	0.00	0.00	1.00
1.A.4	Other Sectors - Liquid Fuels	NITROUS OXIDE (N2O)	3.42	12.07	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Liquid Fuels	NITROUS OXIDE (N2O)	0.63	3.89	0.00	0.00	1.00
1.B.2.a	Oil	METHANE (CH4)	0.54	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Liquid Fuels	NITROUS OXIDE (N2O)	1.56	3.18	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Liquid Fuels	METHANE (CH4)	0.33	2.06	0.00	0.00	1.00
1.A.1	Energy Industries - Solid Fuels	METHANE (CH4)	0.00	1.02	0.00	0.00	1.00
2.G	Other Product Manufacture and Use	SF6, PFCs	0.00	0.92	0.00	0.00	1.00
1.A.4	Other Sectors - Liquid Fuels	METHANE (CH4)	0.99	2.06	0.00	0.00	1.00
4.C	Incineration and Open Burning of Waste	METHANE (CH4)	2.02	5.26	0.00	0.00	1.00
3.C.6	Indirect N2O Emissions from manure management	NITROUS OXIDE (N2O)	0.00	0.32	0.00	0.00	1.00
1.A.1	Energy Industries - Liquid Fuels	NITROUS OXIDE (N2O)	0.10	0.05	0.00	0.00	1.00
1.A.1	Energy Industries - Liquid Fuels	METHANE (CH4)	0.08	0.03	0.00	0.00	1.00
4.C	Incineration and Open Burning of Waste	NITROUS OXIDE (N2O)	0.23	0.61	0.00	0.00	1.00
4.C	Incineration and Open Burning of Waste	CARBON DIOXIDE (CO2)	0.16	0.42	0.00	0.00	1.00
1.B.2.a	Oil	NITROUS OXIDE (N2O)	0.02	0.00	0.00	0.00	1.00
1.B.1.a	Coal mining and handling	CARBON DIOXIDE (CO2)	0.00	0.03	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Liquid Fuels	NITROUS OXIDE (N2O)	0.05	0.13	0.00	0.00	1.00

1.A.5	Non-Specified - Liquid Fuels	NITROUS OXIDE (N2O)	0.02	0.03	0.00	0.00	1.00
1.A.3.c	Railways - Liquid Fuels	METHANE (CH4)	0.02	0.05	0.00	0.00	1.00
1.A.5	Non-Specified - Liquid Fuels	METHANE (CH4)	0.01	0.02	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Liquid Fuels	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Gaseous Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Peat	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Biomass - solid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Biomass - liquid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Biomass - gas	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Biomass - other	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Gaseous Fuels	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Other Fossil Fuels	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.1	Energy Industries – Peat	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Biomass - liquid	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Biomass - gas	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Biomass - other	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Gaseous Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Other Fossil Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.1	Energy Industries – Peat	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Biomass - liquid	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Biomass - gas	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.1	Energy Industries - Biomass - other	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.1	Energy Industries	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.1	Energy Industries	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00

1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Peat	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Biomass - solid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Biomass - liquid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Biomass - gas	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Biomass - other	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Other Fossil Fuels	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Peat	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Biomass - liquid	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Biomass - gas	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Biomass - other	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Other Fossil Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Peat	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Biomass – liquid	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Biomass – gas	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.2	Manufacturing Industries and Construction - Biomass – other	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Solid Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Gaseous Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Biomass - solid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00

1.A.3.a	Civil Aviation - Biomass - liquid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Biomass - gas	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Biomass - other	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Solid Fuels	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Gaseous Fuels	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Other Fossil Fuels	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Biomass - solid	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Biomass - liquid	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Biomass - gas	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Biomass - other	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Solid Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Gaseous Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Other Fossil Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Biomass - solid	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Biomass - liquid	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Biomass - gas	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.a	Civil Aviation - Biomass - other	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Solid Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Gaseous Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Biomass - solid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Biomass - liquid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Biomass - gas	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Biomass - other	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Solid Fuels	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00

1.A.3.b	Road Transportation - Gaseous Fuels	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Other Fossil Fuels	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Biomass - solid	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Biomass - liquid	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Biomass - gas	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Biomass - other	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Solid Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Gaseous Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Other Fossil Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Biomass - solid	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Biomass - liquid	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Biomass - gas	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation - Biomass - other	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.b	Road Transportation	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Solid Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Gaseous Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Biomass - solid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Biomass - liquid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Biomass - gas	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Biomass - other	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Solid Fuels	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Gaseous Fuels	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Other Fossil Fuels	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Biomass - solid	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00

1.A.3.c	Railways - Biomass - liquid	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Biomass - gas	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Biomass - other	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Solid Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Gaseous Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Other Fossil Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Biomass - solid	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Biomass - liquid	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Biomass - gas	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.c	Railways - Biomass - other	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Liquid Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Solid Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Gaseous Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Biomass - solid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Biomass - liquid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Biomass - gas	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Biomass - other	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Liquid Fuels	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Solid Fuels	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Gaseous Fuels	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Other Fossil Fuels	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Biomass - solid	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Biomass - liquid	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Biomass - gas	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00

1.A.3.d	Water-borne Navigation - Biomass - other	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Liquid Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Solid Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Gaseous Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Other Fossil Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Biomass - solid	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Biomass - liquid	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Biomass - gas	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.d	Water-borne Navigation - Biomass - other	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Solid Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Gaseous Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Biomass - solid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Biomass - liquid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Biomass - gas	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Biomass - other	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Liquid Fuels	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Solid Fuels	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Gaseous Fuels	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Other Fossil Fuels	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Biomass - solid	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Biomass - liquid	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Biomass - gas	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Biomass - other	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Liquid Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00

1.A.3.e	Other Transportation - Solid Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Gaseous Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Other Fossil Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Biomass - solid	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Biomass - liquid	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Biomass - gas	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.3.e	Other Transportation - Biomass - other	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Solid Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Gaseous Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Peat	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Biomass - solid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Biomass - liquid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Biomass - gas	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Biomass - other	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Solid Fuels	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Gaseous Fuels	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Other Fossil Fuels	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Peat	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Biomass - liquid	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Biomass - gas	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Biomass - other	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Solid Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Gaseous Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Other Fossil Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00

1.A.4	Other Sectors - Peat	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Biomass - liquid	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Biomass - gas	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.4	Other Sectors - Biomass - other	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Solid Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Gaseous Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Other Fossil Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.5	Non-Specified – Peat	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Biomass – solid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Biomass - liquid	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Biomass – gas	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Biomass - other	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Solid Fuels	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Gaseous Fuels	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Other Fossil Fuels	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.5	Non-Specified – Peat	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Biomass – solid	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Biomass - liquid	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Biomass – gas	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Biomass - other	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Solid Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Gaseous Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Other Fossil Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Peat	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Biomass - solid	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00

1.A.5	Non-Specified - Biomass - liquid	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Biomass - gas	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.A.5	Non-Specified - Biomass - other	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.B.2.b	Natural Gas	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.B.2.b	Natural Gas	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.B.2.b	Natural Gas	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.B.3	Other emissions from Energy Production	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.B.3	Other emissions from Energy Production	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.B.3	Other emissions from Energy Production	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.C	Carbon dioxide Transport and Storage	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
2.A.3	Glass Production	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
2.A.4	Other Process Uses of Carbonates	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
2.A.5	Other (please specify)	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
2.A.5	Other (please specify)	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
2.A.5	Other (please specify)	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
2.B.3	Adipic Acid Production	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
2.B.4	Caprolactam, Glyoxal and Glyoxylic Acid Production	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
2.B.5	Carbide Production	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
2.B.5	Carbide Production	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
2.B.6	Titanium Dioxide Production	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
2.B.7	Soda Ash Production	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
2.B.8	Petrochemical and Carbon Black Production	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
2.B.8	Petrochemical and Carbon Black Production	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
2.B.9	Fluorochemical Production	SF6, PFCs, HFCs and other halogenated gases	0.00	0.00	0.00	0.00	1.00

2.C.1	Iron and Steel Production - Solid Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
2.C.1	Iron and Steel Production - Solid Fuels	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
2.C.1	Iron and Steel Production	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
2.C.2	Ferroalloys Production	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
2.C.2	Ferroalloys Production	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
2.C.3	Aluminium production	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
2.C.3	Aluminium production	PFCs (PFCs)	0.00	0.00	0.00	0.00	1.00
2.C.4	Magnesium production	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
2.D	Non-Energy Products from Fuels and Solvent Use	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
2.D	Non-Energy Products from Fuels and Solvent Use	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
2.E	Electronics Industry	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
2.E	Electronics Industry	SF6, PFCs, HFCs and other halogenated gases	0.00	0.00	0.00	0.00	1.00
2.G	Other Product Manufacture and Use	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
2.H	Other	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
2.H	Other	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
2.H	Other	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
3.B.2.a	Cropland Remaining Cropland	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
3.B.3.a	Grassland Remaining Grassland	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
3.B.4.a.i	Peat Extraction remaining Peat Extraction	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
3.B.4.a.iii	Other Wetlands Remaining Other Wetlands	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
3.B.4.b.i	Land converted for Peat Extraction	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
3.B.4.b.iii	Land converted to Other Wetlands	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
3.B.5.a	Settlements Remaining Settlements	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
3.B.6.b	Land Converted to Other land	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00

3.C.1	Burning	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
3.C.10	CH4 from Rewetting of Organic Soils	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
3.C.11	CH4 Emissions from Rewetting of Mangroves and Tidal Marshes	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
3.C.12	N2O Emissions from Aquaculture	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
3.C.13	CH4 Emissions from Rewetted and Created Wetlands on Inland Wetland Mineral Soils	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
3.C.14	Other (please specify)	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
3.C.14	Other (please specify)	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
3.C.14	Other (please specify)	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
3.C.8	CH4 from Drained Organic Soils	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
3.C.9	CH4 from Drainage Ditches on Organic Soils	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
3.D.1	Harvested Wood Products	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
3.D.2	Other (please specify)	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
3.D.2	Other (please specify)	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
3.D.2	Other (please specify)	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
4.B	Biological Treatment of Solid Waste	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
4.B	Biological Treatment of Solid Waste	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
4.D	Wastewater Treatment and Discharge	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
4.E	Other (please specify)	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
4.E	Other (please specify)	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
4.E	Other (please specify)	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
5.A	Indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
5.B	Indirect CO2 emissions from the atmospheric oxidation of CH4, CO and NMVOC	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
1.B.1.b	Uncontrolled combustion and burning coal dumps - Solid Fuels	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00

1.B.1.b	Uncontrolled combustion and burning coal dumps - Solid Fuels	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
1.B.1.b	Uncontrolled combustion and burning coal dumps - Solid Fuels	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
1.B.1.c	Fuel transformation	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
2.B.10	Hydrogen Production	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
2.B.10	Hydrogen Production	METHANE (CH4)	0.00	0.00	0.00	0.00	1.00
2.B.10	Hydrogen Production	NITROUS OXIDE (N2O)	0.00	0.00	0.00	0.00	1.00
2.C.7	Rare Earths Production	CARBON DIOXIDE (CO2)	0.00	0.00	0.00	0.00	1.00
Total							
			-64606.17241	57027.08418	1.19496	1	

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