Guyana

First Biennial Update Report

To the United Nations Framework Convention on Climate Change

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Foreword

The Government of Guyana is pleased to present Guyana's First Biennial Update Report to the United Nations Framework Convention on Climate Change, including the Technical Annex on REDD+, following the reporting provisions contained within Decision 2/CP.17, Annex III of the same decision: "UNFCCC biennial update reporting guidelines for Parties not included in Annex I to the Convention" and the "Guidelines for the preparation of national communications from Parties not included in Annex I to the Convention" (Decision 17/CP.8, Annex). Given Guyana's status as a small island developing state (SIDS), the submission of the Biennial Update Report is at the discretion of the country.

Gratitude is extended to the individuals and organisations whose substantial contributions played a pivotal role in the successful completion of Guyana's First Biennial Update Report. Special recognition goes to the Global Green Growth Institute (GGGI) and Gauss International Consulting for their support.

Through the submission of this First Biennial Update Report and Technical Annex on REDD+ to the United Nations Framework Convention on Climate Change, Guyana provides an update of the national greenhouse gas (GHG) inventory and information on mitigation actions, needs and support received. It also presents details on results achieved through the reduction of emissions from deforestation, forest degradation, and enhancements of forest carbon stock. This transparently highlights the continuous endeavours of the country in implementing the Convention.

Acronyms and Abbreviations

ACTO	Amazonian Cooperation Treaty
AD	Activity Data
ADF	Amerindian Development Fund
AFOLU	Agriculture, Forestry and Other Land Use
ALT	Amerindian Land Titling
ANAP	Aligned National Action Plan
ART-TREES	Architecture for REDD+ Transactions Environmental Excellence Standard
AR5	Fifth Assessment Report
BAU	Business-As-Usual
BEMS	Building Energy Management System
BOD	Biochemical Oxygen Demand
BoS	Bureau of Statistics
BUR	Biennial Update Report
C	Confidential
CARICOM	Caribbean Community
CCCCC	Caribbean Community Climate Change Centre
CDM	Comprehensive Disaster Management
CDOs	Community Development Officers
CDPs	Community Development Plans
CF	Carbon Fraction
CIF	Caribbean Investment Facility
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMRV	Community Monitoring Reporting and Verification
CMTs	Community Management Teams
COP	Conference of Parties
CRSAP	Climate Resilience Strategy and Action Plan
CRT	Common Reporting Table
DAI-SBG	Development Alternatives Incorporated Sustainable Business Group
DBIS	Demerara-Berbice Interconnected System
DC	Direct Current
DE	Department of Energy
DECC	Department of Environment and Climate Change
Dm	Dry matter

DOC	Degradable Organic Carbon
DOCf	Fraction of DOC Dissimilated
DoE	Department of Environment
DRR	Disaster Risk Reduction
DSA	Data Sharing Agreements
ECOSEO	Ecosystemic Services Observatory of the Guiana
EDWC	East Demerara Water Conservancy
EF	Emission Factor
EIA	Environmental Impact Assessment
EIMMS	Environmental Information Management and Monitoring System
EMISDE	Energy Matrix Diversification and Institutional Strengthening of the Department of Energy
ENSO	El Niño-Southern Oscillation
EPA	Environmental Protection Agency
ERR	Emission Reductions and Removals
ESB	Environmental Baseline Survey
ESMF	Environmental and Social Management Framework
ETF	Enhanced Transparency Framework
EU	European Union
EV	Electric Vehicle
EXIM	Export and Import Bank US
FAO	Food and Agriculture Organization
FCF	Fossil Carbon Fraction
FCPF	Forest Carbon Partnership Facility
F-gases	Fluorinated Gases
FLEGT	Forest Law Enforcement, Governance and Trade
FOD	First Order Decay
FOLU	Forestry and Land Use
FPIC	Free Prior and Informed Consent
FPSO	Floating Production Storage and Offloading
FREL	Forest Reference Emission Level
FRL	Forest Reference Level
FSC	Forest Stewardship Council
FSO	Forest Sector Operator
GCCI	Georgetown Chamber of Commerce and Industry
GCF	Green Climate Fund
GDP	Gross Domestic Product

GEA	Guyana Energy Agency
GEF	Global Environment Facility
GFC	Guyana Forestry Commission
GFOI	Global Forest Observations Initiative
GGGI	Global Green Growth Institute
GGMC	Guyana Geology and Mines Commission
GHG	Greenhouse Gas
GLDA	Guyana Livestock and Development Authority
GMSA	Guyana Manufacturing & Services Association
GOG	Government of Guyana
GPL	Guyana Power and Light Inc.
GRA	Guyana Revenue Authority
GRDB	Guyana Rice Development Board
GRIF	Guyana REDD+ Investment Fund
GSF	Guyana Shield Facility
GTA	Guyana Tourism Authority
GTI	Guyana Technical Institute
GTLAS	Guyana Timber Legality System
GUYSOL	Guyana Utility Scale Solar Photovoltaic Program
GuySuCo	Guyana Sugar Corporation
GWI	Guyana Water Incorporated
GWP	Global Warming Potential
HDI	Human Development Index
HECI	Hinterland Electrification Company Incorporated
HFLD	High Forest Low Deforestation
HFO	Heavy Fuel Oil
HPRCs	Hinterland, Poor, and Remote Communities
ICT	Information and Communications Technology
IDB	Inter-American Development Bank
IE	Included Elsewhere
IPCC	Intergovernmental Panel on Climate Change
IPED	Institute for Private Enterprise Development
IPLC	Indigenous Peoples and Local Community
IPP	Independent Power Producer
IPPU	Industrial Processes and Product Use
IsDB	Islamic Development Bank
ITCZ	Inter-Tropical Convergence Zone

JICA	Japan International Cooperation Agency
KfW	German Development Bank
KMPA	Kanuku Mountains Protected Area
LAS	Legality Assurance System
LCDS	Low Carbon Development Strategy
LCOE	Levelized Cost of Electricity
LDC	Least Developed Country
LED	Light-Emitting Diode
LIDCO	Livestock Development Company
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
LULUCF	Land Use, Land Use Change, and Forestry
MCF	Methane Correction Factor
MMA	Mahaica Mahaicony Abary
MNR	Ministry of Natural Resources
MoA	Ministry of Agriculture
MoAA	Ministry of Amerindian Affairs
MoB	Ministry of Business
MoPW	Ministry of Public Works
MoU	Memorandum of Understanding
MPGs	Modalities, Procedures, and Guidelines
MPs	Members of Parliament
MRV	Monitoring, Reporting, and Verification
MRVS	Guyana REDD+ Monitoring Reporting and Verification System
MSMs	Micro and Small Enterprises
MSMEs	Micro, Small and Medium Enterprises
MSW	Municipal Solid Waste
NA	Not Applicable
NAP	National Adaptation Plan
NAREI	National Agricultural Research and Extension Institute
NASA	National Aeronautics and Space Administration
NBSAP	National Biodiversity Strategy and Action Plan
NC	National Communication
NCSA	National capacity self-assessment
NCV	Net Calorific Value
NDC	Nationally Determined Contribution
NDMA	National Data Management Authority

NDA	National Designated Authority
NDC	National Determined Contribution
NDIA	National Drainage and Irrigation Authority
NE	Not Estimated
NFP	National Focal Point
NGL	Natural Gas Liquids
NGMC	New Guyana Marketing Corporation
NGO	Non-Governmental Organisation
NIR	National Inventory Report
NLUP	National Land Use Plan
NMVOCs	Non-Methane Volatile Organic Compounds
NO	Not Occurring
NORAD	Norwegian Agency for Development Corporation
NPC	National Parks Commission
NPAS	National Protected Areas System
NRF	Natural Resource Fund
NRAC	Natural Resources Advisory Committee
NRW	Non-Revenue Water
NTC	National Toshaos Council
OCC	Office of Climate Change
OLADE	Latin-American Energy Organization
OPM	Office of the Prime Minister
OPS	Office of the President
O&G	Oil and Gas
PAC	Protected Areas Commissions
PAM	Policy and Measure
PATF	Protected Areas Trust Fund
PCG	Petroleum Commission of Guyana
PMO	Project Management Office
PPP	Public-Private Partnership
PSA	Public Service Announcement
PSSP	Power Sector Support Programme
PUC	Power Utility Commission
PV	Photovoltaic
QA	Quality Assurance
QC	Quality Control
RDC	Regional Democratic Council

REDD+	Reducing Emissions from Deforestation and Degradation
R-PIN	Readiness Plan Idea Note
R-PP	Readiness Preparation Proposal
RRU	REDD+ Results Unit
SBB	Small Business Bureau
SCADA	Supervisory Control and Data Acquisition
SDG	Sustainable Development Goal
SESA	Social Environmental and Strategic Assessment
SIDS	Small Island Developing State
SNC	Second National Communication
SOP	Standard Operating Procedure
SWDS	Solid Waste Disposal Site(s)
TERI	The Energy and Resources Institute
TNA	Technology Needs Assessment
UAE-CREC	United Arab Emirates Caribbean Energy Development Fund
UNCBD	United Nations Convention on Biological Diversity
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
VAR	Volt-Ampere-Reactive
VAT	Value Added Tax
VCM	Voluntary Carbon Markets
VCS-JNR	Verified Carbon Standard Jurisdictional and Nested REDD+ Framework
VPA	Voluntary Partnership Agreement
VSATs	Very Small Aperture Terminals
VSP	Village Sustainability Plan
WCMC	Wildlife Conservation and Management Commission
WTS	Wood Tracking System
WWF	World Wildlife Fund

Chemical Species

CFCs	Chlorofluorocarbons
CH_4	Methane
CO_2	Carbon Dioxide
HCFCs	Hydrochlorofluorocarbons
HFCs	Hydrofluorocarbons
NF_3	Nitrogen Trifluoride
N_2O	Nitrous Oxide
PFCs	Perfluorocarbons
SF_6	Sulphur Hexafluoride

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Executive Summary

Chapter 1 – National Circumstances

Guyana is part of the Guiana Shield and the Amazon Biome. It is located on the north-eastern coast of South America, and it is bound by Venezuela on the west, Brazil on the south-west and south, Suriname on the east and the Atlantic Ocean to the north.

Due to its geographic location, Guyana features a diverse natural heritage, including coastal artesian basins, a vast river and creek network, and wetlands. Rich in natural resources, it boasts a remarkable 85% forest coverage, and unique biodiversity. The large carbon sequestration that happens within its forest makes the country a significant sink of GHG emissions, and the protection of this resource and marketing of these global ecosystem services are key national priorities. In this context, major efforts are being undertaken to monitor the economic use of the forest and to avoid deforestation. Its natural resources further allow for mining activities of precious and semi-precious metals such as gold and bauxite and its fluvial networks provide great potential for the use of hydropower.

Experiencing fluctuations in population size and growth rate over the past decades, Guyana's population has increased to approximately 808,726 in 2022. The majority of the population resides in low-lying coastal areas, where most urban centres, including the capital Georgetown, are situated. With 88% of the population younger than 55 years and an average birth rate of 2.6 children per woman, the population is poised for further growth.

Fuel consumption, transport and electricity generation account for the highest source of emission, followed by agriculture, forestry, and fishing sectors. Efforts are underway to enhance the contribution of renewable energy sources to meet the country's energy demands.

The expansion of the national oil and gas sector in recent years has spurred remarkable economic growth. In fact, while historically Guyana's gross domestic product (GDP) per capita ranked among the lowest in South America, economic growth since 2020, has averaged 42.3% over the last three years. According to the International Monetary Fund (IMF), Guyana was one of the fastest growing economies in the world in 2023.

Guyana's abundant natural resources and remarkable economic development have set the country on a path of growth. Guyana has emphasized that while capitalizing on the expanding economic strength, it is imperative to adopt prudent measures that support ongoing and sustainable growth. As such, Guyana has prioritized the balancing of economic progress with environmental conservation as the key to ensuring a harmonious and resilient future for Guyana.

Chapter 2 – National Greenhouse Gas Inventory

In this initial Biennial Update Report (BUR), Guyana presents a revised greenhouse gas (GHG) inventory spanning the period 1990-2022. The inventory utilizes the 2006 IPCC Guidelines for National GHG Inventories [referred to as the 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines] and the 2019 Refinement to the 2006 IPCC Guidelines for National GHG Inventories (referred to as the 2019 Refinement). The recalculated time series from 1990 to 2016 and the newly calculated time series from 2017 to 2022 incorporate recent guidelines, additional available information, and methodological improvements. The GHG inventory spans 32 years, from the base year 1990 to the inventory year 2022, covering four sectors outlined in the 2006 IPCC Guidelines: energy, industrial processes and product use (IPPU), agriculture, forestry and other land use (AFOLU), and waste.

The GHG emissions inventory for Guyana's first BUR is conducted under the centralized leadership and coordination of the Department of Environment and Climate Change (DECC) within the Office of the President. Employing a sector-based approach, the inventory ensures accurate data collection, avoiding double counting or omission, with sectoral data collection forms distributed to relevant data providers within each sector. Gauss International Consulting, an international technical consultancy, was enlisted to handle data processing, emission estimation, and quality assurance and quality control procedures.

Guyana's national GHG inventory covers seven GHGs emitted to or removed from the atmosphere within the national territory: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6), and nitrogen trifluoride (NF_3).

As previously mentioned, the four sectors covered in the national GHG inventory are energy, IPPU, AFOLU, and waste. The inventory is organized by numerical designations, followed by categories (indicated by capital letters), sub-categories (identified by numbers), and emissions sources (denoted by small letters).

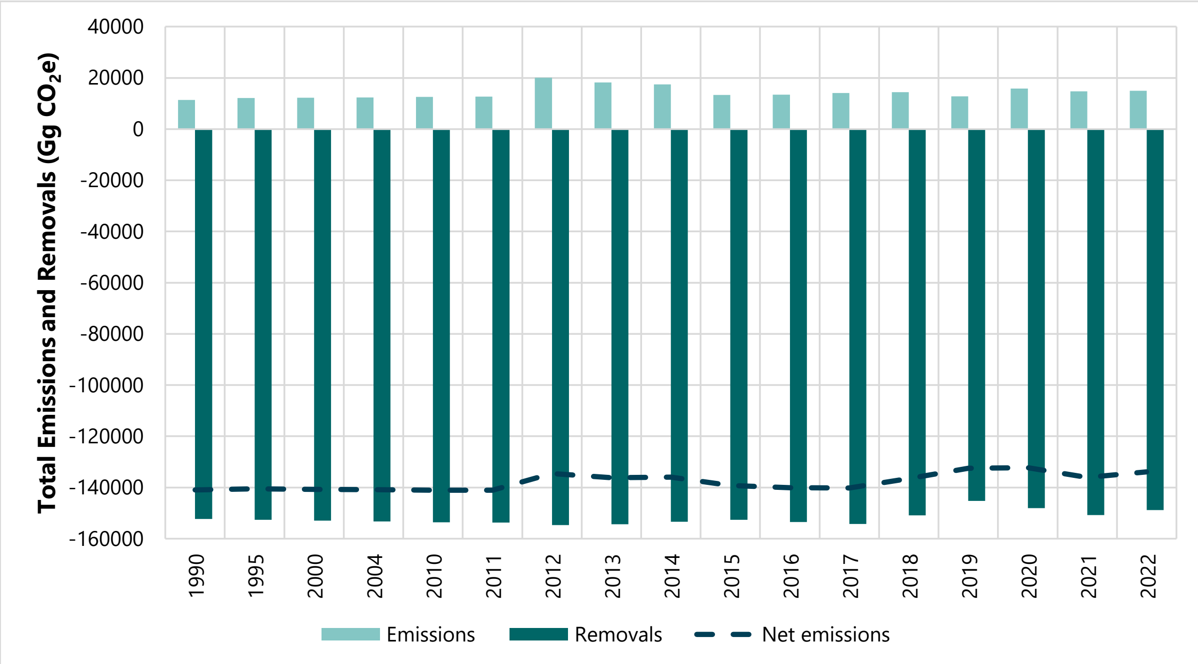
Guyana's national GHG inventory spans the entire national territory, covering a geographic area of 214,970 km^2, which includes four biophysical regions: Coastal Plain, Hilly Sand and Clay, Forested Highland, and Interior Savannahs. The inventory comprises 196,850 km^2 of land and

18,120 km^2 of water, featuring a 430-kilometer Atlantic coastline to the northeast and extending continentally for about 724 km.

The GHG inventory follows Tier 1 methodologies from the 2006 IPCC Guidelines, with most Key Categories estimated using advanced methodologies (Tier 2/Tier 3). To address data gaps, notation keys (NO, NE, NA, IE) are employed.

Quality is maintained throughout the inventory compilation, adhering to the good practice principles defined by the 2006 IPCC Guidelines and 2019 Refinement. The inventory complies with the TACCC principles: Transparency, Accuracy, Completeness, Consistency, and Comparability. Country-specific emission factors and official activity data are prioritized, supplemented by default values when necessary.

Guyana's GHG emissions are strongly influenced by its extensive national forest cover, which has a remarkable ability to absorb CO_2 from the atmosphere. Over the reporting period of this BUR, Guyana has maintained a vast net carbon sink, with a negative emission level, surpassing -130 Mg of CO_2-eq per annum for the entire period from 1990 to 2022.



GHG emissions and removals of Guyana – 1990-2022.

Examining the breakdown of national GHG emissions reveals an undulating trend from 2019 to 2022. In the latest inventory year, the major contributors to the country's emissions include deforestation (category 3B6b – accounting for 37% of national emissions), fugitive emissions from fuels (category 1B2 – contributing to 21% of national emissions), road transport (category 1A3b – responsible for 8% of national emissions), energy industries (1A1 – contributing 6% to national emissions), and fuel consumption in the residential, commercial, and institutional sectors (category 1A4 – making up 6% of emissions). In terms of gases, the distribution by sectors makes CO_2 the main GHG emitted due to the contribution from the energy and the Forestry and Other Land Use sectors. CO_2 contributed to 86% of total GHG emissions in 1990, slowly increasing to a peak 89% by 2012, and subsequently decreasing to 69% by 2022.

Following the methodologies and good practices of the 2006 IPCC Guidelines and its 2019 Refinement, the national GHG inventory provide a detailed picture of the GHG emissions of the energy, IPPU, AFOLU, and the waste sectors. The following table shows the GHG emissions calculated by sector for year 1990, 2000, 2010, 2020 and 2022.

Sectoral GHG emissions and removals of Guyana – 1990-2022 (Gg CO_{2}-eq).

Sector/category	1990	2000	2010	2020	2022
Energy	1266	1768	1850	4905	6116
Agriculture	1123	1570	1797	2253	1927
FOLU	-143718	-144381	-145044	-139804	-142407
Waste	351	358	354	428	445
Total	**-140 977**	**-140 685**	**-141 043**	**-132 218**	**-133 919**

Chapter 3 – Mitigation Actions and their Effects

Under the strategic vision set out by Guyana´s nationally determined contribution (NDC) and Low Carbon Development Strategy (LCDS), Guyana has actively engaged over the past decade in a wide range of actions to mitigate climate change, both nationwide and at a regional scale, towards low-emission socioeconomic development. Such mitigation actions encompass activities within the energy and forestry sector, where the majority of the nation´s current and historic emissions are produced, in addition to some cross-cutting actions.

Guyana´s LCDS was originally developed in 2009, being the first developing country to publish a strategy of its kind. The LCDS was based on (i) a payment for forest climate services mechanism which generated (ii) new revenues from ecosystem conservation to invest in the country's emerging low carbon economy. Later updated in 2013, and subsequently updated in 2022 following an extensive national stakeholder consultation process, Guyana´s updated LCDS 2030 outlines the country's plans to continue advancing Guyana's payment for forest climate services model and its expanding vision to include Guyana's other globally significant ecosystem services taking into consideration the new national circumstances.

The LCDS 2030 therefore establishes a unique world-class self-financing model that seeks to avoid deforestation and maintain forest cover, while at the same time growing the economy five-fold over 10 years and keeping energy emissions flat or decreasing; investing in urban, rural, and Amerindian sustainable development; protecting the coast and hinterland through adaptation to climate change; creating jobs in a suite of low carbon sectors; aligning the education and health sectors with low carbon development; and integrating Guyana's economy with its neighbours.

Regarding energy, Guyana has implemented various solar photovoltaic (PV) and hydroelectric infrastructure and capacity-building developments to increase the coverage and penetration of renewable energy sources across the country. Furthermore, the country has developed several actions to increase energy efficiency and promote sustainable transportation.

Summary of Guyana´s mitigation actions by status and sector.

Mitigation Action	Status	Sector
Electric Vehicle Supporting Infrastructure	Complete	Energy
Pilot Rice Husk Biogas Power Plant	Complete	Energy
EcoMicro Guyana	Complete	Energy
Expanding Bioenergy Opportunities in Guyana	Complete	Energy
Enhancing Guyana’s Access to Transition to Renewable Energy	Complete	Energy
Amaila Falls Hydroelectric Project Preparation Studies	Complete	Energy
Solar PV Public Buildings Program	Complete	Energy
Promotion of Private Solar PV Rooftop Systems	Complete	Energy
Promoting Energy Efficiency Measures in Manufacturing and Service Sectors	Complete	Energy
Introduction of Renewable Energy and Improvement of Power System	Complete	Energy
Sustainable Business Models for Rural Electrification and Energy Access	Complete	Energy
Power Utility Upgrade Program	Complete	Energy
Sustainable Operation of the Electricity Sector and Improved Quality of Service	Complete	Energy
Power Sector Support Program	Complete	Energy
Strengthening Capacity in Energy Planning and Supervision	Complete	Energy
Mabaruma 0.4MWp Solar PV Farm	Complete	Energy
Caribbean Renewable Energy Development Programme	Complete	Energy
Moraikobai Micro-grid PV System	Complete	Energy
Guyana Utility Scale Solar Photovoltaic Program	Ongoing	Energy
Sustainable Energy Program for Guyana	Ongoing	Energy
Energy Matrix Diversification & Department of Energy Institutional Strengthening	Ongoing	Energy
Wakenaam 0.75MWp Solar Farm	Ongoing	Energy
Small Hydropower Project for the Cooperative Republic of Guyana	Ongoing	Energy
Transitioning to National Energy Security: Bartica as a Model Green Town	Ongoing	Energy
Solar Home Systems	Ongoing	Energy
Solar PV Mini-grids	Ongoing	Energy
Gas to Energy Project	Ongoing	Energy
Leguan 0.6MWp Solar PV Farm	Planned	Energy
Hinterland Solar PV Farms	Planned	Energy
Institutional Strengthening LCDS 2030 Implementation under REDD+ Partnerships	Complete	Forestry
Forest Carbon Partnership Facility Project in Guyana	Complete	Forestry
Guyana-EU FLEGT-VPA	Ongoing	Forestry
Guyana REDD+ Monitoring Reporting & Verification System (MRVS)	Ongoing	Forestry
Securing a Living Amazon through Landscape Connectivity in Southern Guyana	Ongoing	Forestry
Amerindian Development Fund	Complete	Cross-cutting
Supporting Micro & Small Enterprise & Vulnerable Low-Carbon Livelihoods	Complete	Cross-cutting
Strengthened Environmental Regulations in Guyana's Gold Mining Sector	Complete	Cross-cutting
Amerindian Land Titling	Ongoing	Cross-cutting
ICT Access and E-services for Hinterland, Remote, and Poor Communities	Ongoing	Cross-cutting
Village Sustainability Plans	Ongoing	Cross-cutting

Chapter 4 – REDD+ in Guyana

Guyana has maintained one of the world's lowest deforestation rates, making it a high forest cover low deforestation rate (HFLD) country with approximately 85% forest cover. Guyana's forests, rich in natural resources, are utilised for sustainable logging, agriculture, and mining, with mining being the primary driver of the limited amount of deforestation that takes place. The sustained high performance in maintaining Guyana's forests has been supported by the LCDS, and in particular Guyana's growing revenue streams from forest climate services.

The latest LCDS, which sets out plans up to 2030, envisages continuing to leverage the economic incentives grounded in United Nations Framework Convention on Climate Change (UNFCCC) modalities, including REDD+ and market-based mechanisms of the Paris Agreement, to maintain Guyana's low deforestation and high HFLD score. Guyana has been actively engaged in the REDD+ framework for years.

The original LCDS 2009 set out a three-phase plan for accessing REDD+ financing for forest climate services. This commenced with results-based payments under the Guyana-Norway Agreement (Phase 1), and in 2022, this transitioned to access to the voluntary and compliance markets (Phase 2) with a plan to transition to a fully-fledged UNFCCC market mechanism once this has been operationalized (Phase 3).

During Phase 1, the Guyana-Norway Agreement saw Guyana receive over US$220 million for its REDD+ performance during the period 2009-2015. Phase 2 saw payments from the voluntary carbon markets received for performance from 2016 onwards, albeit the first payments were received in 2022. To date in Phase 2, Guyana has earned US$187.5 million from sales in the voluntary carbon market (for results in the period 2016-2020), with a further US$100 million to come for the remainder of the period covered in this Technical Annex (2021 and 2022).

Building from these positive foundations, the expected opportunity to access carbon financing for forest climate services and other ecosystem services will continue to enable Guyana to participate in emissions reduction while, at the same time, growing its economy five-fold over 20 years, keeping energy emissions flat, investing in its people, both indigenous in the hinterland communities and the vast majority living along the coast, from climate change; create jobs; and integrate Guyana's economy with its neighbours.

Phase I establishes a forest reference emission level (FREL) and the bilateral agreement with Norway utilised this FREL. Phase II uses the FREL as a benchmark for voluntary carbon market engagement up to the end of 2022 with a new FREL being formulated to take effect from 2023 following a national consultation that took place in 2021 and 2022. Phase III will integrate the FREL into a fully-fledged UNFCCC REDD+ mechanism.

The revised FREL will account for all biomass and soil carbon pools

Chapter 5 – Constraints, Gaps and Support Received

Seeking to continually strengthen and build out existing system, substantial resources are mobilised to finance targeted activities in energy and forestry representing the priority sectors outlined in Guyana's NDC and LCDS. Additionally, operational support for fulfilling reporting obligations under the UNFCCC and to enhance decision-making for climate change action is provided.

In this context, numerous projects are supported across these sectors. The majority of these projects involve capacity-building, seeking to address prevalent capacity gaps identified. Moreover, in line with the technology needs of Guyana in particular in the energy sector, the majority of projects implemented in that sector seek to strengthen the transfer of technology to improve the renewable capacity and energy efficiency in the country.

To support these actions, Guyana depended in the past strongly on the disbursement of grants and concessional loans from bilateral partners and from multilateral development banks. However, in recent years, mobilisation of market instruments and private sector investments as major sources of climate finance has increased substantially. In fact, nearly all the support anticipated stems from private investments in the power generation sector and from an innovative carbon credit mechanism, providing financial resources in return for the forest protection services provided by Guyana.

Summary of total support received and anticipated by sector (updated to 2022).

Sector	Support received (USD)	Support anticipated (USD)
Energy	**127,253,732.00**	**1,702,650,452.00**
Power Generation	34,401,492.00	1,696,895,452.00
Energy Efficiency	2,975,000.00	3,045,000.00
Rural Electrification	13,603,240.00	2,710,000.00
Training and Development	76,274,000.00	0.00
Forestry	**351,175,362.00**	**575,283,409.00**
Cross-cutting	**61,410,457.00**	**103,804,349.00**
Grand Total	**539,839,551.00**	**2,381,738,210.00**

Chapter 6 – National MRV

The Government of Guyana has proactively worked towards strengthening its national monitoring, reporting, and verification (MRV) system for climate change reporting. In establishing a national MRV system, Guyana has a unique opportunity to efficiently conform to the requirements of the approaching enhanced transparency framework (ETF) and initiate the incorporation of institutional arrangements that encompass all MRV subsystems essential for implementing the Paris Agreement.

The DECC under the Office of the President, is the national focal point (NFP) to the UNFCCC and is tasked with coordinating Guyana's international engagements with the UNFCCC and other climate change processes both nationally and internationally.

Guyana has been actively developing and setting up a national MRV system aimed at putting in place a sustainable institutionalised framework with clear processes and procedures. The recently designed MRV frameworks for the energy and agriculture sectors of the GHG inventory exemplify these ongoing initiatives, while the IPPU and waste sectors of the GHG inventory MRV framework will commence in 2024. This will allow Guyana to further strengthen national capacity to communicate comprehensive information to the UNFCCC and take informed policy decisions at national level.

The country has also implemented a fully operational MRV system for REDD+. In collaboration with Norway, Guyana developed a roadmap for REDD+ MRV system implementation, divided into three phases spanning from 2010 to 2025. The roadmap aims to guide the development of the MRV system for REDD+ in Guyana, consolidate and expand capacities for national REDD+ monitoring and MRV, and maintain an efficiently functioning MRV system that meets international and national requirements and that supports natural resources management. Through the REDD+MRV system, Guyana is able to comprehensively, consistently, and transparently provide information on forest area change and protect and maintain its forests, while attracting resources to foster growth and development along a low carbon emissions pathway.

1 National Circumstances

1. Introduction

Guyana, nestled in the Guianas Shield and the Amazon Biome, is located on the north-eastern coast of South America. It operates as a parliamentary democracy with ten regions that span over 214,970 km^2, showcasing diverse topography and ecological richness.

Named for its abundant hydrological resources, Guyana features a diverse natural heritage, including coastal artesian basins, a vast river and creek network, and wetlands. Rich in natural resources like gold and offshore oil, it boasts 85% forest coverage, arable land, and unique flora and fauna. The fisheries sector and agriculture are crucial for protein supply and employment. The coastal areas, the most densely populated, experience diverse climate and weather patterns, including two distinct rainy seasons. These areas face vulnerability to climate-related events, recurrent flooding, and the threats of tidal floods and storms, plus the rise in mean annual air temperature, poses risks to economic stability, emphasizing the need for robust sea defences and drainage systems.

Guyana, with a population of 808,726 [1], exhibits a balanced gender distribution and diverse demographics, including six ethnic groups and nine Indigenous groups. Employment and education are critical, with an average unemployment rate of 12.4% and a 10% national illiteracy rate in 2022.

In 2022, Guyana's gross domestic product (GDP) was G$3,068,784 million ($14.66 billion USD approximately)], with the agricultural sector contributing over 25% to the non-oil GDP and employing 17% of the workforce [3].

Guyana's energy sector so far relies on petroleum-based fuel imports, particularly diesel, fuel oil, and motor gasoline. Changes in economic activities, such as reduced energy-intensive agriculture and the growth of the service sector, have influenced Guyana's energy consumption patterns.

Guyana has responded to significant climate changes by establishing a climate change policy and institutional framework aligned with international and regional environmental agreements. Key institutions, such as the Department of Environment and Climate Change

(DECC), and legislation like the Environmental Protection Act, have been developed based on these agreements. Initiatives in Protected Areas and wildlife conservation and management are also integral. Guyana's strategic policies, including the Low Carbon Development Strategy (LCDS) 2030, focus on sectors like Agriculture, Forest, and Energy, aligning with comprehensive sector-wide considerations such as the Nationally Determined Contributions (NDC). The LCDS 2030 serves as a comprehensive plan to shift away from petroleum dependency for national power generation, emphasizing sustainable and low-carbon alternatives in the energy sector. It includes targeted measures to mitigate and adapt to climate change impacts, aiming to enhance the country's ability to cope with environmental challenges and protect vulnerable communities. The LCDS 2030 aligns with Guyana's commitments under the NDC framework, emphasizing dedication to international climate goals.

In this chapter of the first Biennial Update Report (BUR), Guyana explores its national context, delving into crucial aspects across ten distinct sections to depict the country's current circumstances and pertinent considerations. The report offers detailed insights, incorporating relevant subsections as needed.

2. Administrative Structure

Guyana operates as a parliamentary democracy with a representative system of government. It is divided into 10 regions and the capital is Georgetown (Figure 1.1). The administrative structure of Guyana includes the following key components:

Executive Branch:

- President: The President is the head of state and government. The President is elected by the people and is responsible for the overall administration of the country.
- Cabinet: The President is supported by a Cabinet, which consists of ministers responsible for various government departments and functions. Ministers are appointed by the President.

Legislative Branch:

- National Assembly: Guyana's unicameral legislature is called the National Assembly. Members of the National Assembly, known as Members of Parliament (MPs), are elected by the public. The Parliament is responsible for making laws and overseeing the executive branch.

Judicial Branch:

- Judiciary: The judicial branch is independent and includes the Supreme Court. The Chief Justice heads the judiciary, and there are other justices and judges responsible for interpreting and upholding the law.

Local Government:

- Regional Democratic Councils: Guyana is divided into regions, each with its own Regional Democratic Council (RDC) responsible for local governance within the region.
- Municipalities: There are also municipalities that have their own local government structures.

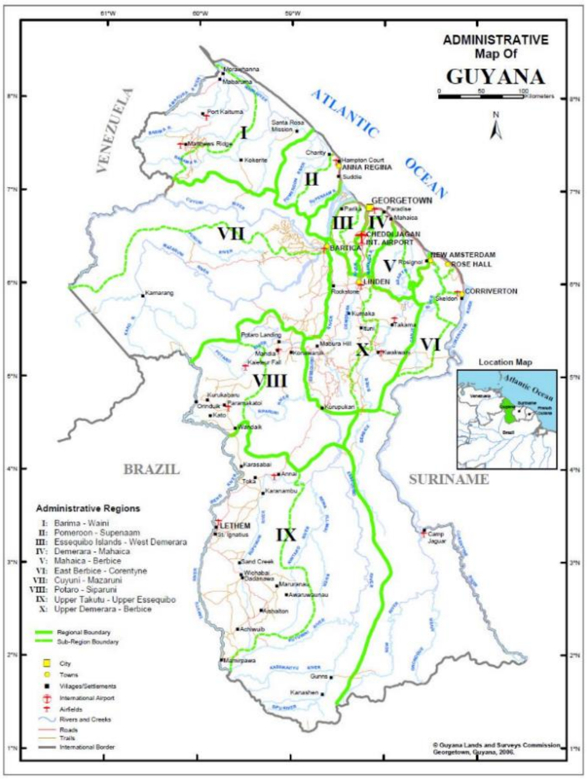


Figure 1.1. Guyana's Administrative Regions [9].

3. Geography and Topography

Guyana is an integral part of the expansive Guianas Shield and the Amazon Biome. It is bordered by Venezuela to the west, Brazil to the southwest and south, and Suriname to the east, with the Atlantic Ocean stretching along its northern border.

Encompassing 214,970 km^2, Guyana's territory comprises 196,850 km^2 of land and 18,120 km^2 of water, making it the third smallest independent state on the South American mainland. With

430-kilometre Atlantic coastline on the northeast, and a continental extent of about 724 km, the country has a coast that is 0.5 m to 1 m below mean high tide level of the Atlantic Ocean.

Despite its modest size, Guyana's diverse topography and ecological richness are remarkable. Geographically situated in South America, the nation shares deep cultural and historical ties with the Caribbean, underscored by its role as a founding member of the Caribbean Community (CARICOM) [10].

The country's landscape is marked by four Biophysical Regions (Figure 1.2) as follows:

1. Low Coastal Plain;
2. Hilly Sand and Clay;
3. Forested Highland; and
4. Interior Savannahs.

The Coastal Plain, vital for its population concentration, sits between 0.5 meters to 1 meter below the mean high tide level of the Atlantic Ocean. It extends from Waini Point to the Corentyne River, with an area of approximately 9,120 km^2 and it is geologically divided into the Demerara (sandy old beach ridges forming higher deltaic terrain) and Coropina (fluvio-marine clays and silts) Formations. The coastal region features sandy old beach ridges and fluvio-marine clays and silts.

Further inland, the Hilly Sand and Clay Region extends approximately 160 km southward to the Coastal Plain, the Crystalline Basement Rock Outcrops with an area of approximately 28,920 km^2. The Forested Highlands showcase plateaus and tepuis (table-topped mountains) with steep escarpments, waterfalls, and rapids permeate the Region. It makes up about 73% of the country's land mass with an area of approximately 156,450 km^2. The interior (Rupununi) Savannahs are bordered by the Pakaraima Mountains in the north, a low-forested plateau in the east, the Marudi Mountain in the south-east, and the headwaters of the Kuyuwini River in the south-west. The forested Kanuku Mountains divide the area into two – the North and South Savannahs. The vegetation consists of mostly grassland, scrub and low trees with hills [11].

The nation's soils vary, from coastal and riverine clay, sand, and alluvial soils to laterites and gley soils in fluctuating water table areas. Clay, sand, and alluvial soils are found on unconsolidated sediments of the coast and riverine areas. In depressions, where the water table fluctuates, groundwater laterites are formed in lower layers of the soil profile while in water-logged areas the lower layers have gley soils. However, in poorly drained low-lying areas, deep peat soils are formed. On steep sloping areas with rock outcrops, such as the Pakaraima Mountains, lithosols (thin soils) are common. Deep reddish-brown soils with visible horizons (latosols) develop in most of the country, especially on old erosion surfaces.

Key to Guyana's natural wealth that endows the country with fertile agricultural lands, are valuable mineral deposits, including bauxite, gold, and diamonds. Additional to the extensive forest that covers about 85% of the country and the recently discovered large offshore oil and gas reserves, Guyana has hydrological resources such as the major rivers Demerara, Essequibo, and Berbice flowing through the landscape [12]. The highest rainfall volume occurs in the Upper Mazaruni Mountains with more than 4,000 mm annually.

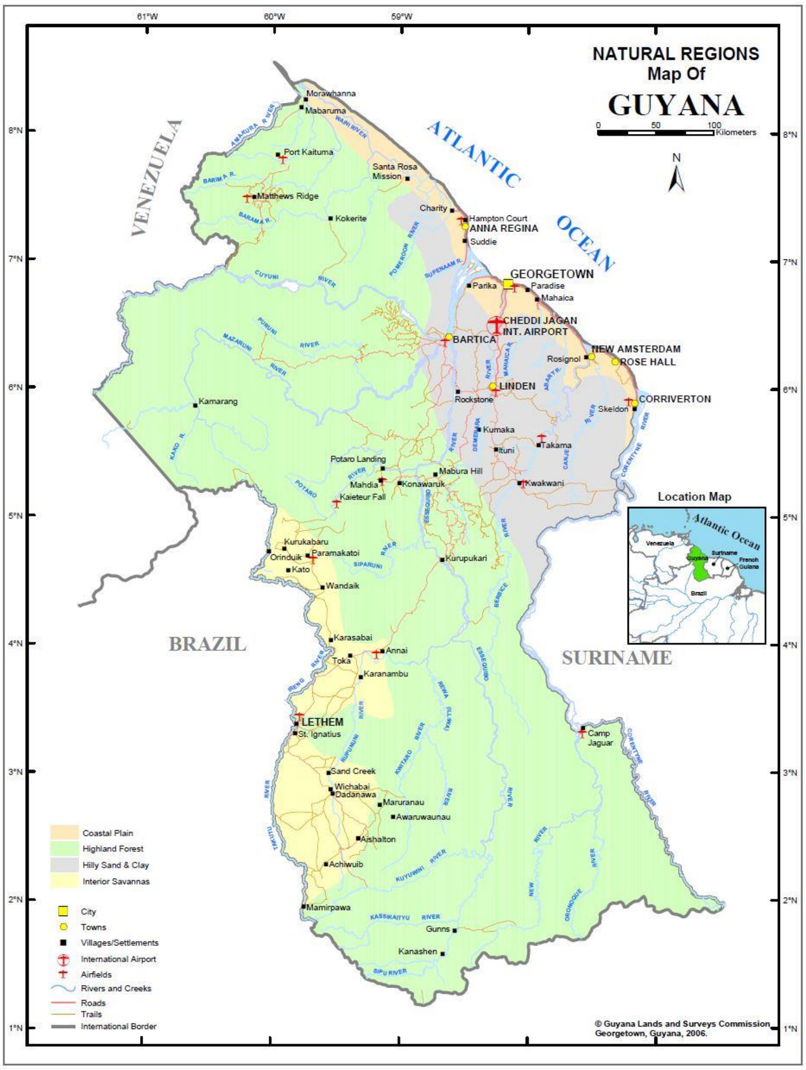


Figure 1.2. Guyana's Natural Regions [9].

4. Hydrological Resources

With the looming threats of climate change, Guyana's water resources face substantial challenges, primarily due to the anticipated rise in sea levels, leading to saltwater intrusion into rivers and potential adverse effects on aquifers, among others.

4.1. Coastal Artesian Basin and Aquifers

The coastal artesian basin, covering 20,000 km^2, houses three main aquifers: Upper Sands, "A" Sands, and "B" Sands. The Upper Sands, the shallowest, ranges from 30 to 60 m in depth. The "A" Sands, the primary source of domestic water supply, varies from 20 to 60 m in thickness. The "B" Sands, the deepest aquifer, extends eastwards from the Demerara River [13].

4.2. Rivers

Guyana boasts an extensive network of rivers and creeks, primarily flowing into three major rivers: Essequibo, Demerara, and Berbice. The Essequibo River Basin, the largest among them, includes major rivers such as Essequibo, Cuyuni, Mazaruni, and Potaro, draining an estimated area of 66,563 km^2. Along its course, smaller rivers like Mazaruni, Potaro, Cuyuni, Kuyuwini, Rupununi, and Rewa contribute to its flow.

The Berbice River, the second largest, flows for 595 km from its source in the Rupununi highlands to the Atlantic Ocean, draining an estimated area of 5,102 km^2. Several smaller rivers discharge into the Berbice River. These include Canje, Wikki, and Wairuni Rivers [14].

The Demerara River, the smallest of the main rivers, covers approximately 346 km from its source in the Marakari Mountains and drains over 4,000 km^2.

Besides the major rivers, smaller rivers along the Coastal Plain play a crucial role in drainage, forming essential drainage basins. Apart from the Essequibo, Demerara, and Berbice Rivers, other smaller rivers also empty into the Atlantic Ocean. These form very important drainage basins along the Coastal Plain (Table 1.1).

Guyana features fourteen drainage basins, each characterized by varied river flows throughout the year, contributing to the country's diverse hydrological landscape [15].

Table 1.1. Secondary coastal rivers [14].

Names of Rivers	Location
Barima River Waini River Kaituma River	Region 1 - Barima Waini
Pomeroon River Supenaam River Moruca River	Region 2 - Pomeroon-Supenaam
Mahaica River	Region 4 - Demerara- Mahaica Region 5 - Mahaica-Berbice

Mahaicony River	Region 5 - Mahaica-Berbice
Abary River	Region 5 - Mahaica-Berbice
Canje River	Region 6 – East Berbice-Corentyne

Tidal influence within the Essequibo, Demerara, and Berbice Rivers can extend up to 80 km upstream, particularly during the dry season, and over 20 km upstream for smaller rivers.

4.3. Watersheds

The eight watersheds are Essequibo, Mazaruni, Berbice, New River, Demerara, Barama, Cuyuni, and Barima [15]. Some of the watersheds are considered transnational or shared watersheds which originate or flow across national borders contiguous with Guyana. The main river in the Cuyuni watershed, the Cuyuni River, originates in the Guiana Highlands of Venezuela and flows 560 km into Guyana where it empties into the Essequibo River.

4.4. Lakes and Conservancies

Guyana has an extensive system of lakes and conservancies. There are 37 natural lakes scattered throughout the country. Seven water conservancies were constructed along the Coastal Plain to provide water for agricultural and domestic purposes as well as drainage for flood control through a network of canals. The conservancies are shallow reservoirs of varying sizes and receive freshwater supplies from upland creeks and streams, mainly from the Hilly and Sandy physiographic region [16]. The conservancies are located along the Essequibo Coast (Region 2), East Bank Essequibo, West and East Demerara (Regions 3 and 4), and West Coast Berbice (Region 5). Collectively, these structures provide irrigation water and flood control to over 10,100 hectares of rice lands, 150 hectares of cash crops and the populated centres of the Region.

The major conservancies in Guyana include:

- The Abary Conservancy on the Abary River, also called Mahaica Mahaicony Abary (MMA) Conservancy, has a capacity of 609 million m^3 and irrigates 17,500 ha of land. It is located in Region 5, which plays an important role in the agricultural landscape of Guyana, contributing between 35 to 50% of the gross national rice production [9].
- The East Demerara Water Conservancy (EDWC), which dams the Maduni River and Lama Creek, has a capacity of 16 million m^3 and irrigates 350 km^2 (34,500 ha) of land. It provides one of the primary sources of drinking water of Georgetown (60%), as well as the irrigation of the Guyana Sugar Corporation as a whole [17].

- The Boerasirie Conservancy collects the flow from the Boerasirie River, Warimia Creek, Jumbi Creek, and finally the South Durabana Creek. It has a total capacity of 166 million m^3 and has been designed to provide irrigation to about 360 km^2 (36,000 ha) of land. It is one of Guyana's major flood control facilities [18].
- The Tapakuma Conservancy dams the water from three inland lakes on the Essequibo coast and releases it as needed for irrigation. It has a total capacity of 18 million m^3 and has been designed to provide irrigation to about 120 km^2 (12,000 ha) of land.

4.5. Wetlands

There is an intricate system of wetlands that exists in Guyana, at least 22 naturally occurring wetlands are recognised. These wetlands are a unique and highly diverse ecosystem that is extremely important for biodiversity and ecosystem services [19]. The intricate characteristics of these environments, coupled with the delicate and ever-changing interactions among the organisms that dwell in these areas, render wetland ecosystems particularly susceptible to environmental disruptions, including climate change [20]. The largest wetlands in the country are the North Rupununi wetlands which cover an area of 220 km^2 (22,000 hectares). These wetlands are vast areas of flooded savannahs that store enormous quantities of water in the rainy season and slowly release it into the Essequibo River, limiting the severity of flooding in coastal Essequibo communities. They supply water from the Rupununi, Rewa, and Essequibo Rivers, along with its lakes, and water inlets [21].

4.6. Groundwater Resources

The groundwater system comprises three coastal aquifers that cover an area of 20,000 km^2 - Upper Sand (1831 to 1931), A Sand (1931 to present) and B Sand (1962 to present). The Upper Sand is the shallowest among the three, with depths ranging from 30 m to 60 m and thickness from 15 m to 120 m. However, it is not utilized as a water source due to its elevated iron content (>5 mg/l) and salinity (up to 1,200 mg/l) [22]. The latter two aquifers are the primary sources of potable water [16]. The A Sand is usually found at depths between 200 m and 300 m, with a thickness ranging from 15 m to 60 m. Water from the "A" aquifer needs treatment to eliminate iron. The B Sand is situated at approximately 300 m to 400 m and has a thickness ranging from 350 m to 800 m. Water from this aquifer contains minimal iron, a high temperature, and a trace of hydrogen sulphide, which can be addressed through aeration [22]. Others found in the Hinterlands are the White Sands Plateau (Linden, Region 10), the Takutu Sandstone Formation (northern Rupununi Savannah, Region 9), Barima Mazaruni Supergroup (underlays the Kanuku Mountains), and the Merume Mountains in the western parts of the country between 10 m to 30 m depth. There is also a brackish aquifer system along the Waini River at 3 m to 30 m depth [16].

Due to the coastal region of Guyana being at or near sea level, there is an ongoing risk of salinization. This phenomenon occurs in dry periods due to elevated salt levels in irrigation water and the intrusion of saltwater into groundwater resources [23]. Estimated values of water withdrawal in Guyana in 2010 were 1444.7 million m^3, where agricultural use accounted for 94%, followed by municipal, and industrial uses which accounted for 4% and 2%, respectively. The total volume of water produced by the Guyana Water Incorporated (GWI) decreased from 2012 (126,776,564 m^3/yr.) through 2014 (120,457,196 m^3/yr.) and rose in 2015 (122,743,829 m^3/yr.) but to a level lower than the previous three years. In 2015, the total water production of GWI was over 122 million m^3/yr. with a customer base of 183,000, a decrease of 3% or 4,032,735 m^3/yr. compared to production volume in 2012 (Table 1.2) [25].

Table 1.2. Water production in m^3/year [26].

Year	Water Production
2012	126,776,564
2013	125,387,658
2014	120,457,196
2015	122,743,829
2019	160,000,000

According to the GWI strategic plan 2021-2025, the Public Corporation charged with the responsibility for water production throughout Guyana and sewerage services in Central Georgetown produced 160 million m^3 of water in 2019.

5. Natural Resources

5.1. Minerals

In Guyana, mineral mining is generally allowed in six designated districts [27]. About 90% of the mining leases issued by the Guyana Geology and Mines Commission (GGMC) are within the state forest boundary, while approximately 61% of prospecting licenses issued for mining overlap with the state forest [28].

There are also deposits of semiprecious stones, laterite, manganese, kaolin, sand resources, radioactive minerals, copper, molybdenum, tungsten, iron, and nickel among others. The mining and quarrying sector represents a critical component of Guyana's economy. The sector contributed 12% to Guyana's non-oil GDP in 2021 [29] and the extractive industries accounted for approximately 52 % of Guyana's total exports in 2016. According to the World Bank, the mining industry contributed to employment with 17,363 in direct employment and 21,626 in indirect employment in 2013, making up a combined 14% of the total labour force [10]. Mining output expanded by 14.8% (2012) and 8.0% (2013) then contracted by 11.5% (2014) as a result of relatively less favourable gold and bauxite prices. It grew by 9.0% and 45.5% in 2015 and 2016 respectively.

Based on Guyana's national statistics, the gold production in Guyana was documented at 15,129 kg in December 2022, indicating a slight decline from the earlier figure of 15,522 kg in December 2021 [30]. Guyana produced 14,024 kg of gold in 2015 contributing 13% to 16% to Guyana's GDP. Diamond production increased to 118,451 carats in 2015. Data for bauxite indicate that production decreased by about 6.4% compared with that of 2014 to about 1.5 million Mt. Crushed stone production decreased by 56% owing to a decrease in construction activity. Bauxite is also another mineral in Guyana's mining sector, though production has decreased from 2012 to 2016 with the highest production growth being recorded in 2012 (21.8%).

In 2015, offshore petroleum was discovered in commercial quantities (more than 5 billion barrels), adding to Guyana's many resources. There are currently additional exploration activities being carried out [32]. Figure 1.3 illustrates the extent of petroleum exploration offshore Guyana.

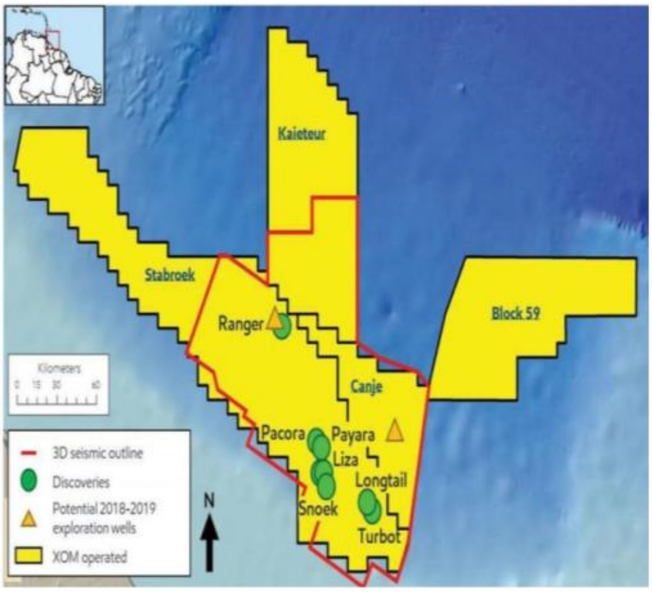


Figure 1.3. Guyana's coastal offshore petroleum exploration area [26].

During the oil extraction significant amounts of associated gas are extracted. All FPSOs have been designed as non-routine flaring to minimize the number of emissions. The gas is compressed and reinjected in the well, increasing production of oil and reducing the amount of flaring. From the first two FPSOs commissioned a 50 million cube feet per day, which represent 8.6% of the gas production in the first two FPSO [35] will be diverted for onshore electricity production.

The environmental permit for the FPSO has been issued with a carbon tax on flaring in amounts exceeding the non-routine flaring. The latest permit includes a carbon tax of $50 USD/ton$CO_2$ emitted.

5.2. Forests

Guyana has around 85% forest cover. Guyana's forested region is approximated at 17.84 million hectares, housing around 19.5 billion tons (or Gt) of carbon dioxide (CO_2) within live and deceased biomass reservoirs[1]. There are different types of forest areas in the country, grouped in four under tenure classifications (Figure 1.5).

There are approximately 120 species being logged in various forms, with between 12 and fifteen 15 of these logged on a commercial scale through a system of concessions. These follow sustainable forest management practices as prescribed by Codes of Practice for Timber Harvesting set again international standards.

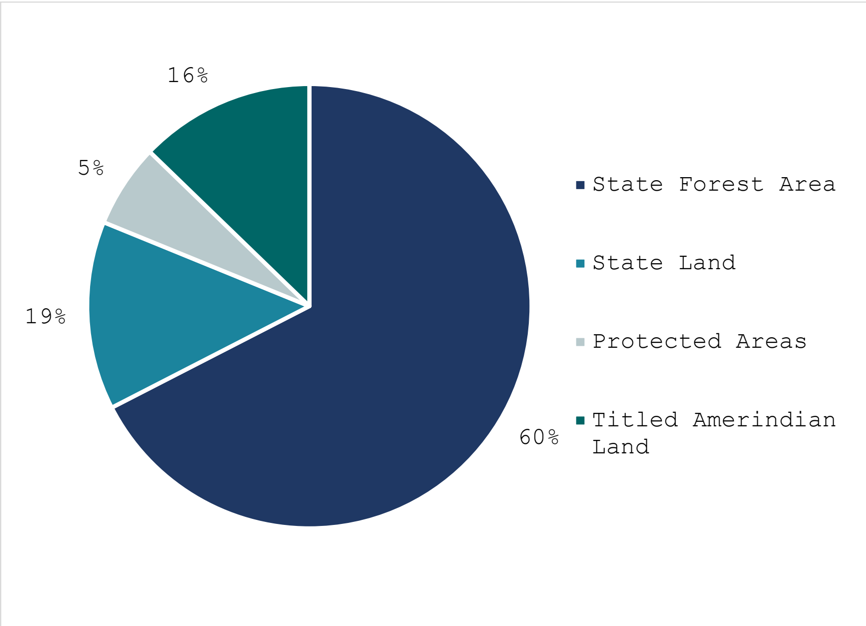


Figure 1.5. Type of Forest areas in Guyana [36].

Furthermore, the average forestland from 2011 to 2022 is 18.6 million hectares, fluctuating over the years but averaging 85% of the total land area of Guyana, which is 21.5 million hectares. The annual average deforestation from 2011 to 2022 is 10.16 thousand hectares, signifying the yearly loss due to deforestation. This translates to a forest loss rate of 0.056% per year during that period – one of the lowest in the world

[1] CO_2 removals from forests have been calculated in the GHG emissions inventory of Guyana for the period 1990-2022, presented in this BUR.

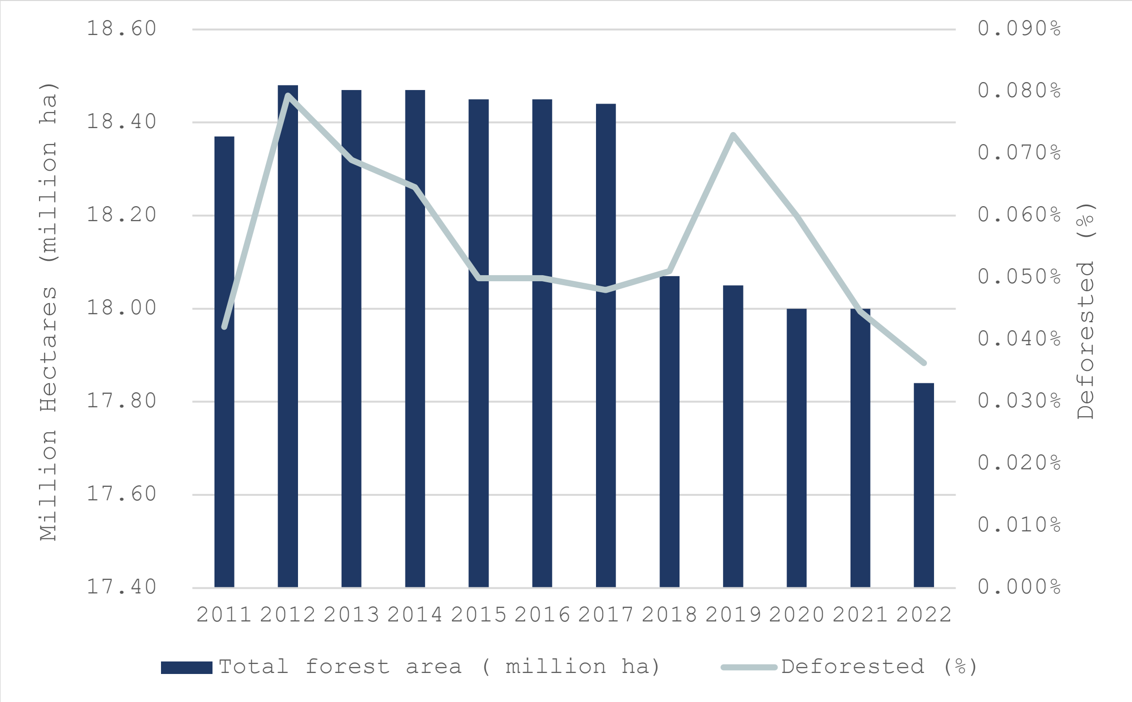


Figure 1.6. Forest lost from 2011 to 2022 [37].

According to the national Reducing Emissions from Deforestation and Degradation (REDD+) Monitoring Reporting and Verification System, also known as the MRVS, gold mining stands out as the predominant driver behind deforestation in Guyana. Additional factors impacting on deforestation include fires, agricultural conversion, infrastructure development for forestry, and settlements change [38].

There are numerous products derived from the forest resource that are both timber and non-timber in nature [39]. Guyana's forest resource is dominated by mixed forest types.

From the 12.5 million hectares of state forest, 4.8 million ha are allocated for sustainable production, with 59.9% of that allocated area for large concessions. In 2021, the Forestry Sector contributed 1.2% to the non-oil GDP. Production in 2021 was 380,000 m^3. The sector is estimated to employ around 22,000 people.

Guyana continually enhances a policy and regulation framework that aims to maintain the forest with very low levels of deforestation and degradation. Guyana has established a selective logging procedure in all concessions, including a system for log tagging allowing the tracking of any log back from where it has been cut in the forest. The deforestation associated to logging is practically zero, and the greenhouse gas (GHG) emissions associated to logging are accounted as degradation. Guyana signed a Forest Law Enforcement, Governance and Trade Voluntary Partnership Agreement (FLEGT VPA) with the European Union (EU) in December 2022.

Preserving Guyana's forests is critical for mitigating climate change, given their significant role in absorbing carbon dioxide. The country actively engages in the REDD+(Reducing emissions from deforestation and forest degradation) framework, part of the Paris Agreement, enabling it to receive payments for reducing deforestation and pursuing climate-friendly activities [40]. Guyana's focus on trading forest carbon stocks brings economic benefits, notably through its partnership with Norway, from which Guyana received over US$220 million in result-based payments, followed by entry into the voluntary carbon markets which has seen Guyana receive a total of US$187.5 million by the end of January 2024 and a further US$100 million anticipated for the remainder of the period covered by this BUR (up to end 2022) [41].

5.3. Arable Land and Agriculture

Cultivated through regular ploughing or tilling, and following a crop rotation system, arable land is an important natural resource for Guyana. According to the data from the World Bank, in 2021 it accounts for approximately 420,000 hectares (2.1% of Guyana's total land area), which computes to approximately 0.52 hectares per person [43]. The arable land is the basis for Guyana's enviable food security, agriculture's contribution to its GDP, rural employment, exports, and foreign exchange earnings. The bulk of the arable land is located on the coast and along the banks of the main rivers.

A pillar of the national economy, the agricultural sector contributed 13% to Guyana's GDP in 2021 and 25% for the non-oil GDP [44]. In Ministry of Agriculture's Performance Report 2015-2020, is estimated that it was close to 16% of GDP, providing over 17.8% of employment, and constituting almost 26% of Guyana's export earnings [45]. Furthermore, an average of approximately 5% of the national budget is dedicated to the agricultural sector [45].

The substantial contributions of agriculture are expected to endure. An estimated 1.74 million hectares are under agrarian production with rice, sugar, and coconut (90,000, 48,000, and 25,000 hectares, respectively) (Figure 1.7). Non-traditional crops (crops other than rice and sugarcane) occupy 40,000 hectares. Roughly 68% of the country's land can accommodate agricultural activity. Most of the agricultural activities are carried out on the Coastal Plain in Regions 2, 3, 4, 5, and 6 [24].

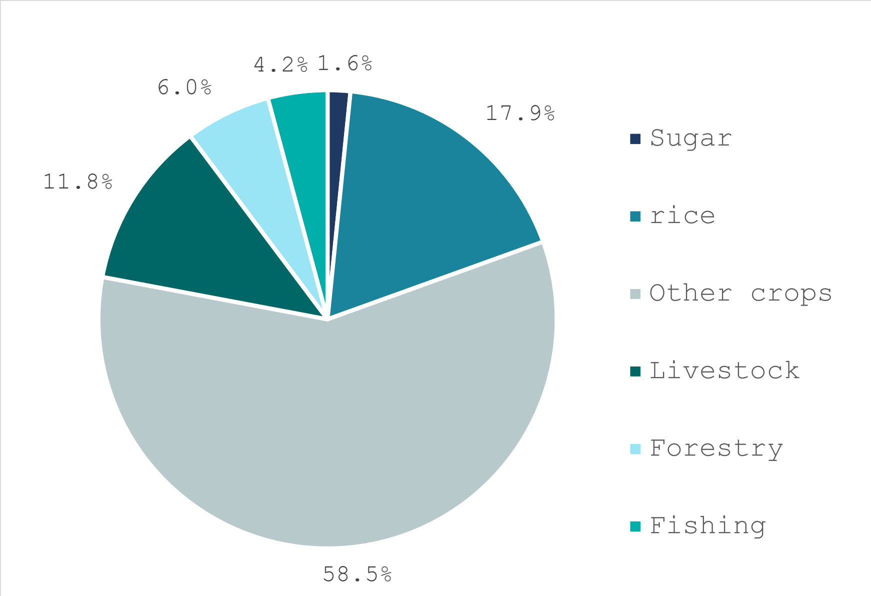


Figure 1.7. Economic contribution to Agriculture Share in GDP [46].

Agriculture has expanded in the Intermediate Savannahs, Rupununi Savannahs, other hinterland areas, and riverine communities. These areas will be in addition to Canal Polder 1, 2 and 3 (areas designed and modified specifically for large-scale production). Agricultural diversification and product transformation have also been promoted in areas such as Bina Hill, Ebini, Manari, and Hosororo. Drought has negatively affected agriculture in Region 9 - Upper Takutu-Upper Essequibo over the past few years.

Agriculture is one of the key sectors for the diversification of the economy. The government plans are to increase production of agriculture without deforesting the forest land.

The Ministry has followed a strategic path focusing on decreasing disaster risk, improving productivity, and encouraging exports. Programs aimed at disaster risk reduction involve activities related to drainage, irrigation, and hinterland development. Simultaneously, endeavours to amplify productivity and exports centre around utilizing technology and extension support to enhance agricultural productivity and fostering market-driven production through initiatives promoting exports and substituting imports [45]. These efforts to enhance the national capacity to contain disaster risks are reflected in the Guyana country work programme for comprehensive disaster management 2021-2025 [47] implemented under the Sendai Framework [48]. Under the programme a detailed analysis of the quality and readiness of the Comprehensive Disaster Management (CDM) and Disaster Risk Reduction (DRR) capabilities was conducted. The outcome attests overall satisfactory results, with disaster preparedness and mitigation scoring highest.

5.4. Fisheries

This is an essential natural resource for Guyana and comprises marine fishery, inland fishery, and aquaculture. It serves as one of the primary sources of relatively cheap protein for the country and contributes 1.2% to 2% to Guyana's GDP [49, 50].

In 2017, the fisheries sector employed an estimated 8,386 people, reflecting a growing trend from 2015 when the total was 7,760 individuals. Numerous individuals derived indirect benefits from occupations associated with fishing, including boat building, supply, and repair [51].

Freshwater or inland fishing activities are conducted in the rivers, lakes, swamps, and flooded plains mainly for subsistence. The only commercial exploitation in this sector is for ornamental fishes. Aquaculture is pursued on a small scale on the coast in impoldered areas bordering the seashore and in ponds. In marine fisheries, the target species is mainly shrimp and prawns [52].

5.5. Water

Guyana´s enormously rich hydrological profile includes renewable internal freshwater resources per capita of 314,963 m^3, ranking Guyana the country with the third highest quantity of freshwater per capita globally. Most other countries around the world have renewable internal freshwater resources per capita of fewer than 100,000 m^3. This is a critical resource for domestic purposes as well as for the country's economically essential industries, such as agriculture and mining. Agriculture utilizes an estimated 94% of extracted water [53].

In terms of the total estimated freshwater supply, the Essequibo, Demerara, and Berbice Rivers contribute an estimated 55.8 % of the freshwater supply for the country. The plentiful supply of freshwater is enormous (defined as >400,000 litres/min) quantities for 8 months annually (wet seasons) and large (4,000-40,000 l/min) to very large (40,000-400,000 l/min) quantities for 4 months annually (Table 1.3).

Table 1.3. Fresh water flow of three main rivers in Guyana [54].

Name of River	Total Annual Flow (km^3/yr)	% freshwater in Guyana
Essequibo River	1,247	40.4
Demerara River	153	5.0
Berbice River	322	10.4
Total	**1,722**	**55.8**

Despite having institutions, agencies, policies, and regulations dedicated to fostering effective water management, Guyana continues to confront various water-related challenges. These include insufficient irrigation water supply during dry seasons, flooding in farming and residential areas during wet seasons, and the contamination of potable water supplies [55].

5.6. Biodiversity and Protected Areas

Guyana is estimated to have more than 8,000 plant species, including numerous endemic species. According to the Convention on Biological Diversity, 6,500 of the total floral diversity have been identified and 50% are considered endemic [56].

There are also unique landscapes, such as the Kaieteur National Park, which hosts a unique assemblage of plants. The rich fauna encompasses around 1,815 recognized species of fishes, amphibians, birds, reptiles, and mammals [57].

Guyana has more than 400 species of fish with at least 10 new species found annually for the last five years in areas such as the Mazaruni Basin [58]. There are over 130 species of amphibians with several endemic species: 814 species of birds and over 200 species of mammals [59]. There are more than 1,600 species of arthropods with significant discoveries being made within the last five years. The count on the number of fungal and bacteria species is 1,200 and 33, respectively. In terms of nematodes and algae, there are 13 and 44 species, respectively; 17 molluscs, and an estimated 30 viruses [30].

Guyana, as one of the eight nations in the Amazonian Cooperation Treaty (ACTO), plays a role in preserving the extensive biodiversity of the Amazon, recognized as the world's largest tropical rainforest [56].

In terms of agricultural biodiversity, 85% of the fruits and vegetables that are cultivated are landrace varieties. Currently, more than 200 species of fruits and vegetables are cultivated in the agro-ecosystem. It is also estimated that more than 1,000 species are grown as ornamentals in the horticultural industry of Guyana [61].

For livestock, various types are reared including poultry, goats, sheep, cattle, swine, horses, and mules. Although the different kinds of livestock reared are not as diverse, there is a high diversity in terms of breeds. These breeds are mostly exotic and are interbred with local breeds to improve production. Livestock and crop breeding falls within the purview of the Guyana Livestock Development Authority (GLDA) and National Agricultural Research and Extension Institute (NAREI) respectively.

Guyana has several protected areas which include the Kaieteur National Park, Iwokrama International Centre for Rain Forest Conservation and Development, Shell Beach and Kanuku Mountains Protected Areas, and Kanashen Amerindian Protected Area, as well as the urban parks including the National Park, Botanical Gardens, Zoological Park, and Joe Viera Park.

Guyana's protected areas currently account for approximately 8.4% of the country's landmass [62].

6. Climate Profile

Guyana's climate, defined by tropical conditions, the influence of northeast trade winds, and notable regional variations, significantly moulds the nation's ecosystems and susceptibility to climate-related hazards. This intricate interplay of winds, convection currents, and orographic lifting, give rise to a Tropical Marine Climate, nurturing persistent humidity and resilience within Guyana's ecosystems [63].

The mean temperature is 27.5°C [64]. The average daily temperatures vary across regions, ranging from 20°C to 32°C [12] approximately. Coastal areas maintain temperatures between 25°C and 27.5°C, while highland regions have temperatures ranging from 20°C to 23°C [65]. Guyana's climate features a Tropical Savannah Climate in the Savannahs. Humidity is high all year round.

Guyana experiences two distinct rainy seasons influenced by the annual migration of the Inter-Tropical Convergence Zone (ITCZ): mid-April to mid-August and mid-November to January in the north, and a singular wet season from May to July in the south [66]. Rainfall during the rest of the year is influenced by northeasterly winds coming from the Atlantic as well as convection currents and Orographic lifting. The northward movement of the ITCZ generally brings heavy rainfall [65]. The Upper Mazaruni Mountains, receiving over 4,000 mm of rainfall, contribute to the country's intricate humid climate [67], as well as the 2,200 mm average rainfall along the coast. The city witnesses an average annual rainfall of approximately 2,300 mm, while in the Savannahs, only one wet season occurs [66].

According to the 2022 World Bank report [10], recurrent flooding from rainfall impacts Guyana's residents during two annual rainy seasons. Projected economic repercussions of rainfall-induced flooding are anticipated to surge by approximately 60% toward the middle of the 21st century due to climate change. By mid-century, an estimated tidal flood with a 20% chance of occurring in any given year could lead to a $150 million USD economic damage, and a storm with a similar probability may flood nearly 5,000 households and over 1,000 commercial or industrial buildings in Georgetown alone, resulting in around $ 30 million USD of economic damage. To address these challenges, key strategies include emergency and extreme events/flood control and management, sea defence enhancement and maintenance, and the reinforcement of drainage and irrigation systems. This complex interplay of geographical, geological, and climatic factors provides the backdrop for a comprehensive examination of Guyana's National Circumstances amid the ongoing challenges posed by climate change.

6.1. Climate Change Trends

The climate in Guyana varies significantly across the country and between seasons. According to Guyana's Second National Communication on Climate Change, the following climate trends were observed since 1960:

- **Mean annual air temperature** has increased with up to 0.3°C, or an average rate of 0.07°C per decade [68].
- **Mean annual precipitation** has increased at an average rate of 4.8 mm per month per decade, or 2.7% per decade.
- **Sea level rise** has increased at a rate more than 10 mm/year, which is 2 to 5 times faster than the global estimate.
- **Change in seasonality**: Rainy seasons have become shorter and more intense, leading to a reduction in agricultural production and events such droughts in dry areas and floods and saltwater intrusion in areas experiencing heavy rains and/or in coastal settings. Seasonal changes in temperature and variability in precipitation are very sensitive to the El Niño-Southern Oscillation (ENSO) cycle resulting in rainfall deficits (e.g. 2023-2024 El Niño) and excesses (e.g. 2020-2023 La Niña).

6.2. Climate Impacts and Vulnerabilities

Guyana has been impacted by a number of climate-related disasters in recent decades that have resulted in major economic losses and infrastructural damages. Climate sensitive sectors such as agriculture are not only important in terms of export revenue earnings, but critical to safeguarding local food security and nutrition for the Guyanese. High-intensity rainfall events and tidal action have resulted in several major floods, such as in 2005 where an estimated $52.6 million USD worth of damages was felt by Guyana's agriculture sector, impacting 69,560 thousand mainly rural households. The country-wide damages from the same event amounted to $465 million USD, or 60% of the GDP [69]. The rice sub-sector was impacted the most with flood damages of $8.8 million USD, while other crops (including fruit, vegetables and tubers) faced losses of $7.8 million USD. Severe floods and damages occurred in subsequent years making the ability to recover and build back stronger, very challenging, flooding were experienced in 2006, 2009, 2010, 2015, 2017 and 2021. The first half of 2021 saw catastrophic flooding and impacted large parts of the population, over 29,900 hectares (17,500 hectares of cash crops and 12,500 hectares of rice) of farmlands and over 20,000 farmers were affected.

While sea levels are rising on a global scale at a rate of 2-4 mm/yr [70], past model results indicate that sea level in the region of Guyana is increasing at a rate in excess of 10 mm/yr - or 2 to 5 times faster than the global estimate [71]. Model predictions for Guyana indicate that mean sea level is projected to rise in Guyana by up to 26 cm by the 2030´s, 43 cm by the 2050´s, 5 cm by the 2070´s [69] and by as much as 80 cm by the year 2100 [72]. When storm surge heights are incorporated in the projections, expected storm surge heights may be close to 3 m in the minimum scenario, and close to 6 m in the maximum scenario by the 2030´s [73].

Despite being outside of the mid-Atlantic hurricane belt, Guyana has suffered from high winds and storm surges triggered by hurricane activities in the past.

Drought events have also become more pronounced in recent years. In 2010, drought also caused severe losses and damage to the country's agriculture sector with overall costs estimated at $14.7 million USD and over 4,050 hectares of rice, livestock and other crops lost. In a recent report published by the United States Department of Agriculture Foreign Agriculture Service, it was indicated that in 2016 up to 20% of the first-crop rice [74] that was grown in the month of January was affected by prevailing drought conditions and another 15% was impacted by saltwater intrusion. In 2023, Guyana has gone through a drought period, with low rainfall during the two wet seasons [75].

The coastal zone's sensitivity to climatic changes is a function of its geographic setting, biophysical characteristics and its economic importance. In terms of geographic setting, the area is situated along a low-lying coastal plain that is highly susceptible to the impacts of sea level rise and saltwater intrusion. Regions 2 through 6 are generally flat and significant sections of the coastline are below sea level, measuring up to a meter below mean sea level in some places [69]. Even Georgetown, the country's capital, is mostly below sea level and depends on dikes and other forms of coastal protection to avoid inundation from the Demerara River and the Atlantic Ocean. The area is also vulnerable to storm surge, coastal erosion, and riverine flooding. Much of the coastal plains already flood during high tide. In response to these ongoing threats, the GoG has had to spend millions of dollars in recent years to rehabilitate seawall defences, a situation that will be made worse as mean sea level continues to rise.

The physical characteristic of the area also heightens its vulnerability, particularly to saltwater intrusion. The coastal plain is made up largely of alluvial mud swept out to sea by the Amazon River, carried north by ocean currents, and deposited on the Guyanese shores. As such, Guyana does not have a well-defined shoreline and a significant portion of the coastal zone is made up of reclaimed land. The area is therefore highly susceptible to saltwater intrusion which threatens an already fragile underground freshwater system. Added to this, drainage throughout most of the coastal zone is poor and river discharge is slow owing to the flat topography of the area. The average gradient of the main rivers is only about one meter every five kilometres. This low gradient and poor drainage account for the highly dense network of irrigation canals seen throughout most of the coastal region. Without these drainage infrastructures most land in the coastal region would not be suitable for crop cultivation.

7. Socioeconomic Profile

7.1. Economy

Guyana´s traditional economy was based in agriculture and mining, yet at the end of 2019 oil extraction started, and the economic profile is changing. Over the last 16 years, the average Constant growth rate GDP in constant 2012 prices have been 11.1%, with a minimum of 0.7% in 2015 and a maximum in 2022 at 63.3%. This demonstrates that Guyana's economy has tripled over the past years. The notable spikes (Figure 1.9) in recent years are primarily attributed to the expansion of oil production since 2019 and consequently, substantial growth in the non-oil economy including a significant scale-up of infrastructure investment to support growth in other industries. In fact, the GDP growth of the non-oil sector was 4.6% in 2021 and 11.5% in 2022 [77].

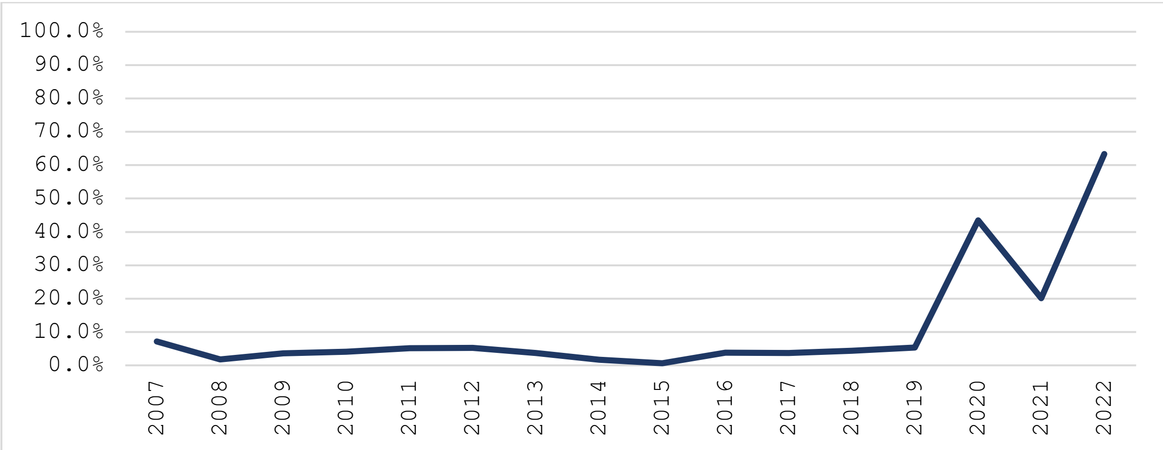


Figure 1.8. Constant growth rate GDP at purchaser prices [78].

Figure 1.9. GDP per capita current prices in USD/capita [79].

Guyana stands as one of the fastest-growing economies, according to the World Bank [10], with promising indicators and a dynamic economic structure. The official currency is the Guyanese dollar, and the exchange rate is regularly adjusted, currently standing at G$210.34 (Jun 2023) to $1 USD [75] (note that the decline depicted in the figure above may not be as visually apparent here since the former is denominated in Guyanese dollar, while the latter is in USD).

As per the Bureau of Statistics, in terms of inflation, the monthly average hovers at a modest 0.3% (August 2023 - September 2023). The provisional data for the year reveals a robust economic performance, with exports reaching $11.3 billion USD and imports at $3.61 billion

USD. This trade dynamic results in a substantial surplus of $7.69 billion USD in the overall commercial balance [75].

Guyana's economic structure is diverse, with key sectors including agriculture (focused on rice and Demerara sugar), bauxite mining, gold mining, timber, shrimp fishing, minerals, tourism, and services. According to the data until 2021, the agricultural sector was contributing over a quarter to the GDP. Additionally, the service sector contributed to more than half of Guyana’s non-oil GDP in 2019, with tourism being the second largest export sector after gold, and sugar (and its by-products) and rice accounted for most of the agricultural exports [80]. However, a significant shift occurred in 2019 with the discovery of substantial offshore oil deposits, leading to a pivotal role for the oil sector since 2020, driving economic growth and development.

Historically rooted in natural resources and agriculture, Guyana is advancing a diversification programme of its domestic economy. While the oil and gas sector present opportunities, there is an early recognition of the risks associated with overreliance on this industry. Sustained real non-oil GDP growth is also expected, as the government continues to invest in human capital, lower energy costs, and build infrastructure, including for climate change adaptation [4]. Revenues from the oil activities are deposited in a Sovereign Natural Resource Fund (NRF), the NRF Act allows for transfers from the NRF to the national budget to allow for public expenditure in key development projects and sectors. The diversification of the economy will include agriculture development.

Data from the World Bank [10] indicates that oil exports alone accounted for about 88% of total exports in 2022. Excluding oil, the major contributors to exports are sugar, gold, bauxite, shrimp, timber, and rice, representing nearly 90% of the country's non-oil exports. This emphasizes the importance of economic diversification for long-term sustainability and resilience against external shocks.

The public sector gross debt was 26% of the GDP and is expected to continue in the same levels over next years.

Guyana’s Human Development Index (HDI) in 2021 was 0.714, position Guyana in 108 out of 191 countries [82]. Between 1990 and 2021 Guyana’s HDI increased by 40.3%. Guyana’s Gender Inequality Index was 0.454 ranking 114 [83]. Women usually participate in agricultural production; however, some are not remunerated in family run businesses. Women represent a higher percentage of Unpaid Family Workers in the agricultural sector [84] compared to the percentage of men Unpaid Family Workers.

7.2. Population and Demographics

The Guyana Bureau of Statistics conducts population census approximately every 10 years with the latest census conducted in 2012 [85]. The following figure illustrates population growth between 1946 to 2022. According to the Pan American Health Organization [86], the population structure has evolved irregularly due to various migrations, resulting in certain age groups predominating national demographics. Once expansive until 1980, population growth stagnated until 2012 with occasional episodes of decline, until a recent 8% growth observed in the past decade attributed to significant economic development, manifesting in Guyana's current demographic landscape, with a population of 808,726 (Figure 1.10).

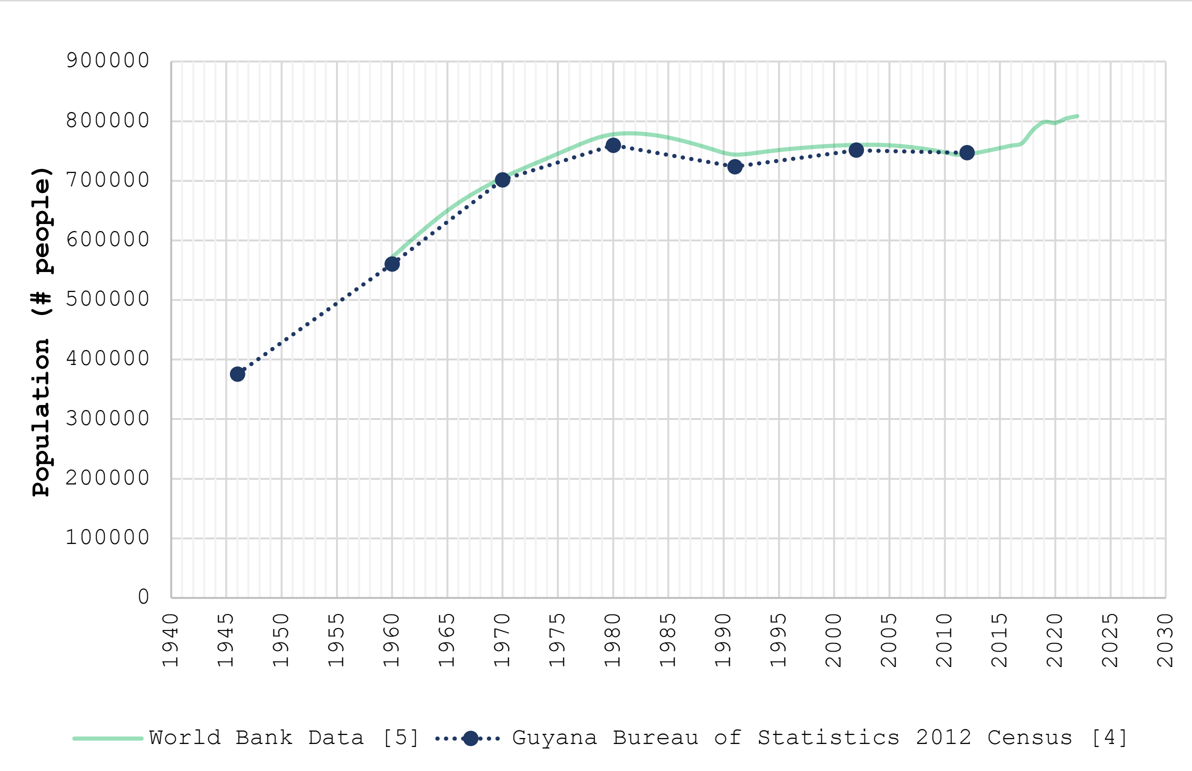


Figure 1.10. Estimated Population by year [78].

As illustrated in Figure 1.11, the population evolution resulted in a structure by 2015 featuring an expansive group older than 40 years of age and below 20 years of age, with a notable 88% of the population being younger than 55 years. Such pattern is observed from elevated fertility rates and relatively low life expectancy, coupled with bi-directional migratory patterns.

The crude birth rate was 20 and 19 per 1,000 population in 2012 and 2014, respectively. The rate remained constant at around 8 per 1,000 population in the years 2012 through 2015. Infant mortality rates experienced fluctuations during the period 2010-2013, reaching a peak of 23.9 per 1,000 live births in 2014. The total fertility rate in 2012 stood at 2.6 children per woman in the 15-49 age group, while life expectancy at birth in 2014 was reported at 66.4 years by the Pan American Health Organization [86].

On the other hand, Guyana witnesses a shrinking prime working age group (20-39 years of age) due to continuous outward migration counter-balanced by influx of foreign-born individuals mostly 20-49 years age. However, Guyana maintains a balanced gender distribution, with 49.7% male and 50.2% female as of 2012 [87] (Figure 1.12).

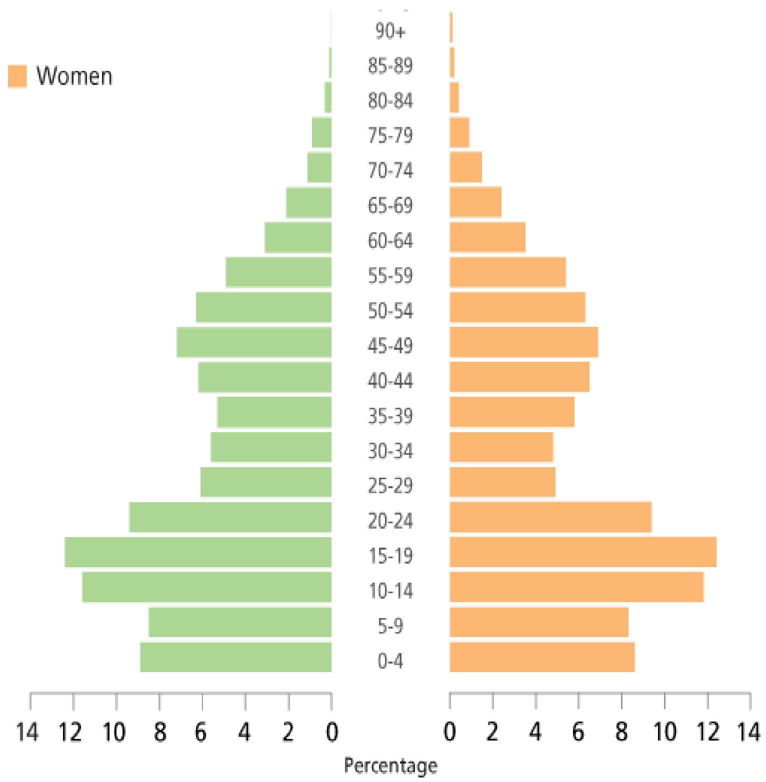


Figure 1.11. Population Age-Sex distribution 2015 [87].

Approximately 89% of the national population resides on the narrow coastal strip, constituting only 10% of the country's total land area [88]. The highest population density occurs in Region 4: Demerara-Mahaica, accounting for over 41% of the total national population. The Administrative Regions with the lowest population densities are those most distant from the coast, namely Region 7: Cuyuni-Mazaruni, Region 8: Potaro-Siparuni, and Region 9: Upper Takutu-Upper Essequibo (Figure 1.12).

Continued urbanization migration patterns are observed as challenges persist in the hinterland. Such high population density in the coastal strip increases the potential impact of climate change-induced events, such as flooding and sea-level rise, posing substantial challenges for the well-being and resilience of the population in these vulnerable areas.

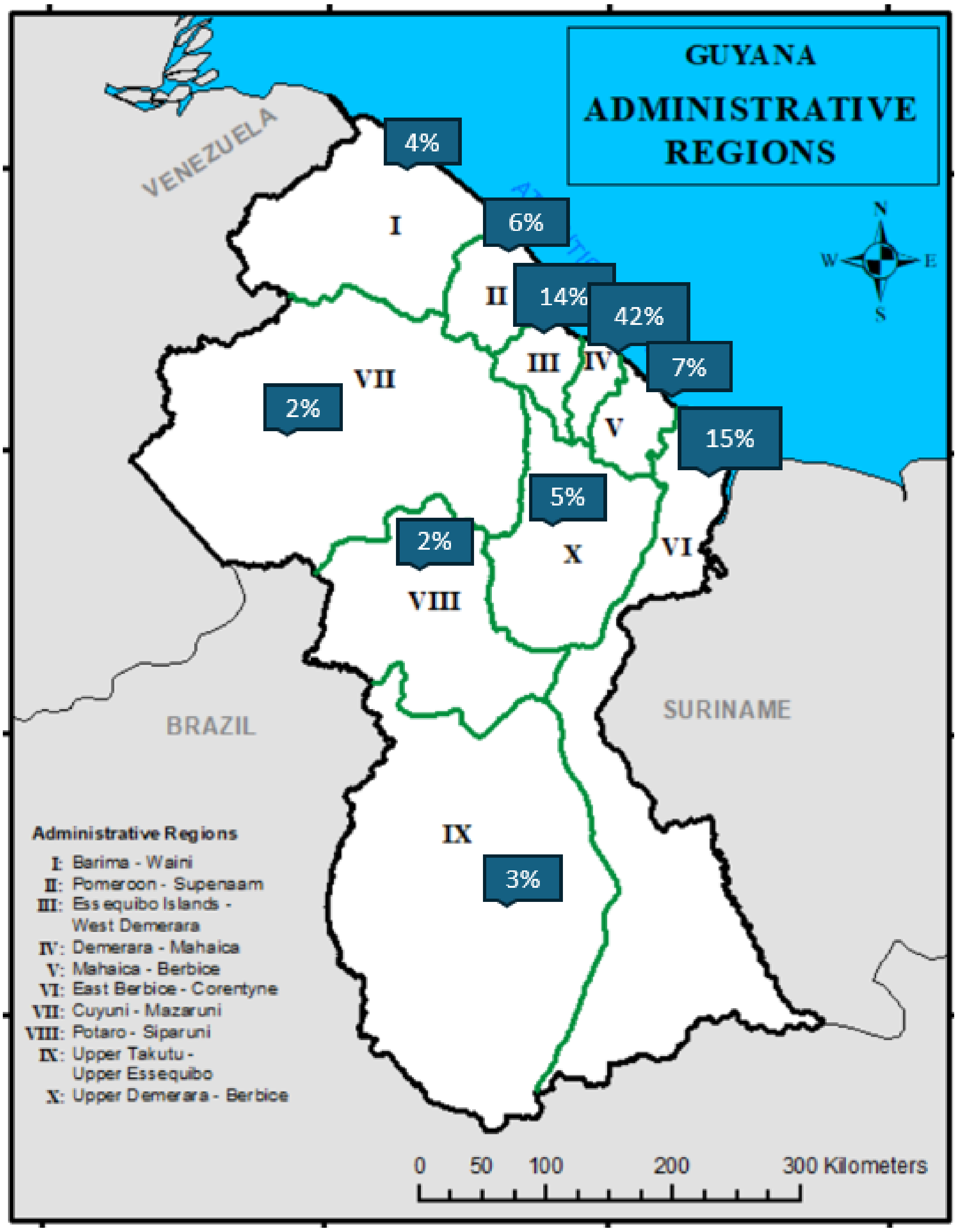


Figure 1.12. Regional population distribution [89].

Guyana's population is a tapestry of multi-ethnicity, consisting of six main ethnic groups with ancestry from India, Africa, Europe, Madeira, and China, as well as Indigenous peoples, the original inhabitants. These include Indo-Guyanese (40%), Afro-Guyanese (26%), Amerindian (11%), and ethnically mixed individuals (20%). Minor ethnic groups such as the Chinese, Portuguese, and white populations collectively constitute less than 1% of the total population [90].

Ethnic groups also exhibit distinct territorial distribution, with Indigenous populations more prevalent in rural areas. The country has migrants from Suriname, Brazil, Venezuela, and Caribbean countries.

The languages spoken include English, Amerindian dialects, Creole, Hindi, and Urdu [91].

Education plays a pivotal role in societal advancement, and in 2022, Guyana reported an average national illiteracy rate of 10% [87]. Overall, the country's illiteracy rates for males and females were 11.1% and 10.2% respectively.

As per the latest available figures, in 2022, the overall unemployment rate, calculated from the workforce aged 15-64, was 12.4%, while the unemployment rate of the 15- to 24-year-old workforce (youth) stood at about 25%.

7.3. Infrastructure

Improving the existing infrastructure is one of the key development objectives of the Government of Guyana, with large investments over last 2 years. As a result, the numbers discussed below are expected to change in the coming years.

Road network

There is a total of 2,604 km of roads in the national network (428 km primary roads, 583 km secondary roads, and 1,593 km interior roads). Paved roads only account for 35 % of the total road network and unpaved 65%.

Sea defences

The main area of focus is from Pomeroon to the Corentyne River (230 km). The country has 169 km of earthen embankments, 69 km of masonry seawalls, and 78 km of sand banks protected by the 80,432 hectares of mangroves in several places. The sea defence is supported by an intricate drainage and irrigation system consisting of dams, canals, and sluices.

The Government is working to develop green-grey solutions (engineered infrastructure-mangroves). Green-grey technologies use a combination of engineered infrastructure and natural solutions such as mangrove ecosystems to capture sediments and speed up the natural process to reclaim areas and later naturally regrow the coast. Beside the additional area reclaimed to the sea, the green-grey solutions provide other benefits, like reduction in flooding and other ecosystem services like carbon capture, increase fishing stock, increase biodiversity, apiculture, or ecotourism opportunities [41].

Drainage and irrigation

Guyana's drainage and irrigation system is a network of conservancies, canals, sluice gates/kokers, and pumping stations for flood control, and water storage and distribution for agricultural and domestic purposes and drainage. In the event of heavy rainfall, which may result in the conservancies becoming full or near capacity, water is released using a gravity-dependent drainage system of canals leading to the sea (or rivers). The release of water to the Atlantic Ocean is regulated by the 136 sluice gates/kokers located in the 109.27 km of seawall. The conservancies store water during the dry seasons.

The drainage and irrigation system has 500 km of main irrigation canals, 1,100 km of secondary canals, 500 km of main drainage channels, and 1,500 km of secondary drainage channels. The National Drainage and Irrigation Authority (NDIA) operates 58 D&I pumps supported by earth moving equipment for maintenance and rehabilitation.

Deterioration of drainage and irrigation and sea defence structures is due to both anthropogenic factors (poor maintenance, mangroves deforestation) and natural factors (longshore drift).

8. Energy

8.1 Current Energy Usage

According to the report from Guyana Light and Power (GPL), the exclusive electricity provider in Guyana, 97% of the energy produced in the country is generated using fossil fuels, specifically Heavy Fossil Fuel and diesel [95]. These petroleum-based products are simultaneously dependent on Guyana importing them, indicating a heavy reliance on imported petroleum-based fuels for the country's energy sector. Import of petroleum-based fuels include products such as diesel, fuel oil, motor gasoline, avjet (jet fuel), avgas (aviation gasoline), kerosene, liquefied petroleum gas (LPG), and liquefied natural gas (LNG).

The table and figure below (Table 1.6, Figure 1.13) illustrate the total annual fuel imports by product for the years 2017-2022 and tracks the changes in fuel imports over this period.

Between 2017 and 2022, Guyana imported a total of 39.4 million barrels of petroleum-based products, averaging about 6.57 million barrels per year. The data indicates that a significant volume of 7.74 million barrels of petroleum-based products was imported in 2022, averaging approximately 21,198 barrels per day. The highest increase occurred from 2020 to 2021, showing an 11.8% jump [7]. In 2023, 49% of the imports originated from Trinidad and Tobago, with the remaining imports coming from various countries, including the United States, Sweden, Spain, Italy, Netherlands, United Kingdom, Argentina, St. Lucia, Latvia, Saudi Arabia, Kuwait, and Martinique [7].

Table 1.6. Total annual imports of petroleum-based products for 2017-2022 (barrels) [7].

Product	2017	2018	2019	2020	2021	2022
Mogas	1,323,717	1,317,450	1,375,211	1,505,954	1,676,056	1,635,026
Gasoil	2,388,315	2,572,503	3,013,280	3,140,147	3,597,281	3,849,991
Kero	78,893	76,488	77,976	80,409	85,962	74,278
Avjet	187,576	149,660	160,106	130,861	208,371	200,513
Fuel oil	1,378,196	1,458,369	1,450,255	1,504,966	1,563,278	1,694,130
LPG	193,916	209,844	225,570	247,151	264,682	266,514
LNG	3,082	333	2,538	9,685	8,263	11,068
Avgas	10,037	8,209	8,805	6,903	6,736	5,829
Total	5,563,733	5,792,857	6,313,740	6,626,075	7,410,630	7,737,349

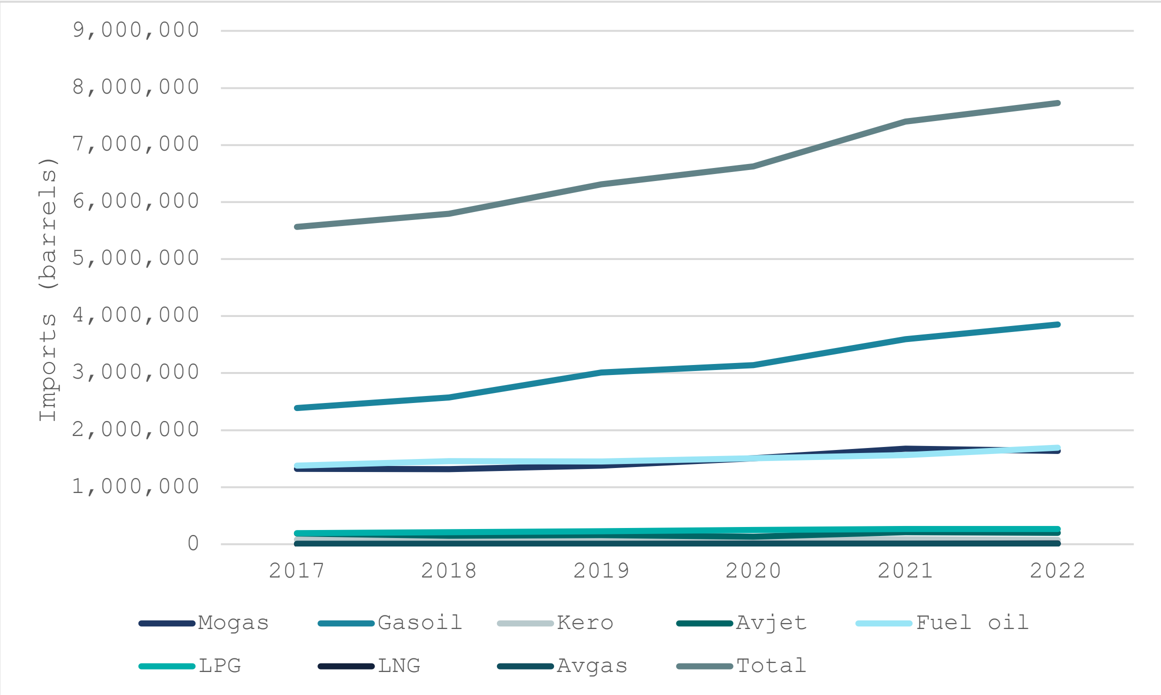


Figure 1.13. Total annual imports of petroleum-based products for 2017-2022 (barrels) [7].

Over the past five years, the most imported products were gasoil, accounting for 46.8% of the total fuel products imported in 2017-2022, followed by fuel oil at 23.1% and mogas at 22.5% (Figure 1.14). While gasoil exhibits an increasing trajectory over the years, the other two main imports are decreasing. The remaining products maintain a relatively consistent average over the five years, except for avjet, which experienced a substantial decline from 2017 to 2018 followed by a steady decrease.

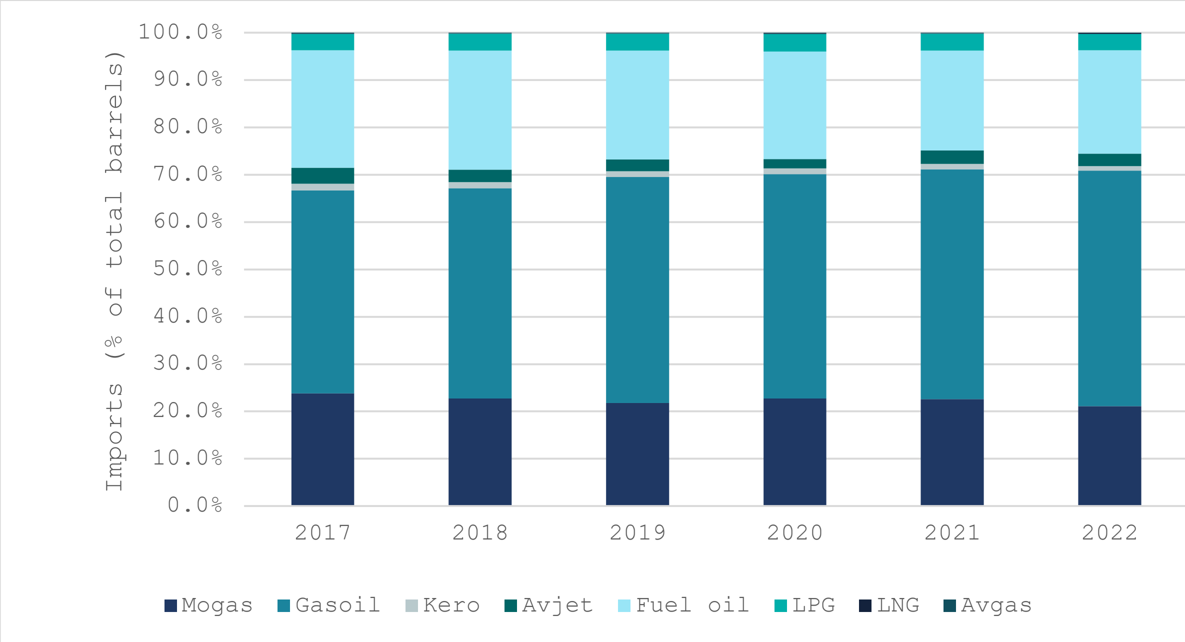


Figure 1.14. Average annual imports of petroleum-based products for 2017-2022 (barrels) [7].

All of Guyana's oil production is directed towards exports. In the year 2021 alone, the country exported a total of 42 million barrels of oil [7].

A comparable upward trend of total annual consumption of petroleum-based products, as observed in imports, is evident from 2017 to 2022. The provided data (Table 1.7, Figure 1.15) illustrates total fuel consumption by product for the period 2017-2022 and the corresponding changes over time. Between 2017-2022, the total annual consumption of petroleum-based products amounted to 39.9 million barrels, averaging 6.48 million barrels per year. The highest consumption occurred in 2022, reaching 7.7 million barrels, equivalent to 21,270.8 barrels per day. The evidence indicates a consistent upward trajectory, aligning with the import trends, exhibiting an average growth rate of 18.7% with 2017 as the reference year. There was a decline in annual consumption in 2020 compared to 2019 by 3.4% (222,541 barrels less), followed by the most substantial increase from 2020 to 2021 at 12% (748,256 barrels more).

Table 1.7. Total annual consumption of petroleum-based products for 2017-2022 (barrels) [7].

Product	2017	2018	2019	2020	2021	2022
Mogas	1,340,712	1,349,687	1,503,160	1,509,019	1,383,728	1,666,448
Gasoil	2,428,990	2,578,600	3,010,868	3,022,700	3,558,522	3,838,161
Kero	91,009	83,581	86,221	89,230	66,637	67,880
Avjet	164,564	154,992	168,921	128,935	183,209	210,913
Fuel oil	1,373,781	1,453,668	1,435,560	1,213,098	1,510,343	1,685,367
LPG	218,665	230,612	242,878	257,799	267,295	278,027
LNG	9,499	8,250	8,747	6,801	6,611	5,980
Avgas	3,082	333	2,538	8,769	8,263	11,068
Total	5,612,475	5,859,724	6,458,893	6,236,352	6,984,608	7,763,843

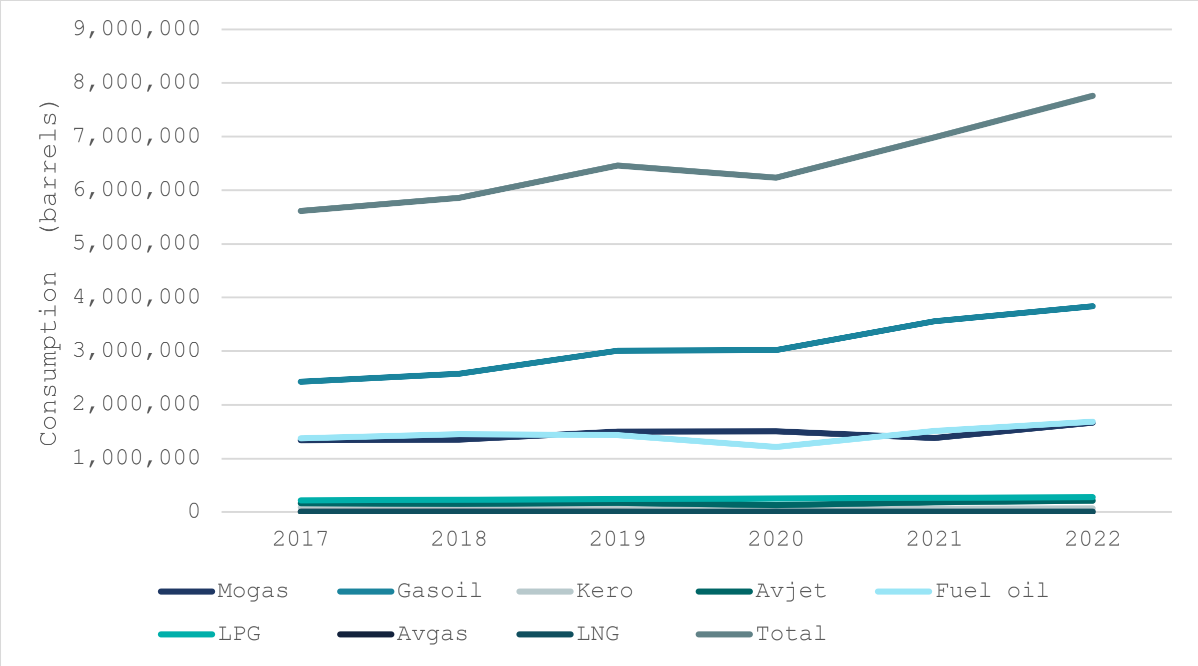


Figure 1.15. Total annual consumption of petroleum-based products for 2017-2022 (barrels) [7].

Over the past five years, gasoil has been the most consumed petroleum-based product, averaging 47.1%, followed by fuel oil at 22.4%, and mogas at 22.6% (Figure 1.16). Gasoil exhibits an increasing trajectory until 2022, where it slightly drops, while the others show a modest decreasing trend. Other petroleum-based products, such as kerosene, are decreasing, while others maintain a relatively consistent average over the five years.

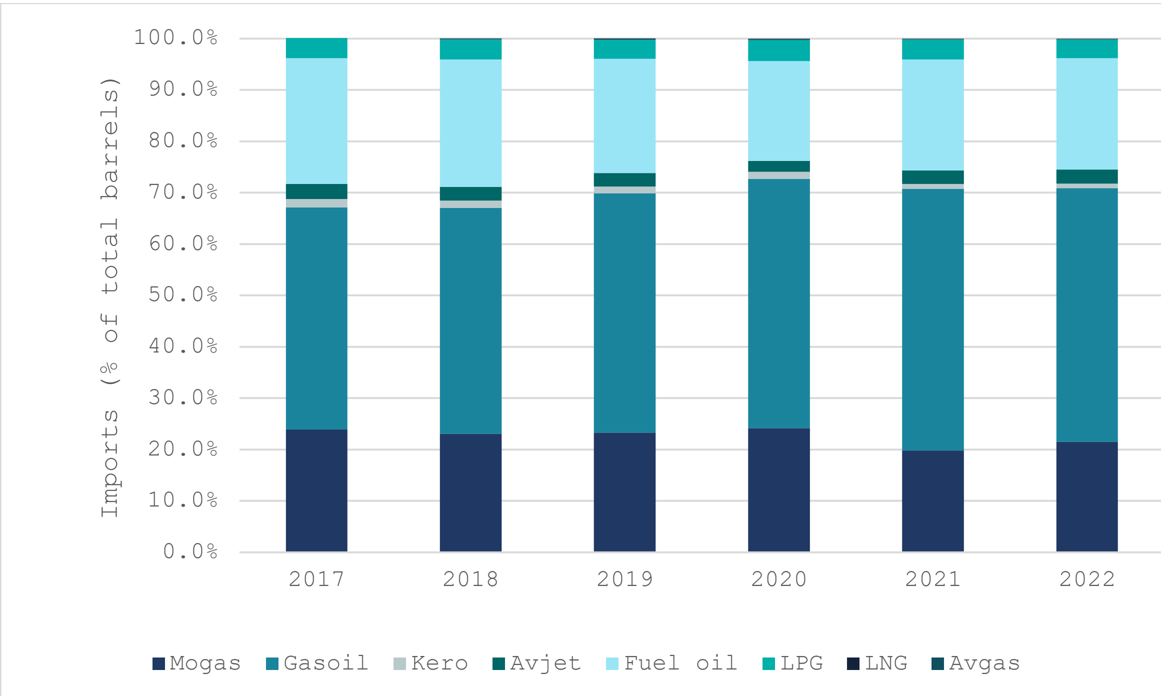


Figure 1.16. Average annual consumption of petroleum-based products for 2017-2022 (barrels) [7].

Guyana's energy dependency rate on imports (Table 1.8) is exceptionally high. This rate is defined as imports divided by consumption. It represents the proportion of petroleum-based products consumed at the national level that relies on imports of such products for the same year. In the years 2017-2022, approximately 100% depended on imports of petroleum-based products. This underscores Guyana's substantial reliance on imported petroleum-based products, which constitute the primary source of its energy.

Table 1.8. Imports and consumption of petroleum-based products for 2017-2022 (barrels) [7].

Product	2017	2018	2019	2020	2021	2022
Imports	5,563,733	5,792,857	6,313,740	6,626,075	7,410,630	7,737,349
Consumption	5,612,475	5,859,724	6,458,893	6,236,352	6,984,608	7,763,843
Dependency rate (%)	99.1%	98.9%	97.8%	106.2%	106.1%	99.7%

The breakdown of energy consumption by sector reveals that transport and electric power generation are the predominant consumers of imported fuel products in Guyana. Other sectors, including agriculture, fishing, mining, and households, follow in consumption. The accompanying figure (Figure 1.17) illustrates the final consumption by sector for Guyana from 1990 to 2020.

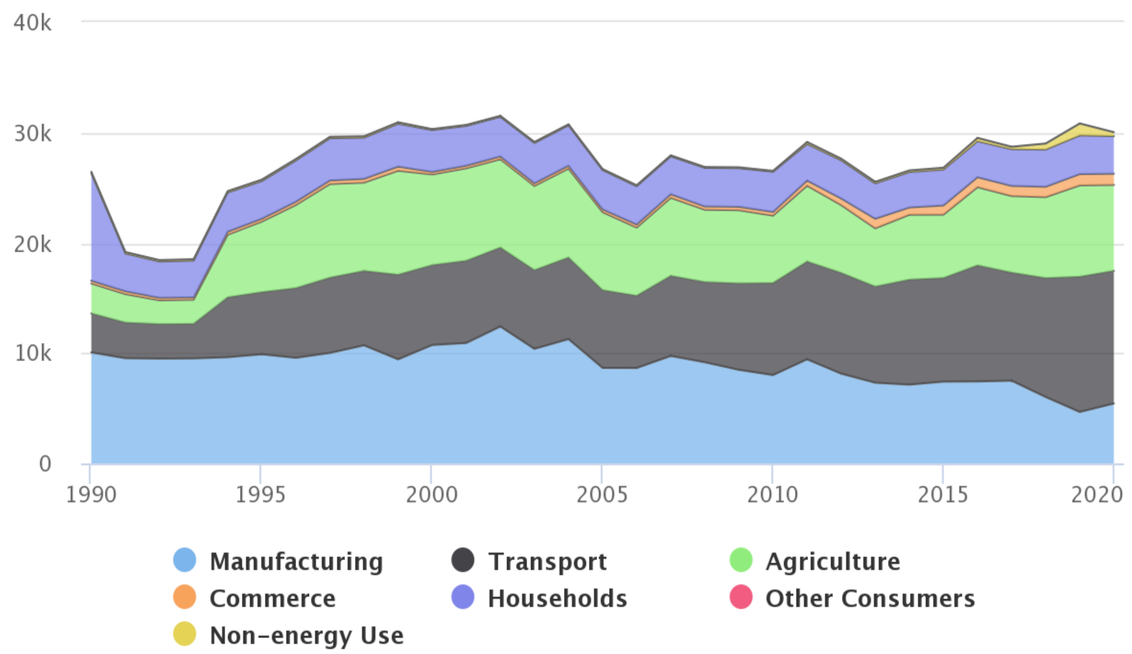


Figure 1.17. Final consumption by sector in terajoules (TJ) [97].

Aligned with the reported trends, the United Nations Economic Commission for Latin America and the Caribbean indicates that in 2020, nearly 75% of total fuel products were allocated to the transportation and electricity generation sector. In 2021, the breakdown shifted with 37% of fuel consumed for transport, 32% for electricity generation, 26% for agriculture, forestry, and fishing, and 6% for non-electric building purposes. The electricity generated in total amounted to 1,138 GWh [95].

The Energy Agency's Annual Report [98] anticipates increased gasoline consumption in 2022, likely due to heightened public transport use following the full reopening of schools. A notable uptick in LPG usage suggests a preference for cooking gas over kerosene. The overall surge in fuel oil consumption is linked to expanded bauxite production, increased manufacturing, and higher energy demand from the electric utility. The rise in jet fuel usage corresponds to an increase in international flight travel, while there is a simultaneous decline in the consumption and sales of aviation gasoline.

Recently, more than 80% of the electricity demanded is in the Demerara-Berbice Interconnected System (DBIS) and the rest is consumed in 12 other isolated grids across Guyana. The main grid has currently a cost of generation that varies with the fuel cost. In 2021 the cost of generation of electricity in DBIS was $150 USD/MWh, and grid losses accrued to staggering 24.7% (including technical and commercial losses). The electricity is sold to the end-users at prices between $0.20-0.25 USD/kWh [99]. The other isolated grids have higher generation cost, as they use more percentages of diesel (which is more expensive than heavy fuel oil) and the transport of fuel further increases the total the generation cost. All the grids are operated by public utilities which receive financial support from the central government to keep customer tariffs at lower levels. These subsidies are bigger for isolated grids.

8.2 Planned Energy Transition

As set out above, Guyana’s historic energy supply has been carbon-intensive and expensive. However, as set out in the LCDS 2030, the country is on the threshold of an ambitious energy situation to change this reality.

Due to rapid economic growth, the demand for electricity has been increasing significantly and is expected to continue growing at a fast pace, (Figure 1.18).

The LCDS 2030, endorsed by the National Assembly in July 2022, includes a transition plan to reduce the dependency of imported fossil fuel and to reduce GHG emissions [100].

The plan outlines the incorporation of natural gas as a transitional fuel for electricity generation, with a gradual integration of solar, wind, and hydro sources to achieve a 60% renewable energy share by 2030. Despite an anticipated sevenfold increase in demand by 2030 compared to 2021, the goal is to maintain GHG emissions at the 2021 levels.

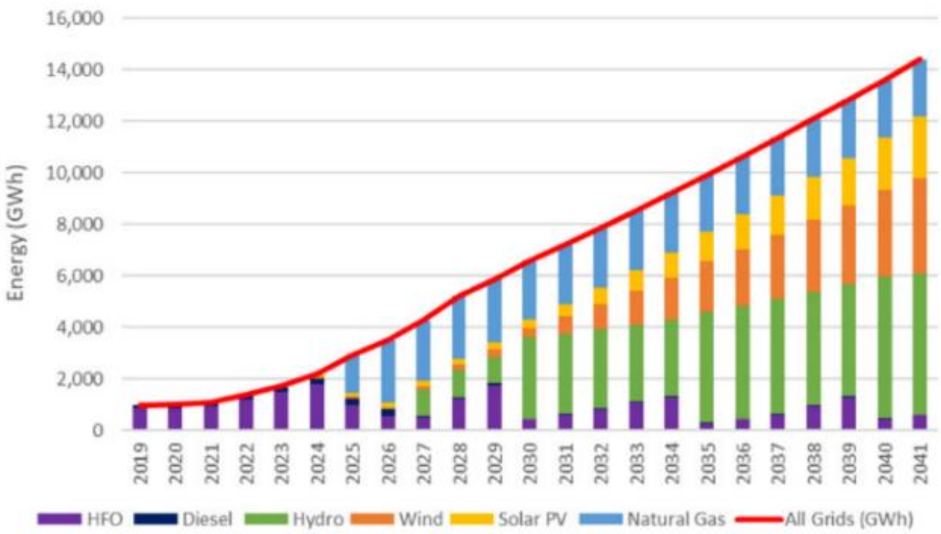


Figure 1.18. Projection of Energy Mix in all public grids (left) and GHG emissions (right) [100].

Guyana has actively pursued an increased share of renewable energy sources and energy efficiency initiatives, incorporating wind and solar farms, small hydropower projects, and promoting energy efficiency in various sectors. Measures include the replacement of inefficient lighting technology with energy-efficient light emitting diodes (LEDs) in households, businesses, and public buildings [26]..

9. Tourism

The tourism sector in Guyana is skewed towards ecotourism which is concentrated mainly in the hinterland regions. The geography of these regions, the geomorphological features, and the array of exquisite fauna and flora make Guyana a prime destination for tourism. As from the Guyana Office for Investment, in 2021, the sector's economic contribution is modest, estimated at 2.3% of GDP, generating 15,700 indirect jobs. The number of tourists increased by 82.1% over 2021, totalling 288,322 in 2022. Tourism contributes to Guyana's Low Carbon Agenda and all 17 United Nations Sustainable Development Goals (SDGs) [101].

10. Climate Change Policy and Institutional Framework

10.1. International Environmental Agreements

Guyana actively participates in international and regional efforts to safeguard the Earth's natural resources, being a signatory to key agreements such as the United Nations Framework for Climate Change Convention (UNFCCC), the Kyoto Protocol, and the Paris Agreement, among others (Table 1.9).

At the regional level, Guyana is committed to CARICOM's 2009 objectives for enhancing climate change resilience. Notably, between 2012 and 2016, Guyana ratified three significant international agreements: the Paris Agreement, the Nagoya Protocol, and the Minamata Protocol.

Table 1.9. International environmental agreements to which Guyana is a signatory.

Name of international agreement	Dates of adoption / Entry into force	Guyana´s ratification
UNFCCC	Adopted on 09 May 1992; entered into force on 21 March 1994	Ratified on 29 August 1994
Kyoto Protocol	Adopted on 11 December 1997; entered into force on 16 February 2005	Acceded on 05 August 2003
Paris Agreement	Adopted 12 December 2015; Entered into force 04 November 2016	Ratified on 20 May 2016
Vienna Convention for the Protection of the Ozone Layer	Adopted on 22 March 1985; entered into force on 22 September 1988	Acceded on 12 August 1993
Montreal Protocol on Substances that Deplete the Ozone Layer	Adopted on 16 September 1987; entered into force on 1 January 1989	Acceded on 12 August 1993
United Nations Convention on Biological Diversity (UNCBD)	Signed on 5 June 1992, entered into force in 29 December 1993.	Ratified on 29 August 1994
Cartagena Protocol on Biosafety to the Convention on Biological Diversity	Adopted on 29 January 2000; entered into force on 11 September 2003	Acceded on 18 March 2008
Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity	Adopted on 29 October 2010; entered into force on 12 October 2014	Acceded on 22 April 2014

Name of international agreement	Dates of adoption / Entry into force	Guyana´s ratification
United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa (UNCCD)	Adopted on 17 June 1994; entered into force on 26 December 1996	Acceded on 26 June 1997
United Nations Convention on the Law of the Sea	Opened for signature on 10 December 1982; entered into force 16 November 1994	Ratified on 16 November 1993
Agreement relating to the implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982	Adopted on 28 July 1994; entered into force on 28 July 1996	Ratified/acceded on 25 September 2008
International Convention for the Prevention of Pollution from Ships (MARPOL 73/78)	Adopted on 2 November 1973; the Convention and the Protocol of 1978 were combined and entered into force on 2 October 1983	Acceded on 10 December 1997
Cartagena Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region and its Oil Spill Protocol	Adopted on 24 March 1983; Entered into force on 11 October 1986	Ratified on 14 July 2010
Special Protected Areas and Wildlife Protocol under the Cartagena Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region	Entered into force on 18 June 2000	Acceded on 14 July 2010
Protocol Concerning Pollution from Land Based Sources and Activities	Entered into force on 13 August 2010	Acceded on 14 July 2010
Basel Convention for the Control of Transboundary Movements of Hazardous Wastes and their Disposal	Adopted on 22 March 1989; entered into force on 5 May 1992	Acceded on 04 April 2001

Name of international agreement	Dates of adoption / Entry into force	Guyana´s ratification
Rotterdam Convention on Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade	Adopted on 10 September 1998; entered into force 24 February 2004	Acceded on 25 June 2007
Stockholm Convention on Persistent Organic Pollutants	Adopted on 22 May 2001; entered into force on 17 May 2004.	Acceded on 12 September 2007
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	Opened for signature on 3 March 1973; entered into force on 1 July 1975	Acceded on 27 May 1977
Minamata Convention on Mercury	Adopted on 10 October 2013; entered into force on 16 August 2017	Ratified on 24 September 2014
Amazon Cooperation Treaty Organization (ACTO)	Signed on 3 July 1978; entered into force on 2 August 1980	Adopted
The 2030 Agenda for Sustainable Development	Approved in September 2015 by the United Nations General Assembly	Adopted
Sendai Framework for Disaster Risk Reduction 2015-2030	March 18, 2015	Adopted

10.2. Department of Environment and Climate Change

The Department of Environment and Climate Change (DECC) supports Guyana's transition to a low carbon state and works closely with agencies such as the Guyana Forestry Commission, Environmental Protection Agency (EPA), Protected Areas Commission (PAC), National Parks Commission (NPC), and the Wildlife Conservation and Management Commission (WCMC). The DECC coordinates all reporting to the UNFCCC.

National Constitution of Guyana

The Constitution of the Co-operative Republic of Guyana of 1980 provides for the protection of the environment by the state and by the people; Article 36 reads: *"In the interests of the present and future generations, the State will protect and make rational use of its land, mineral* *and water resources, as well as its fauna and flora, and will take all appropriate measures to conserve and improve the environment."*

Additionally, Article 25 states that "*Every citizen has a duty to participate in activities designed to improve the environment and protect the health of the nation*."

10.3. Environmental Protection Act

The Environmental Protection Act of 1996 and its amendment in 2005 serve as the legislative framework for implementing environmental provisions outlined in the Constitution. Encompassing ten sections, these acts address the management, conservation, protection, and enhancement of the environment, pollution prevention and control, impact assessment of economic development on the environment, and sustainable use of natural resources. The Environmental Protection Agency (EPA) was subsequently established in 1996 under these acts, tasked with implementing effective measures for the management of the natural environment and its components. The EPA's jurisdiction spans various sectors, including waste, health, and the environment, with a legislative focus on mitigation efforts.

The EPA also ensures that developmental activities which have the potential to cause adverse effects on the natural environment are assessed before the activities are implemented. A critical role of the EPA is the establishment, monitoring, and enforcement of environmental regulations. To this end, among others, the EPA has established the following regulations:

- Hazardous Wastes Management Regulation 2000;
- Water Quality Regulations 2000;
- Air Quality Regulations 2000;
- Litter Enforcement Regulations 2013;
- Styrofoam Regulations (Expanded Polystyrene Ban) 2015.

In its efforts to prevent pollution and evaluate developmental initiatives, the EPA plays a crucial role in ensuring the safeguarding of the environment. These measures aim to curb pollution and support reduce greenhouse gas emissions, making a significant contribution to the fight against climate change.

10.4. Protected Areas Act

The Protected Areas Act (2011) was enacted to safeguard and conserve Guyana's natural heritage and capital. It establishes the Protected Areas Commission (PAC), the National Protected Areas System (NPAS), and the Protected Areas Trust Fund (PATF). These Acts aims to maintain crucial ecosystem services with global importance, fulfil international environmental responsibilities, and encourage public participation in conservation efforts. The NPAS, a tool for addressing climate change, plays a key role in preserving and expanding Guyana's terrestrial and aquatic environments, aligning with the country's international environmental commitments.

Under the PAC's legislative framework, the Minister has the role of declaring national protected areas which applies to various maritime zones and empowers village councils to seek recognition for Amerindian protected areas. The legislation outlines the management of protected areas and focuses on conserving biological diversity, natural landscapes, seascapes, wetlands, and ecosystems. Emphasizing principles of ecologically sustainable development, the Act is integral to Guyana's commitment to environmental.

10.5. Wildlife Conservation and Management Act

The Wildlife Conservation and Management Act 2016 serves the purpose of establishing a supportive mechanism aligned with national goals for wildlife protection, conservation, management, and sustainable use. This legislation creates a framework governing local and international trade in all species of Guyana's wildlife, ensuring compliance with the Convention. The Act aims to provide a transparent and fair framework of licensing and decisions. In addition to establishing the Guyana Wildlife Conservation and Management Commission (WCMC), the Act addresses the protection, conservation, management, and sustainable use of all wildlife within and beyond Guyana. The WCMC plays a pivotal role in effective wildlife management and conservation, preventing overexploitation through various measures. It also takes steps to protect endangered ecosystems, habitats, and species while advising on regional and international compliance. The Act empowers the WCMC to promote and facilitate the rescue, rehabilitation, and return of wildlife to their natural habitats. Furthermore, the WCMC, along with the EPA, enforces the Act, ensuring Guyana's fulfilment of international environmental commitments, particularly under the UNCBD and CITES, where the WCMC serves as the focal point. Additionally, through the promotion of reforestation programs, the Commission contributes to climate change mitigation efforts.

10.6. Other Key Legislation

There are some other natural resources legislation and those that ensure the country's environment is protected. Among these are:

- Fisheries Act, 2002[2];
- Amerindian Act, 2006[3];
- Forest Act, 2009[4]; and
- Mining Act, 1989[5] and its regulations, particularly, Mining Regulations, 2005.

10.7. National Plans/Policies/Strategies

Guyana's commitment to sustainable development is evident through various strategic frameworks and plans.

The LCDS, launched in 2009, positions Guyana on a low carbon, green trajectory. The LCDS, updated in 2013 and subsequently in 2022, aims to transform the economy while providing a model for addressing climate change. Notably, the strategy addresses climate change mitigation, adaptation, and resilience-building priorities [41].

The National Biodiversity Strategy and Action Plan (NBSAP), aligned with the UNCBD, guides biodiversity conservation efforts until 2020 [102]. Additionally, the Aligned National Action Plan (ANAP) works against land degradation, aligning with the UNCCD Strategic Plan [103]. The National Land Use Plan (NLUP) strategically guides land development, promoting multiple land uses [104].

The Draft Climate Resilience Strategy and Action Plan (CRSAP), spanning 2016-2020, outlines key objectives and actions to enhance resilience to climate change across various sectors. This draft Plan informs the development of Guyana's National Adaptation Plan (NAP) [155].

Several pre-existing strategies and plans contribute to Guyana's comprehensive approach, including the National Development Strategy (2001), Integrated Coastal Zone Management Action Plan (2000), National Mangrove Management Action Plan (2001), National Agricultural Sector Climate Change Adaptation Policy (2009), Guyana Climate Change Action Plan (2001), and the National Action Plan for Combating Land Degradation (2006). In 2018, the National Forest Policy Statement and National Forest Plan were revised. The overall objective goal of the National Forest Policy Statement and Plan is "*The conservation, protection and utilization of the state's forest, by ensuring its social, economic and environmental attributes and benefits are sustained and enhanced for the benefit of cur-rent and future generations of Guyanese, whilst fulfilling Guyana's commitments under international agreements and conventions*".

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2 https://faolex.fao.org/docs/pdf/guy142497.pdf
3 https://parliament.gov.gy/documents/acts/4680-act_no_6_of_2006.pdf
4 https://forestry.gov.gy/wp-content/uploads/2016/07/Forests-Act-2009.pdf
5 https://faolex.fao.org/docs/pdf/guy81462.pdf

These collectively reflect Guyana's dedication to sustainable development, conservation, and climate resilience.

10.8. Mainstreaming Rio Convention Implementation

The Department of Environment and Climate Change, initiated a project funded by the Government of Guyana (GoG), United Nations Development Programme (UNDP), and the Global Environmental Facility (GEF). This project aimed to enhance technical capacities across agencies for mainstreaming and monitoring the Rio Conventions – UNFCCC, UNCBD, and UNCCD. The key components involved establishing the Environmental Information Management and Monitoring System (EIMMS), strengthening the capabilities of stakeholders, enhancing awareness of global environmental values, and updating the national capacity self-assessment (NCSA) to align with post-2015 sustainable development goals.

Following the project, the Guyana Forestry Commission (GFC) has successfully enhanced its capacity, achieving a detailed analysis of emissions through the REDD+ MRVS. The MRVS has significantly improved accuracy and specificity in the commitment to preserving forests. Notably, the MRVS has established a crucial link between indigenous communities and the national level, fostering community engagement. An important impact of the MRVS creation is the recognition by other sectors of the value in establishing similar systems for their respective work. [106].

11. Development Priorities and Objectives

The key policies, strategies and development plans that were being implemented after Guyana´s third national communication to the UNFCCC published in 2021 are summarized in Table 1.10 – 1.13 by sector. This section provides a comprehensive overview of Guyana's development priorities and objectives across four crucial areas: **Agriculture, Natural Resources, Energy, and Climate Change**. Each sector is strategically aligned with national goals and global sustainability targets. The objectives and priorities outlined herein reflect Guyana's commitment to fostering economic prosperity, environmental sustainability, and climate resilience.

11.1. Agriculture Sector

Table 1.10. Agriculture objectives and priorities.

Title	Year	Description
National Policy on Inland Fisheries and Aquaculture	2012	Objectives: • Promote sustainable development of inland fisheries and aquaculture. • Ensure food security and social and economic benefits. • Protect, maintain, and rehabilitate the ecosystem. Priorities: • Institutional strengthening. • Capacity building. • Research and development.
A National Strategy for Agriculture in Guyana (updated in 2021)	2013-2020	Objectives: • Achieve sustained economic and social prosperity through agriculture. • Ensure food security and social and economic benefits. • Protect, maintain, and rehabilitate the ecosystem. Priorities (F-5 Strategic Approach): • Food security consolidate end hunger. • Fiber and nutritious food accessibility. • Fuel production via alternative fuel sources. • Fashion and health products based on agro-process industry. • Furniture and crafts industry expansion.
Disaster Risk Management Plan	2013-2018	Objectives: • Strengthen technical capacities and institutional frameworks. • Improve decision-making and coordination.

Title	Year	Description
for the Agriculture Sector		• Articulate sustainable mechanisms for integrated financial resource mobilization. Priority: • Strengthening institutional and technical capacities. • Risk identification, information system and early warning. • Building resilience for sustainable livelihoods. • Preparedness response and rehabilitation.
Marine Fisheries Management Plan	2013-2018	Objectives: • Manage key fisheries - artisanal, industrial seabob and prawn, semi-industrial red snapper, and shark. Priorities: • Data collection and management. • Monitoring, control, and surveillance. • Fisheries Department capacity building.
Hydrometeorological Service Strategic Development Plan	2014-2018	Objectives: • Study Guyana's weather and climate. • Provide meteorological, hydrological, and oceanographic services. Priorities: • Implement the 6 program areas: Administration, Warning and weather forecasting, Agrometeorology, Climate services, Water survey, and Informatics and technical services.
Technology Actions Plan	2018	Objectives: • Mitigation and adaptation through prioritized technologies. Priorities (technologies for agriculture): • Freshwater Harvesting: Empoldering of Water Collection Areas. • Agrometeorology for Forecasting and Early Warning.

Title	Year	Description
Agriculture Development Strategy 2021-2025 (Draft)	2021-2025	Objectives: • Growth of agriculture and agri-business while employing new developments and technologies. • Ensure diversity and inclusivity in the sector. • Improve synergies across sectors. Priorities (technologies for agriculture): • Diversify agriculture production. • Improve land access. • Create a robust marketing system. • Promote food and nutrition security. • Strengthen resilience and sustainability. • Modernize supporting infrastructure. • Strengthen support services. • Develop human resources. • Improve multi-sectoral coordination. • Strengthen data systems.
Guyana's National Pathway for Food systems Transformation	2021	Objectives: • Transform the national food systems. Priorities: • Food Security. • Climate Resilience. • Funding and Financing.

11.2. Forestry Sector

Table 1.11. Forest objectives and priorities.

Forest	Year	Description
National Forest Policy Statement and National Forest Plan	2018	Objectives: • Deriving development benefits from the forest (ECONOMICS). • Conserving, protecting, and sustaining the forest (CONSERVATION). • Governing the forest to ensure current and future benefits (GOVERNANCE). • Building human and institutional capacity for forest management activities (CAPACITY). Priorities: • Deriving development benefits from the forest (ECONOMICS). • Conserving, protecting, and sustaining the forest (CONSERVATION). • Governing the forest to ensure current and future benefits (GOVERNANCE). • Building human and institutional capacity for forest management activities (CAPACITY).
Action Plan for Implementing the Program of Work on Protected Areas of the Convention on Biological Diversity	2012-2020	Objectives: • Identify, manage, and improve effectiveness of the protected areas both at national and regional level. Priorities: • Establish and strengthen the institutional framework for protected areas. • Improve capacity building for planning, establishment, and management of protected areas. • Ensure financial sustainability of protected areas and national/regional systems. • Evaluate and improve the effectiveness of protected areas management.

Forest	Year	Description
Protected Areas Commission Strategic Plan 2016-2020	2016-2020	Objectives: • Development of Guyana's National Protected Areas System (NPAS). • Encompasses hinterland and urban parks. Priorities: • Administration and Management. • Finances. • Stakeholder Involvement and Benefits. • Awareness, Education, and Outreach.
Protected Areas Trust Strategic Plan 2017-2021	2017-2021	Objectives: • Increase funds for NPAS management. • Raise global, regional, and national awareness of PAT and its functions. • Implement an agile and transparent grant-making process. • Strengthen capacity of board trustees in PAT administration. Priorities: • Mobilization of resources to co-finance the management of the NPAPS objectives.
National Mangrove Management Action Plan	2010-2012	Objectives: • Establish administrative capacity for mangrove management. • Promote sustainable mangrove forest management. • Develop legal framework encouraging community-based participation. • Support research and development of Guyana's mangrove forest. • Implement effective protection or rehabilitation of mangrove ecosystems. • Increase public awareness and education on mangrove benefits. Priorities: • Respond to climate change and mitigate its effects through mangrove ecosystem protection, rehabilitation, and wise use.

Forest	Year	Description
National Mangrove Action Plan (NMAP) 2022-2032	2022-2032	Objectives: • Continue increasing the mangrove national area as it has been observed since 2011. Priorities: • Increase mangrove forest width by 2030. • Conserve 15-20% of coastal and marine ecosystems. • Update institutional arrangements for integrated mangrove management. • Protect ecosystem services, floral and faunal biodiversity. • Enhance economic benefits through sustainable resource management. • Maintain and enhance the biological productivity of mangroves. • Target public awareness and improve livelihood opportunities. • Focus on sustainable aquaculture, tourism, and mangrove utilization. • Provide economic benefits to communities, especially women and youth.

11.3. Energy Sector

Table 1.12. Energy objectives and priorities.

Title	Year	Description
Draft National Energy Policy of Guyana – Report 2 – Green Paper	2016	Objectives: • Position the energy sector as an engine of national economic growth using a green development strategy. • Minimize the foreign exchange cost of energy to the national economy. • Increase the efficiency of energy use per unit of GDP. • Diversify away from imported fossil fuels with indigenous renewable energy resources. • Enhance environmental sustainability by minimizing negative environmental impact. • Attain universal access and equitable distribution of green energy services at the least cost. • Establish a regional export trade of green energy services and commodities. • Develop the oil and gas sector for export. Priorities: • Target energy demand and end-use in residential, agriculture, transport, mining, industry and commerce, and tourism.
Arco Note study	2016	Objectives: • Build a sustainable connection across Brazil, the three Guianas and the Caribbean. Priorities: • Assess the implementation of a large transmission power system connecting northern Brazil, the three Guianas, and the Caribbean Sea. • Explore opportunities for Guyana to participate in cross-border electric grids. • Evaluate the potential for large-scale hydro power resources.

Title	Year	Description
		• Consider infrastructure development, including roadways, high-speed communication systems, and a port or harbour in Guyana or neighbouring countries.
Guyana's Power Generation System Expansion Study	2018	Objectives: • Update the study on system expansion of the generation system, considering the availability of indigenous natural gas for power generation. • Assess the impact of increased electrical demand associated with the oil industry. • Compare the current situation with three other cases: two cases of gas availability and a "green case" where hydropower supplies a significant portion of the demand. Priorities: • Explore the feasibility and benefits of utilizing indigenous natural gas for power generation. • Plan for increased electrical demand resulting from the growing oil industry. • Evaluate and compare different scenarios, including gas availability and a green energy approach. • Consider options for the Demerara-Berbice Interconnected System, weighing the benefits and challenges of each

11.4. Climate Change

Table 1.13. Climate change objectives and priorities.

Title	Year	Description
National Determined Contributions (NDCs)	2015	Objectives: • Outline Guyana's conditional and unconditional contributions to the UNFCCC's Paris Climate Agreement. • Provide the basis for climate change mitigation actions in the energy and forestry sectors. Priorities: • Develop and implement strategies to meet the specified mitigation targets. • Enhance resilience and adaptive capacity to address the impacts of climate change.
Technology Needs Assessment project	2016-2018	Objectives: • Identify and prioritize technologies for mitigation and adaptation in line with national sustainable development goals. • Identify barriers hindering the acquisition, deployment, and diffusion of prioritized technologies. • Develop Technology Action Plans (TAP) to overcome barriers and facilitate technology transfer, adoption, and diffusion. Priorities: • Prioritize adaptation technologies in agriculture, water, and coastal zones. • Prioritize mitigation technologies in forests (including mining) and energy.
Climate Change Adaptation Program (CCAP)	2016	Objectives: • Reduce risks to human and natural assets resulting from climate change vulnerability. Priorities: • Promote the use of climate data and information for decision-making. • Support innovative adaptation approaches to secure additional financing.

Climate Resilient Strategy and Action Plan (Draft)		• Foster climate financing for the scale-up and replication of sustainable adaptation initiatives.
Low Carbon Development Strategy (LCDS) 2030	2022	Objectives: • Value ecosystem services. • Invest in clean energy and stimulate low carbon growth. • Protect against climate change and biodiversity loss. • Align with global climate and biodiversity goals. Priorities: • Implement measures to enhance the value of ecosystem services. • Invest in clean energy initiatives to promote low carbon growth. • Implement strategies to protect against climate change and biodiversity loss. • Align local strategies with global climate and biodiversity goals.
Low Carbon Development Strategy (LCDS) 2009 and 2013	2009 and 2013	Objectives: • Advance low-carbon development. • Conservation of forest resources and enhance carbon sequestration. • Expand access to low-carbon and clean energy sources. • Engage in international cooperation. Priorities: • Implement sustainable land use practices. • Invest in green technologies. • Build climate resilience. • Promote stakeholder engagement.
Guyana-Norway Agreement	2009	Objectives: • Maintenance of deforestation rates against a set target. • Promote sustainable land use practices.

		• Performance based payments. Priorities: • Effective monitoring and reporting. • Multi-stakeholder engagement and participation. • Prioritize capacity building initiatives to enhance the technical and institutional capabilities. • Biodiversity protection within the forests. • Promote research and innovation to identify and implement best practices.

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2 National Greenhouse Gas Inventory

1. Introduction

As a Party to the United Nations Framework Convention on Climate Change (UNFCCC), Guyana has committed to develop, periodically update, publish, and make available national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases (GHGs) not controlled by the Montreal Protocol. These inventories are to be compiled using comparable methodologies to be agreed upon by the Conference of the Parties (COP).

In this context, national GHG inventories can be defined as a comprehensive account of the annual GHG emissions by sources and GHG removals by sink within a national territory over a specified time period whereby the national territory covers the mainland territory and the offshore areas over which the country has jurisdiction and the time series refers to the specified period of time over which the national GHG inventory accounts emissions and removals annually, starting from the base year.

In compliance with its commitments under the UNFCCC, Guyana has thus far completed three national GHG inventories as follows:

- The national GHG emissions inventory for the period 1990-1998 reported in the first National Communication (NC) according to the Revised 1996 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National GHG Inventories [1].
- The national GHG emissions inventory for the period 1990-2004 reported in the second NC according to the Revised 1996 IPCC Guidelines for National GHG Inventories [2].
- The national GHG emissions inventory for the period 1990-2016 reported in the third NC according to the Revised 1996 IPCC Guidelines for National GHG Inventories (in draft) [3].

In this first Biennial Update Report (BUR), Guyana presents an updated GHG inventory for the period 1990-2022 using the 2006 IPCC Guidelines for National GHG Inventories (hereinafter referred to as the 2006 IPCC Guidelines) and the 2019 Refinement to the 2006 IPCC Guidelines for National GHG Inventories (hereinafter referred to as the 2019 Refinement). The entire time series 1990-2016 has been recalculated and the time series 2017-2022 has been calculated considering the transition to more recent guidelines, incorporating additional available information, and implementing methodological improvements. This inventory spans 32 years, commencing from the base year 1990 and extending to the inventory year 2022. It encompasses the four sectors outlined in the 2006 IPCC Guidelines, namely Energy, Industrial Processes and Product Use (IPPU), Agriculture, Forestry and Other Land Use (AFOLU), and Waste.

2. Overview of the National GHG Inventory

2.1. Institutional Arrangements for Inventory Preparation

Guyana is actively working on establishing a GHG inventory MRV system that encompasses all relevant sectors. More information on the institutional arrangements for the GHG inventory are provided in Chapter 6 to the BUR.

In the context of the preparation of the GHG emissions inventory prepared as part of this first BUR of Guyana, it has been conducted under the centralised leadership and coordination of the Department of Environment and Climate Change (DECC) under the Office of the President.

The inventory preparation adheres to a sector-based approach for gathering emissions and removal data while ensuring that sectoral synergies are taken into account to avoid double counting or omission. To compile the necessary data, sectoral data collection forms are employed. These forms are distributed to the pertinent data providers within each sector. Guyana enlisted the expertise of Gauss International Consulting, an international technical consultancy, to handle data processing, emission estimation, and the implementation of quality assurance and quality control procedures.

To ensure the enduring enhancement of the GHG inventory system and the timely delivery of transparent, accurate, consistent, complete, and coherent information, Guyana aims to further institutionalise the procedures, roles, and responsibilities for future national GHG inventories.

2.2. Definitions and Scope

The definitions of the GHG inventory principles as provided in Section 1.4, Chapter 1 of Volume 1 of the 2006 IPCC Guideline shall be adhered to throughout the national GHG inventory of Guyana.

The scope of the national GHG inventory of Guyana can be defined by (i) the coverage of the GHGs, (ii) the sectoral coverage, and (iii) the area that makes up the national territory of the country.

The national GHG inventory covers a total of seven GHGs that are either emitted to or removed from the atmosphere within the national territory of Guyana, namely:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulphur hexafluoride (SF_6)
- Nitrogen trifluoride (NF_3)

As previously stated, the four sectors covered by the national GHG inventory of Guyana are the Energy, Industrial Processes and Product Use (IPPU), Agriculture, Forestry and Other Land Use (AFOLU), and Waste Sectors. These sectors, identified by a numerical designation, are subsequently broken down into categories (indicated by capital letters), sub-categories (identified by numbers), and emissions sources (denoted by small letters), as shown in Figure 2.1.

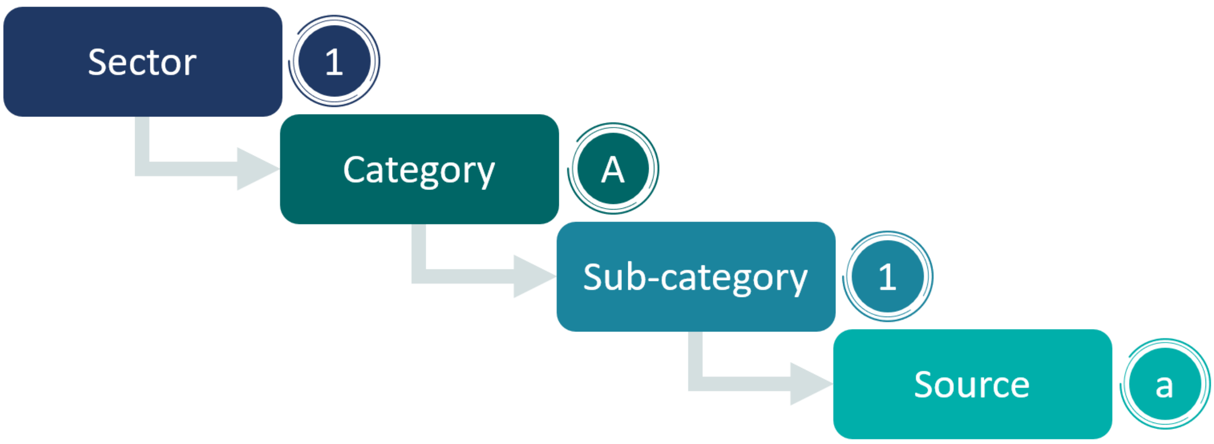

Figure 2.1. Nomenclature of the 2006 IPCC Guidelines.

Considering the coverage of the seven GHGs and the four categories, the following table presents the specific GHGs covered under each of these categories within the national GHG inventory of Guyana (Table 2.1).

Table 2.1. GHGs and sectors covered by the national GHG inventory of Guyana.

Sector		GHG						
		CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	NF_3
1	Energy	X	X	X				
2	IPPU	X	X	X	X	X	X	X
3	AFOLU	X	X	X				
4	Waste	X	X	X				

Guyana's national GHG inventory encompasses emissions and removals occurring throughout the entirety of the national territory, spanning a total geographic area of 214,970 km^2. This area includes four biophysical regions: the Coastal Plain, Hilly Sand and Clay, Forested Highland, and Interior Savannahs. The distribution comprises 196,850 km^2 of land and 18,120 km^2 of water. Notably, Guyana features a 430-kilometre Atlantic coastline to the northeast and extends continentally for about 724 km.

2.3. Description of Methodologies

The national GHG inventory of Guyana is prepared in accordance with the recommended methods (tier level) for individual source and sink categories outlined in the 2006 IPCC Guidelines and 2019 Refinement.

The IPCC inventory methodology is divided into various levels of tiers, with generally higher tiers being more detailed methodology and more accurate while the tier 1 level represents the minimum, or default methodology.

In its most basic form, the estimates of emissions and removals involve a direct relationship between an emission factor (EF) (which denotes the emission rate per unit of activity) and the activity data (AD) representing the associated level of activity. The AD outlines the annual magnitude of a specific activity, while the EF quantifies the amount of gas emitted per unit of that activity. Default emission factors are provided by the 2006 IPCC Guidelines for the direct GHGs emissions.

The national GHG inventory of Guyana for the period 1990-2022 is generally estimated using the tier 1 methodology. The basic equation for estimating the emission of one category is the following:

$$Emissions_{c,g,t} = AD_{c,t} \cdot EF_{c,g,t}$$

Where:

$Emissions_{c,g,t} = E\ missions\ of\ category\ c, gas\ g\ and\ year\ t$

$AD_{c,t} = \ Activity\ data\ of\ category\ c, year\ t$

$EF_{c,g,t} = Emission\ factor\ of\ emissions\ of\ category\ c, gas\ g\ and\ year\ t$

Frequently, the available activity data do not align with the available or utilised emission factor. In such instances, conversion factors are employed to adjust the data. In these cases, the equation is as follows:

$$\{2\}\ Emissions_{c,g,t} = \ AD_{c,t} \cdot \ EF_{c,g,t} \cdot Conversion\ factor$$

Furthermore, to ensure completeness, the national GHG inventory of Guyana uses notation keys where numerical data are not available. These notation keys include:

- **NO" (not occurring):** Used for categories or processes, including recovery, under a particular source or sink category that do not occur within a Party.
- **"NE" (not estimated):** Used for activity data and/or emissions by sources and removals by sinks of GHGs that have not been estimated but for which a corresponding activity may occur within a Party.
- **"NA" (not applicable):** Used for activities under a given source/sink category that do occur within the Party but do not result in emissions or removals of a specific gas.
- **"IE" (included elsewhere):** Used for emissions by sources and removals by sinks of GHGs estimated but included elsewhere in the inventory instead of under the expected source/sink category.
- **"C" (confidential):** Used for emissions by sources and removals by sinks of GHGs where the reporting would involve the disclosure of confidential information.

Table 2.2 provides an overview of the used IPCC inventory methodology and corresponding EF of Guyana's national GHG inventory in the inventory year 2022.

Table 2.2. Methodological tiers used the national GHG inventory of Guyana in the inventory year 2022.

Categories by sources and sinks	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6		NF_3	
	Method	EF	Method	EF	Method	EF	Method	EF	Method	EF	Method	EF	Method	EF
1. Energy	T1	D	T1	D	T1	D								
A. Fuel combustion activities (sectoral approach)	T1	D	T1	D	T1	D								
1. Energy industries	T1	D	T1	D	T1	D								
a. Public electricity and heat production	IE	IE	IE	IE	IE	IE								
i. Electricity Generation	IE	IE	IE	IE	IE	IE								
ii. Combined Heat and Power Generation (CHP)	IE	IE	IE	IE	IE	IE								
b. Petroleum refining	NO	NO	NO	NO	NO	NO								
c. Manufacture of solid fuels and other energy industries	IE	IE	IE	IE	IE	IE								
2. Manufacturing industries and construction	T1	D	T1	D	T1	D								
3. Transport	T1	D	T1	D	T1	D								
a. Domestic aviation	T1	D	T1	D	T1	D								
b. Road transportation	T1	D	T1	D	T1	D								
c. Railways	NO	NO	NO	NO	NO	NO								
d. Domestic navigation	IE	IE	IE	IE	IE	IE								
e. Other transportation	NO	NO	NO	NO	NO	NO								
4. Other sectors	T1	D	T1	D	T1	D								
a. Commercial/institutional	T1	D	T1	D	T1	D								
b. Residential	T1	D	T1	D	T1	D								
c. Agriculture/forestry/fishing	T1	D	T1	D	T1	D								
5. Other	NO	NO	NO	NO	NO	NO								
B. Fugitive emissions from fuels	T1	D	T1	D	T1	D								
1. Solid fuels	T1	D	T1	D	T1	D								
2. Oil and natural gas	T1	D	T1	D	T1	D								
a. Oil	T1	D	T1	D	T1	D								
b. Natural Gas	T1	D	T1	D	T1	D								
3. Other emissions from energy production	NO	NO	NO	NO	NO	NO								
C. CO_2 Transport and storage	NO	NO												

Categories by sources and sinks	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6		NF_3	
	Method	EF	Method	EF	Method	EF	Method	EF	Method	EF	Method	EF	Method	EF
2. Industrial Processes and Product Use	NE, NA, NO	NE, NA, NO	NA, NO	NA, NO	NE, NA, NO	NE, NA, NO	NE, NA, NO	NE, NA, NO	NE, NO	NE, NO	NE, NO	NE, NO	NA, NO	NA, NO
A. Mineral Industry	NO	NO	NO	NO	NO	NO								
B. Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Non-Energy Products from Fuels and Solvent Use	NE	NE	NE	NE	NE	NE								
E. Electronics Industry	NO	NO	NA, NO	NA, NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Product Uses as Substitutes for Ozone Depleting Substances	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NE	NE	NE	NE			NA	NA
G. Other Product Manufacture and Use	NA, NO	NA, NO	NA, NO	NA, NO	NE	NE	NA	NA	NE	NE	NE	NE	NA	NA
H. Other	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO								

Categories by sources and sinks	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6		NF_3	
	Method	EF	Method	EF	Method	EF	Method	EF	Method	EF	Method	EF	Method	EF
3. Agriculture, Forestry, and Other Land Use	T3/T2	CS	T3/T2	CS	T3/T2	CS								
A. Livestock			T1	D	T1	D								
1. Enteric Fermentation			T1	D										
2. Manure Management			T1	D	T1	D								
B. Land	T3/T2	CS			NE	NE								
1. Forest Land	T3/T2	CS												
a. Forest Land Remaining Forest Land	T3/T2	CS												
b. Land Converted to Forest Land	NE	NE												
2. Cropland	T3/T2	CS												
a. Cropland Remaining Cropland	NE	NE												
b. Land Converted to Cropland	T3/T2	CS												
3. Grassland	NE	NE												
a. Grassland Remaining Grassland	NE	NE												
b. Land Converted to Grassland	NE	NE												
4. Wetland	NE	NE			NE	NE								
a. Wetland Remaining Wetland	NE	NE			NE	NE								
b. Land Converted to Wetland	NE	NE			NE	NE								
5. Settlements	T3/T2	CS												
a. Settlements Remaining Settlements	NE	NE												
b. Land Converted to Settlements	T3/T2	CS												
6. Other Land	T3/T2	CS												
a. Other Land Remaining Other Land	NE	NE												
b. Land Converted to Other Land	T3/T2	CS												
C. Aggregate sources and non-CO_2 emissions sources on Land	T1	D	T1	D	T1	D								
1. Emissions from biomass burning	IE	IE	T1	D	T1	D								
2. Liming	T1	D												
3. Urea Application	T1	D												
4. Direct N_2O Emissions from managed soils					T1	D								
5. Indirect N_2O emissions from managed soils					T1	D								
6. Indirect N_2O Emissions from manure management					T1	D								
7. Rice cultivations			T1	D	NA	NA								
8. Other	NO	NO	NO	NO	NO	NO								
D. Other	IE, NO	IE, NO												
1. Harvested Wood Products	IE	IE												
2. Other	NO	NO												

Categories by sources and sinks	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6		NF_3	
	Method	EF	Method	EF	Method	EF	Method	EF	Method	EF	Method	EF	Method	EF
4. Waste	T2a	D	T1	D	T1	D								
A. Solid Waste Disposal			T1	D	NE	NE								
1. Managed Waste Disposal Sites			T1	D	NE	NE								
2. Unmanaged Waste Disposal Sites			IE	IE	NE	NE								
3. Uncategorized Waste Disposal Sites			T1	D	NE	NE								
B. Biological Treatment of Solid Waste			NE	NE	NE	NE								
C. Incineration and Open Burning of Waste	T2a	D	T1	D	T1	D								
1. Waste Incineration	NE	NE	NE	NE	NE	NE								
2. Open Burning of Waste	T2a	D	T1	D	T1	D								
D. Wastewater Treatment and Discharge			T1	D	T1	D								
1. Domestic Wastewater Treatment and Discharge			T1	D	T1	D								
2. Industrial Wastewater Treatment and Discharge			NE	NE	NE	NE								
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo items: (1)	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO								
International bunkers	NE	NE	NE	NE	NE	NE								
Aviation	NE	NE	NE	NE	NE	NE								
Navigation	NE	NE	NE	NE	NE	NE								
Multilateral operations	NE	NE	NE	NE	NE	NE								
CO_2 emissions from biomass	T1	D												
CO_2 captured	NO	NO												
For domestic storage	NO	NO												
For storage in other countries	NO	NO												

Abbreviations: T1 - Tier 1 method; T2 - Tier 2 method; T3 – Tie 3 method; D - Default; CS – Country Specific; IE - Included Elsewhere; NA - Not Applicable; NE - Not Estimates; NO - Not Occurring

Explanation for the use of Notation Key NE:

- Emissions from Category 2D – Non-Energy Products from Fuels and Solvent Use were not estimated due to a lack of data for this category.
- HFC and PFC Emissions from Category 2F – Product Uses as Substitutes for Ozone Depleting Substances were not estimated due to a lack of data for this category.
- N_2O, PFC, and SF_6 Emissions from Category 2G – Other Product Manufacture and Use were not estimated due to a lack of data for this category.
- CO_2 Emissions from Category 3B3 – Grassland were not estimated due to a lack of data for this category.
- CO_2 Emissions from Category 3B4 – Wetland were not estimated due to a lack of data for this category.
- N_2O Emissions from Category 4A – Solid Waste Disposal were not estimated given that no methodologies are provided in the IPCC Guidelines for estimating these emissions and the IPCC FOD model does not calculate these emissions.
- CH_4, and N_2O Emissions from Category 4B – Biological Treatment of Solid Waste were not calculated due to the lack of data for this category.
- CO_2, CH_4, and N_2O emissions from Category 4C1 – Waste Incineration were not estimated due to a lack of data for this category.
- CH_4, and N_2O Emissions from Category 4D2 – Industrial Wastewater Treatment and Discharge were not calculated due to the lack of data on on-site industrial wastewater treatment practices in Guyana.
- CO_2, CH_4, and N_2O Emissions from International bunkers were not estimated due to a lack of data.
- CO_2, CH_4, and N_2O Emissions from Multilateral operations were not estimated due to a lack of data.

Explanation for the use of Notation Key IE:

- CO_2, CH_4, and N_2O Emissions from Category 1A1 – Energy Industries were not further disaggregated by sub-category and all was included in 1A1.
- CO_2, CH_4, and N_2O Emissions from Category 1A1cii – Other Energy Industries are included in 1A1.
- CO_2, CH_4, and N_2O Emissions from Category 1A3d – Domestic Navigation are included in the other sectoral fuel consumption.
- N_2O emissions from Category 3A2 – Manure management are included in Category 3C6 – Indirect N_2O emissions from manure management.
- CO_2 Emissions from Category 3C1 – Biomass Burning are included in the Category 3B1.
- CO_2 Emissions from Category 3D1 – Harvested Wood Products are included in Category 3B1.
- CH_4 Emissions from Category 4A2 – Unmanaged Waste Disposal Sites are included in category 4A3 – Uncategorized Waste Disposal Sites due to the lack of data on particular practices and conditions at solid waste disposal sites in Guyana other than the Haags Bosch Landfill, which inhibits their classification as per the IPCC definition of types of solid waste disposal sites. As such, all solid waste disposal sites in the country, except for the Haags Bosch Landfill are considered uncategorized.

2.4. Description of Metrics

GHGs vary in their capacity to absorb energy (referred to as 'radiative efficiency') and the time they stay in the atmosphere (known as their 'lifetime'). In light of these differences, the Global Warming Potential (GWP) was developed, which compares the radiative forcing of one metric tonne of a GHG over a specified time period, typically 100 years, to that of one tonne of CO_2. This allows for the assessment of the global warming impacts of different gases. A higher GWP indicates that a particular gas has a more significant warming effect on Earth compared to CO_2 over the given time period.

As such, GWP is the ratio of the time-integrated radiative forcing resulting from the instantaneous release of 1 kg of a trace substance relative to that of 1 kg of a reference gas. The reference gas used is CO_2, and therefore, GWP-weighted emissions are expressed in units of CO_2 equivalent.

In Guyana's national GHG inventory, the most recent GWPs for a 100-year period, as outlined in the IPCC Fifth Assessment Report (AR5), are applied (Table 2.3).

Table 2.3. GWPs as outlined in AR5 [4].

GHG	GWP
CO_2	1
CH_4	28
N_2O	265
HFC134a	1300
HFC125	3170
HFC143a	4800
HFC32	677

2.5. Quality Control and Quality Assurance Procedures

The national GHG inventory of Guyana is prepared ensuring the quality throughout all steps of the inventory compilation, from data collection to reporting, according to the good practice principles defined by the 2006 IPCC Guidelines and 2019 Refinement.

These emphasise the importance of building inventories that are consistent, comparable, complete, accurate and transparent, also known as the TACCC principles, and maintaining the inventory in a manner that improves its quality over time. As such, the following five quality principles have been adhered to throughout Guyana's inventory compilation process:

- **Transparency:** There is sufficient and clear documentation such that individuals or groups other than the inventory compilers can understand how the inventory was compiled and can assure themselves it meets the good practice requirements for national greenhouse gas emissions inventories.
- **Accuracy:** The national greenhouse gas inventory contains neither over- nor under-estimates so far as can be judged.
- **Completeness:** Estimates are reported for all relevant categories of sources and sinks, and gases.
- **Consistency:** Estimates for different inventory years, gases and categories are made in such a way that differences in the results between years and categories reflect real differences in emissions. Inventory annual trends, as far as possible, should be calculated using the same method and data sources in all years and should aim to reflect the real annual fluctuations in emissions or removals and not be subject to changes resulting from methodological differences.
- **Comparability:** The national greenhouse gas inventory is reported in a way that allows it to be compared with national greenhouse gas inventories for other countries.

Quality assurance/quality control (QA/QC) and verification procedures are essential to ensure the development of national GHG inventories that can be readily assessed in terms of quality. The outcomes of QA/QC and verification will support Guyana in the reassessment of inventory or category uncertainty estimates and to subsequently implement improvements in the estimates of emissions or removals on a continuous basis.

In accordance with the 2006 IPCC Guidelines, quality control (QC) is a system of routine technical activities to assess and maintain the quality of the inventory as it is being compiled. Quality assurance (QA) is a planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process. Verification refers to the collection of activities and procedures conducted during the planning and development, or after completion of an inventory that can help to establish its reliability for the intended applications of the inventory.

For the compilation of the GHG inventory included in the first BUR, the Department of Environment and Climate Change (DECC) under the Office of the President was responsible for overseeing all QA/QC activities in collaboration with international consultants and with the support of the Global Green Growth Institute (GGGI) in Guyana. DECC was responsible for coordinating among all stakeholders involved in the QA/QC plan, and for archiving the relevant data and reports.

The international consultants were responsible for the implementation of QA/QC procedures on a sectoral basis and for the whole GHG inventory related to data collection, handling, processing, quality control, documentation, archiving, and necessary reporting procedures related to the inventory. Throughout this process, GGGI and senior consultants from Gauss conducted QA activities of the work conducted by the international consultants. Furthermore, each entity/organisation contributing data to the development of the national GHG inventory of Guyana is responsible for the quality of its own data.

The results of the QA/QC activities serve as the main input for the development of the inventory improvement plan for the next GHG inventory compilation cycles.

The individuals directly involved in the preparation of the inventory undertook QC procedures in two distinct steps as shown in Table 2.4. These steps involved conducting a data quality assessment and utilising general and sector-specific QC checklists.

Table 2.4. Quality control procedures.

Step	Description
Data quality assessment	After the completion of data collection, the information supplied undergoes an evaluation concerning data availability and quality. This assessment precedes the preliminary estimation of GHG emissions and removals. The primary goal of this evaluation is to pinpoint any existing data gaps and outline immediate, short-term, and long-term corrective actions or areas for improvement within each sector. This process provides an opportunity to take the necessary actions to address immediate and short-term data gaps before finalising the GHG emissions and removals estimates.
General and sector-specific QC checklists	General QC procedures include generic quality checks related to calculations, data processing, completeness. The QC checklist that was followed for all sectors is in line with the recommended QC procedures in Table 6.1, Chapter 6 of Volume 1 of the 2006 IPCC Guidelines. This checklist comprises 12 QC activities, further broken down into QC procedures. These general QC checks are conducted routinely throughout the preparation of the inventory, applying a QC checklist irrespective of the type of data used to develop the inventory estimates. Category-specific QC complements general inventory QC procedures and is directed at specific types of data used in the methods for individual source or sink categories. These category-specific procedures are applied selectively, focusing on key categories and those undergoing significant methodological and data revisions. The objective is to minimise errors during the final selection of data, emission factors, and other parameters. This includes unit conversion, selection of methodological tiers, preparation of computation files,

Step	Description
	evaluation of trends, and documentation of inventory processes. In every instance, the individual responsible for each QC check, the date of its performance, and any corrective actions taken are meticulously documented.

Furthermore, QA procedures were conducted aimed at reviewing and validating the quality of the inventory, determining the conformity of the procedures taken and identifying areas where improvements can be made. The validation has been undertaken at two levels as shown in Table 2.5. These levels include international expert peer review and quality assessment at national level.

Table 2.5. Quality assurance procedures.

Level	Description
International expert peer review	Within the team of international consultants, an expert peer reviewer was assigned by sector to undertake checks, propose improvements, and ensure the quality of the inventory. The international peer reviewers checked the five quality principles at various levels in the data compilation and reporting processes. This included, among others, checking if the chapters and sections provide the activity data and emission factors with the sources used, explain the methods used and summarise the data set, whether the same methods and the same data sources are used for the whole time series, if the same IPCC guidelines for the methodologies and reporting templates have been used for the whole inventory and for the same group of gases, if estimates are provided for all gases, all source categories existing within the national territory of Guyana, and if uncertainty analysis is undertaken and improvement plans proposed.
Quality assessment at national level	Validation was conducted at the national level through a series of meetings and exchanges held throughout the inventory preparation process. These engagements facilitated discussions and collaborative assessments, ensuring a thorough examination of the inventory's accuracy, methodologies, and overall quality.

3. Cross-cutting Elements

3.1. Sources of Activity Data

Tables 2.6, 2.7, 2.8, and 2.9 summarize the principal sources of activity data used for each sector, including assumptions and treatment methods. To the extent possible, official country-specific activity data was used for inventory elaboration, first from official published statistics and secondly from published peer-reviewed or official publications. When such data was not available, default values were adopted primarily from the 2019 IPCC Refinement and secondly from the 2006 IPCC Guidelines.

Table 2.6. Activity data sources for the energy sector.

Category	Type of data	Data source and treatment method
1A1 Energy Industries	Amount of fuel consumption (TJ)	OLADE Guyana supply and demand data obtained upon request [5].
1A2 Manufacturing Industries and Construction	Amount of fuel consumption (TJ)	OLADE Guyana supply and demand data obtained upon request [5].
1A3 Transport	Amount of fuel consumption (TJ)	OLADE Guyana supply and demand data obtained upon request [5].
1A4 Other Sectors	Amount of fuel consumption (TJ)	OLADE Guyana supply and demand data obtained upon request [5].
1A5 Other	Amount of fuel consumption (TJ)	OLADE Guyana supply and demand data obtained upon request [5].
1B1 Solid Fuels	Charcoal production (kt)	OLADE Guyana supply and demand data obtained upon request [5].
1B2 Oil and Natural Gas	Offshore oil produced	Oil and natural gas production data obtained from the Environmental Protection Agency (EPA) [6].
	Offshore oil loaded onto tanker ship	Oil and natural gas production data obtained from the Environmental Protection Agency (EPA) [6].
	Offshore gas produced	Oil and natural gas production data obtained from the Environmental Protection Agency (EPA) [6].

Table 2.7. Activity data sources for the IPPU sector.

Category	Type of data	Data source and treatment method
Domestic Solvent Use Including Fungicides (2D3a)	Total population of Guyana	The total population for Guyana over the period 1990-2022 obtained from World Bank Population Statistics [7].

Table 2.8. Activity data sources for the AFOLU sector.

Category	Type of data	Data source and treatment method
3A1 Enteric Fermentation	Livestock population (number of heads) from 1990 to 2022.	Guyana Livestock Development Authority (GLDA) (Ministry of Agriculture). Complete time series of daily and other cattle from 2018 to 2022 extrapolating from the total cattle data [8].
3A2 & 3C6 Manure Management & Indirect N_2O emissions from Manure Management	Livestock population (number of heads) from 1990 to 2022.	Guyana Livestock Development Authority (Ministry of Agriculture). Complete time series of daily and other cattle from 2018 to 2022 extrapolating from the total cattle data [8].
3B1a Forest Land Remaining Forest Land	Total forest area (ha)	Guyana ART Workbook for REDD+ for period 2011-2022 [9]. Guyana Forestry Commission for period 1990-2010 [10].
	Buffer area (ha)	Guyana ART Workbook for REDD+, held constant for 1990-2015 [9]
	Logging-Skid trail length (km)	Guyana ART Workbook for REDD+, held constant for period 1990-2010 [9].
	Logging volume harvested (m^3)	Guyana ART Workbook for REDD+, held constant for period 1990-2010 [9].
	Total area deforested due to fire and biomass burning (ha)	Guyana ART Workbook for REDD+, held constant for period 1990-2010 [9].
3B2b Land Converted to Cropland	Total area deforested due to agriculture (ha)	Guyana ART Workbook for REDD+, held constant for period 1990-2010 [9].

Category	Type of data	Data source and treatment method
	Total area deforested due to shifting cultivation (ha)	Guyana ART Workbook for REDD+, held constant for period 1990-2016 [9].
3B5b Land Converted to Settlements	Total area deforested due to settlement (ha)	Guyana ART Workbook for REDD+, held constant for period 1990-2010 [9].
	Total area deforested due to infrastructure (ha)	Guyana ART Workbook for REDD+, held constant for period 1990-2010 [9].
	Total area deforested due to forestry infrastructure (ha)	Guyana ART Workbook for REDD+, held constant for period 1990-2010 [9].
3B6b Land Converted to Other Land	Total area deforested due to mining (medium and large scale) (ha)	Guyana ART Workbook for REDD+, held constant for period 1990-2010 [9].
3C1 Emissions from Biomass Burning	Area burnt of sugarcane from 1990 to 2017	Guyana Sugar Corporation (GUYSUCO) (Ministry of Agriculture). Complete time series forecasting to 2022 [11].
	Area harvested of rice from 1990 to 2022	Guyana Rice Development Board (GRDB) (Ministry of Agriculture). It is assumed based on information from the data providers that all rice residues are burnt [12].
	Area burnt of forest from 1990 to 2010	Guyana ART Workbook for REDD+, held constant for period 1990-2010 [9].
3C2 Liming	Limestone applied to sugarcane from 1990 to 2016	GUYSUCO (Ministry of Agriculture). Complete time series forecasting to 2022. Data related to the dolomite applied was not available. [11]
3C3 Urea application	Urea imports data from 2020 to 2023	Guyana Revenue Authority (GRA). The urea imports data is used for estimating the GHG emissions from urea application from 2020 to 2023. The time series of urea imports data obtained from GRA was completed surrogating data from the total urea imported data from 1990 to 2019, obtained from FAO [13].

Category	Type of data	Data source and treatment method
	Total urea imported from 1990 to 2021	FAO [14].
3C4 & 3C5 Direct and Indirect N_2O Emissions from Managed Soils	Synthetic fertilizers usage for sugarcane from 1990 to 2016	GUYSUCO (Ministry of Agriculture). Complete time series forecasting to 2022. [11]
	Harvested rice area from 1990 to 2022	Guyana Rice Development Board (Ministry of Agriculture) [12].
	Paddy production from 2011 to 2022	Guyana Rice Development Board (Ministry of Agriculture) [12].
	Harvested sugarcane area from 1990 to 2022	GUYSUCO (Ministry of Agriculture). [11]
	Sugarcane production from 2000 to 2022	GUYSUCO (Ministry of Agriculture). [11]
	Harvested area and production of several crops from 2016 to 2022	National Agricultural Research and Extension Institute (NAREI), Ministry of Agriculture. The major crop types considered to calculate the N from crop residues and forage/pasture renewal (FCR) were grain (corn) beans and pulses (soya, pigeon peas, other beans), tubers (potato, sweet potato, bitter cassava, cassava, dasheen, eddoes, tannia and yam), root crop (ginger, carrot and peanut) and perennial grasses (sugarcane data from GUYSUCO). The individual crop rice was also considered (data from GRDB). The time series before 2016 until 1990 was maintained as a constant of the value in 2016 due to lack of data for most of the crop types. For calculating the FCR the fraction of annual harvested area burnt (Frac burnt) is considered to be 0 as its N20 emissions associated are calculated at the category 3C1 - Emissions from Biomass Burning [15].
	Livestock population (number of	Guyana Livestock Development Authority (Ministry of Agriculture). Complete time series of daily and other cattle from 2018 to 2022 extrapolating from the total cattle data [8].

Category	Type of data	Data source and treatment method
	heads) from 1990 to 2022	
3C7 Rice Cultivations	Annual harvested area of rice cultivations in Guyana from 1990 to 2022	Guyana Rice Development Board (Ministry of Agriculture) [12].
	Water cultivation period	Guyana Rice Development Board (Ministry of Agriculture). [16].

Table 2.9. Activity data sources for the waste sector.

Category	Type of data	Data source and treatment method
Cross-cutting issues in the waste sector	Total population of Guyana.	Total national population was obtained from the Guyana Bureau of Statistics 2012 Census [17] containing data points for the years 1946, 1960, 1970, 1980, 1991, 2002, 2012, whereby linear interpolation was used to estimate population in years in between 1950-2012. The total population for Guyana over the period 2013-2022 was obtained from World Bank Population Statistics [18].
	Percentage population distribution by region.	Percentage population distribution by region in Guyana was obtained from the Guyana Bureau of Statistics 2002 Census [19] containing data points for the years 1980, 1991, and 2002. The regional distribution for the year 2012 was obtained from the Guyana Bureau of Statistics 2012 Census [17]. Projected regional population change rates over 2010-2024 were obtained from the Guyana National Solid Waste Management Strategy 2013-2024 [20]. Linear interpolation and extrapolation were used to complete the time series 1950-2022.
	Municipal Solid Waste (MSW) per capita generation rates by region.	Regional waste generation rates for the years 2010 and 2024 were obtained from Guyana´s Solid Waste Management Strategy 2013-2024 [20]. Rates were held constant prior to 2010 and linear interpolation was used between 2020 and 2024.
	MSW composition.	Waste composition was obtained from the most recent comprehensive study conducted by Hydroplan for Georgetown in 2010 [21] and grouped as per IPCC categorization. Due to lack of further reliable data, waste composition was assumed constant for all of Guyana and throughout all the time series.
4A Solid Waste Disposal	Climate Zone of Guyana.	Default climate zone extracted from in Figure 3A.5.1 of Volume 4 from the 2019 IPCC Refinement [3].

Category	Type of data	Data source and treatment method
	Percentage of waste sent to solid waste disposal sites (SWDS).	Percentage distribution of waste to SWDS obtained from Guyana´s Solid Waste Management Strategy 2013-2024 [20] and cross-checked with the Analysis of Waste at the Local Level research paper [22], assumed constant throughout the time series.
	Description of Guyana´s SWDS.	SWDS description obtained from Guyana´s Solid Waste Management Strategy 2013-2024 [20], differentiated as sanitary landfill, controlled dump, and open dump, and categorized as per IPCC classification: The Haags Bosch Landfill is the only "anaerobic managed SWDS" operating in the country since 2011 as per the IPCC definition. Due to insufficient information on operating conditions at both controlled and open dumps, these were assumed "uncategorized SWDS" as per the IPCC definition on table 3.1 of Volume 5 from the 2006 IPCC Guidelines [2].
	Quantity of waste treated at managed landfills, controlled dumps, and open dumps.	Actual tonnage of MSW disposed of at Haags Bosch Landfill (anaerobic managed SWDS) were used, as provided by the landfill operators for 2011-2022. Percentage distribution of controlled dumps and open dumps was assumed constant throughout the time series, extracted from Guyana´s Solid Waste Management Strategy 2013-2024 [20] and cross-checked with the Analysis of Waste at the Local Level research paper [22].
	Annual quantity of CH_4recovered at SWDS (R).	No CH_4 recovery takes place in Guyana, consistent with IPCC default expressed in Section 3.2.3 of Volume 5 from the 2006 IPCC Guidelines [2].
4B Biological Treatment of Solid Waste	Although it is known that some small-scale composting activities take place in Guyana, associated emissions from this category were not estimated due to a lack of data.	
4C1 Waste Incineration	Although it is known that incineration of clinical waste takes place in Guyana´s healthcare facilities associated emissions from this category were not estimated due to a lack of data.	
4C2 Open Burning of Waste	Percentage of waste opened burned.	The percentage distribution of waste directly opened burned was obtained from the Analysis of Waste at the Local Level research paper [22], assumed constant throughout the time series. It was also assumed open burning took place in open dumps as per Guyana´s Solid Waste Management Strategy 2013-2024 [20].
	Fraction of the waste amount that is burned relative to the total amount of waste treated (Bfrac).	As per Box 5.1 of Volume 5 from the 2006 IPCC Guidelines [2], a default values of Bfrac=0.6 is assumed when open burning takes place in shallow conditions such as direct open burning. Consistent with this logic, expert judgement by inventory compilers assumed a Bfrac=0.4 value for open burning in open dumps whereby MCF=0.6.

Category	Type of data	Data source and treatment method
	Dry matter content (dm), carbon fraction in dry matter (CF), and fossil carbon fraction in total carbon (FCF) of waste.	Default values obtained from Table 2.4 of Volume 5 from the 2006 IPCC Guidelines [2] and held constant throughout the time series.
4D1 Domestic Wastewater Treatment and Discharge	Description of Guyana´s wastewater treatment systems.	Description of historic evolution obtained from the WHO Country Estimate on SDG6 Monitoring Report [23].
	Degree of utilization of wastewater treatment system (U).	Data for the year 1991 were obtained from the Guyana Bureau of Statistics 2002 Census [19]. Data for 2002 and 2012 obtained from the Guyana Bureau of Statistics 2012 Census [17]. Data for 2020 was obtained from the WHO Country Estimate on SDG6 Monitoring Report [23]. Linear interpolation was conducted between 1991 and 2020. The 1991 value held constant for 1990, while the 2020 value held constant for 2021 and 2022.
	Biochemical oxygen demand (BOD).	The default value for the Latin America region was used, extracted from Table 6.4 of Volume 5 from the 2019 IPCC Refinement [3].
	Correction factor for additional industrial BOD discharged into sewers (I).	Default values from Equation 6.3 of Volume 5 from the 2006 IPCC Guidelines [2].
	Sludge removal.	Very limited sludge removal information is available for Guyana. It is assumed no sludge removal takes place as per de default value in Page 6.9 of Volume 5 from the 2006 IPCC Guidelines [2].
	Annual quantity of CH_4 recovered.	No CH_4 recovery and flaring from wastewater treatment and discharge occurs in Guyana, consistent with default value from Page 6.13 of Volume 5 from the 2019 IPCC Refinement [3].
	Protein Supply.	Per capita protein supply was obtained from FAO Stat Data over the time period 1990-2013 [24] and 2010-2021 [25]. The overlap method (as per Section 5.3.3.1 of Volume 1 from the 2006 IPCC Guidelines) was used to back-cast the 2010-2021 data. The 2021 value was held constant for 2022.
	Protein Consumed as a Fraction of	The default value for the Latin America Region was obtained from Table 6.10A of Volume 5 from the 1019 IPCC Refinement [3].

Category	Type of data	Data source and treatment method
	Protein Supply (FPC).	
4D2 Industrial Wastewater Treatment and Discharge	There is a lack of data on on-site industrial wastewater treatment practices in Guyana. Associated emissions are included in Category 4D1 by accounting for industrial wastewater that is discharged into the domestic sewer system through the default correction factor from the 2006 IPCC Guidelines for additional industrial BOD discharged into sewers (I).	

3.2. Sources of Emission Factors

The principal sources of emission factors used for each sector are described in Tables 2.10, 2.11, 2.12, and 2.13. Country-specific emission factors were used when available to develop the national GHG inventory of Guyana. Otherwise, default values were adopted primarily from the 2019 IPCC Refinement and secondly from the 2006 IPCC Guidelines.

Table 2.10. Emissions factor sources for the energy sector.

Category	Type of data	Data source and treatment method
1A1 Energy Industries	kg/TJ	Default values from Table 2.2 from Chapter 2, Volume 2 of the 2006 IPPC Guidelines [2].
1A2 Manufacturing Industries and Construction	kg/TJ	Default values from Table 2.3 from Chapter 2, Volume 2 of the 2006 IPPC Guidelines [2].
1A3a Domestic Aviation	kg/TJ	Default values from Table 3.6.4 and Table 3.6.5 from Chapter 3, Volume 2 of the 2006 IPPC Guidelines [2].
1A3b Road Transport	kg/TJ	Default values from Table 3.2.1 and Table 3.2.2 from Chapter 3, Volume 2 of the 2006 IPPC Guidelines [2].
1A4 Other Sectors	kg/TJ	Default values from Table 2.4 and Table 2.5 from Chapter 2, Volume 2 of the 2006 IPPC Guidelines [2].
1A5 Other	kg/TJ	Default values from Table 2.4 and Table 2.5 from Chapter 2, Volume 2 of the 2006 IPPC Guidelines [2].
1B1 Solid Fuels	kg/kt	Default values from Table 4.3.3 from Chapter 4, Volume 2 of the 2019 Refinement [3].
1B2 Oil and Natural Gas	tonnes/1,000 m3 offshore oil produced	Default values from Table 4.2.4A from Chapter 4, Volume 2 of the 2019 Refinement [3].

Category	Type of data	Data source and treatment method
	tonnes/1,000 m3 offshore oil loaded onto tanker ship	Default values from Table 4.2.4B from Chapter 4, Volume 2 of the 2019 Refinement [3].
	tonnes/1,000,000 m3 offshore gas produced	Default values from Table 4.2.4G from Chapter 4, Volume 2 of the 2019 Refinement [3].

Table 2.11. Emissions factor sources for the IPPU sector.

Category	Type of data	Data source and treatment method
Domestic Solvent Use Including Fungicides (2D3a)	Kg/capita	Default emission factor for NMVOC emissions from the domestic use of solvents obtained from Table 3.1. of chapter '2.D.3.a Domestic solvent use including fungicides' of the EMEP/CORINAR Emission Inventory Guidebook 2023 [26].

Table 2.12. Emissions factor sources for the AFOLU sector.

Category	Type of data	Data source and treatment method
3A1 Enteric Fermentation	Enteric fermentation emission factors for Tier 1 method	Default values for low productivity systems in Table 10.10 and for Latin America in Table 10.11, Chapter 10, Volume 4 of the 2019 Refinement [3].
3A2 & 3C6 Manure Management & Indirect N_2O emissions from Manure Management	Live weights for animal categories	Default values from the 2019 Refinement, Table 10A.5, Chapter 10, Volume 4 [3].
	CH_4 emission factors by animal category, manure management system and climate zone	Default values from the 2019 Refinement [3], Table 10.14, Chapter 10, Volume 4. Using default data for Latin America, tropical wet climate (>18 C mean annual temp and >2000 mm annual precipitation) and low productivity systems.
	Volatile solid excretion rate	Default values from the 2019 Refinement, Table 10.13A, Chapter 10, Volume 4 [3]. Using default data for Latin America and low productivity systems.
	Nitrogen excretion rate	Default values from the 2019 Refinement, Table 10.19, Chapter 10, Volume 4 [3]. Using default data for Latin America and low productivity systems.

	Emission factors for direct N_2O emissions from manure management	Default emission factors of the 2019 Refinement [3], Table 10.21, Chapter 10, Volume 4.
	Nitrogen loss fractions due to volatilisation of NH_3 and NO_X and leaching of nitrogen from manure management	Default values from the 2019 Refinement [3], Table 10.22, Chapter 10, Volume 4.
	Volatilisation and leaching factors for indirect soil N_2O emissions	Default emission factors of the 2019 Refinement [3], Table 11.3, Chapter 10, Volume 4.
3B1a Forest Land Remaining Forest Land	Average annual above-ground biomass growth (tonnes C/ha)	Country specific emission factor, published in Wiley's Global Change Biology: Trade-offs between carbon stocks and timber recovery in tropical forests are mediated by logging intensity, 2017 Journal Article. Provided by the country [27].
	Annual biomass decrease by degradation from mining and infrastructure (buffer area) (tC/ha)	Country specific emission factor for degradation in buffer zones caused by mining and infrastructure activities [9].
	Annual biomass decrease by degradation from skid trails of logging activities (tC/km)	Country specific emission factor for forest degradation caused by skid trails, Logging Infrastructure Factor (LIF) [9].
	Annual biomass decrease by degradation from logging (tC/m^3)	Country specific emission factor for volume harvested, Logging Damage Factor (LDF) [9].

	Emission factor for deforestation due to fires and biomass burning (t CO_2/ha)	Country specific emission factor for deforestation due to fire and biomass burning. The emission factor includes changes in carbon pools: AG, BG, saplings, standing dead wood, lying dead wood, litter, and CO_2 emissions from fire [9].
3B2b Land Converted to Cropland	Emission factor for deforestation due to agriculture (t C/ha)	Country specific emission factor for forest land converted to agriculture. The emission factor includes carbon pools: Above-ground biomass (AG tree), Below-ground biomass (BG tree), saplings, standing dead wood, lying dead wood, litter, and the change in soil carbon for conversion to permanent agriculture [9].
	Emission factor for deforestation due to shifting cultivation (t CO_2/ha)	Country specific emission factor for forest land deforested due to shifting cultivation. The emission factor includes changes in carbon pools: AG, BG, saplings, standing dead wood, lying dead wood, litter, the change in soil carbon for shifting cultivation (short cycle) [9].
3B5b Land Converted to Settlements	Emission factor for deforestation due to settlements (t C/ha)	Country specific emission factor for deforestation due to settlements. The emission factor includes changes in carbon pools: AG, BG, saplings, standing dead wood, lying dead wood, litter, and the change in soil carbon due to conversion to unpaved roads [9].
	Emission factor for deforestation due to forestry infrastructure (t C/ha)	Country specific emission factor for deforestation due to forestry infrastructure. The emission factor includes changes in carbon pools: AG, BG, saplings, standing dead wood, lying dead wood, litter, and the change in soil carbon due to conversion to unpaved roads [9].
	Emission factor for deforestation due to infrastructure (t C/ha)	Country specific emission factor for deforestation due to forestry infrastructure. The emission factor includes changes in carbon pools: AG, BG, saplings, standing dead wood, lying dead wood, litter, and the change in soil carbon due to conversion to unpaved roads [9].
3B6b Land Converted to Other Land	Emission factor for deforestation due to mining (tC/ha)	Country specific emission factor for deforestation due to medium- and large-scale mining including mining infrastructure. The emission factor includes changes in carbon pools: AG, BG, saplings, standing dead wood, lying dead wood, litter, and the change in soil carbon due to conversion to mining and to unpaved roads [9].
	Fuel biomass consumption	Default values of the 2006 IPCC Guidelines, Table 2.4, Chapter 2, Volume 4 [2].

3C1 Emissions from Biomass Burning	values for fires in a range of vegetation types	
	Emission factors for various types of burning	Default emission factors from the 2006 IPCC Guidelines, Table 2.5, Chapter 2, Volume 4 [2].
3C2 Liming	Emission factor for limestone	Default emission factor for limestone is 0.12 according to the 2006 IPCC, page 11.29, Chapter 11, Volume 4 [2].
3C3 Urea application	Emission factor for carbon emissions from urea applications	The default emission factor is 0.20 for carbon emissions from urea applications, according to the 2006 IPCC Guidelines, page 11.34, Chapter 11, Volume 4 [2].
3C4 & 3C5 Direct and Indirect N_2O Emissions from Managed Soils	Emission factors to estimate direct N_2O emissions from managed soils	Default emission factors from the 2019 Refinement, Table 11.1, Chapter 11, Volume 4 [2].
	Values for NAG, NBG, RAG, RS, DRY	For calculating the annual amount of N in crop residues (above and below ground) it was used the default values of N content of below-ground residues for crop (NBG), N content of above-ground residues for crop (NAG), the ratio of above-ground residue dry matter to harvested yield for crop (RAG), the ratio of below-ground root biomass to above-ground shoot biomass for crop (RS) and the dry matter fraction of harvested crop (DRY) from the 2019 Refinement, Table 11.1A, Chapter 11, Volume 4. [3].
	Volatilisation and leaching factors for indirect soil N2O emissions	Default emission factors of the 2019 Refinement, Table 11.3, Chapter 11, Volume 4 [3].
3C7 Rice Cultivations	CH4 baseline emission factor for continuously flooded fields without organic amendments	Default emission factors of the 2019 Refinement, Table 5.11, Chapter 5, Volume 4 [3].
	CH4 emission scaling factors to account for the differences in	Default emission factors of the 2019 Refinement, Table 5.12, Chapter 5, Volume 4 [3].

	water regime during cultivation period (SFw)	
	Scaling factor to account for the differences in water regime before the cultivation period (SFp)	Default emission factors of the 2019 Refinement, Table 5.13, Chapter 5, Volume 4 [3].
	Conversion factors for different types of organic amendments (CFOA)	Default emission factors of the 2019 Refinement, Table 5.14, Chapter 5, Volume 4 [3].

Table 2.13. Emissions factor sources for the waste sector.

Category	Type of data	Data source and treatment method
4A Solid Waste Disposal	Methane Correction Factors (MCF)	Default values obtained from Table 3.1 of Volume 5 from the 2019 IPCC Refinement [3] and held constant throughout the time series for each SWDS type.
	Degradable organic carbon (DOC)	Default values obtained from Table 2.4 of Volume 5 from the 2006 IPCC Guidelines [2], held constant throughout the time series.
	Fraction of DOC disseminated (DOCf)	Default values obtained from Table 3.0 of Volume 5 from the 2019 IPCC Refinement [3], held constant throughout the time series.
	CH_4 generation rate constant (k)	Default values obtained from Table 3.4 of Volume 5 from the 2019 IPCC Refinement [3], held constant throughout the time series.
	Delay time	Default value from Section 3.2.3 of Volume 5 from the 2019 IPCC Refinement [3], held constant throughout the time series.
	Fraction of CH_4 in developed gas (F)	Default value from Section 3.2.3 of Volume 5 of the 2019 IPCC Refinement [3], held constant throughout the time series.

Category	Type of data	Data source and treatment method
	Oxidation factor (OX)	As per default assumption in Table 3.2 of Volume 5 the 2019 IPCC Refinement [3], it is assumed no oxidation takes place due to lack of further information.
4B Biological Treatment of Solid Waste	Although it is known that some small-scale composting activities take place in Guyana, associated emissions from this category were not estimated due to a lack of data.	
4C1 Waste Incineration	Although it is known that incineration of clinical waste takes place in Guyana´s healthcare facilities associated emissions from this category were not estimated due to a lack of data.	
4C2 Open Burning of Waste	Oxidation factor (OF) for MSW open burning	Default value from Table 5.2 of Volume 5 from the 2019 Refinement [3], held constant throughout the time series.
	CH_4 emission factor (EF_{CH4}) for MSW open burning	Default value from Page 5.13 of Volume 5 from the 2019 Refinement [3], held constant throughout the time series.
	N_2O emission factor (EF_{N2O}) for MSW open burning	Default value from Table 5.6 of Volume 5 from the 2019 Refinement [3], held constant throughout the time series.
	Methane Correction Factors (MCF)	Default values obtained from Table 6.3 of Volume 5 from the 2019 IPCC Refinement [3], held constant throughout the time series.
4D1 Domestic Wastewater Treatment and Discharge	Maximum CH_4 producing capacity (Bo)	Default values obtained from Table 6.2 of Volume 5 from the 2019 IPCC Refinement [3], held constant throughout the time series.
	Fraction of Nitrogen in protein (F_{NPR})	Default value from Equation 6.10 of Volume 5 from the 2019 IPCC Refinement [3], held constant throughout the time series.
	Additional Nitrogen from household chemicals (N_{HH})	Default value from Equation 6.10 of Volume 5 from the 2019 IPCC Refinement [3], held constant throughout the time series.
	Factor for non-consumed protein added to the wastewater ($F_{NON-CON}$)	Default value from Table 6.10A of Volume 5 from the 2019 IPCC Refinement [3], held constant throughout the time series.

Category	Type of data	Data source and treatment method
	N_2O emission factor from effluent	Default value from Table 6.8A of Volume 5 from the 2019 IPCC Refinement [3], held constant throughout the timeseries.
4D2 Industrial Wastewater Treatment and Discharge	There is a lack of data on on-site industrial wastewater treatment practices in Guyana. Associated emissions are included in Category 4D1 by accounting for industrial wastewater that is discharged into the domestic sewer system through the default correction factor from the 2006 IPCC Guidelines for additional industrial BOD discharged into sewers (I).	

3.3. Uncertainty Assessment

Uncertainty is inversely tied to accuracy, denoting a cognitive state of incomplete knowledge that results from a lack of information and/or from disagreement about the extent of knowledge which may impact the level of accuracy of data or results evaluated.

Uncertainty assessments are an essential element for improving the accuracy of the national GHG inventory by identifying the most significant sources of uncertainties in order to prioritise improved data collection efforts and guide methodological selection.

While the National Inventory of Guyana has been prepared with the highest possible accuracy considering the current availability of country-specific data, uncertainties are associated to a varying degree due to the following reasons:

- Lack of high-quality, complete, country-specific, and recent data leading to the use of assumptions, default data, and splicing techniques.
- Model approximations which simplify real systems.
- Random errors from used measurements, studies, and statistics.

Further analysis of the causes of uncertainties for each Sector is provided in is section 6 of this chapter, as well as the identification of improvement methods to reduce these uncertainties, which have been incorporated into the Inventory Improvement Plan in section 7 of this chapter.

The 2006 IPCC Propagation of Error Approach 1 has been used to conduct the uncertainty assessment, based on uncertainties in activity data, emission factors, and other estimation parameters. As such, uncertainty was determined for individual categories and for the inventory as a whole, as well as the trends between the latest inventory year (2022) and the base year (1990).

A description of the main equations used is as follows:

Uncertainty in the Total Level of the Emissions of the Inventory

Combined Uncertainty:

The combined uncertainty is utilized to provide uncertainty estimates of a source or sink based on the combination of the uncertainties of the activity data and emissions factors.

$$U_x = \sqrt{U_{AD,x}^2 + U_{EF,x}^2}$$

Where:

U_x = *Combined uncertainty for source or sink x*
$U_{AD,x}$ = *Uncertainty of the activity data for source or sink x*
$U_{EF,X}$ = *Uncertainty of the emission factor for source or sink x*

Total Level Uncertainty in the Inventory:

Type B sensitivity arises from uncertainties that affect emissions or removals in the current year only.

$U = \sqrt{\sum_x V_x}$, where $V_x = \frac{(U_x \cdot E_{x,t})^2}{(\sum_y E_{y,t})^2}$

Where:

V_x = *Contribution to variance by category x in year t*
U_x = *Combined uncertainty for source or sink x*
$E_{x,t}$ = *Emission or removal estimate of source or sink x in year t*
$\sum_y E_{y,t}$ = *Total inventory estimates in year t*
U = *Uncertainty in the total level of the emissions of the inventory*

Uncertainty Introduced into the Trend in Total National Emissions

Type A Sensitivity:

The Type A Sensitivity arises from uncertainties that affect emissions or removals in the base year and the current year equally.

$$S_{A,x} = \left| \frac{0.01 \cdot E_{x,t} + \sum_y E_{y,t} - \left(0.01 E_{x,0} + \sum_y E_{y,0}\right)}{\left(0.01 E_{x,0} + \sum_y E_{y,0}\right)} \cdot 100 - \frac{\sum_y E_{y,t,} - \sum_y E_{y,0}}{\sum_y E_{y,0}} \cdot 100 \right|$$

Where:

$S_{A,x}$ = *Type A sensitivity for source or sink x*
$E_{x,t}$ and $E_{x,0}$ = *Emission or removal estimate of source or sink x in year t and year 0, respectively*
$\sum_y E_{y,t}$ and $\sum_y E_{y,0}$ = *Total inventory estimates in year t and 0, respectively*

Type B Sensitivity:

Type B sensitivity arises from uncertainties that affect emissions or removals in the current year only.

$$S_{B,x} = \left| \frac{E_{x,t}}{\sum_y E_{y,0}} \right|$$

Where:

$S_{B,x}$ = *Type B sensitivity for source or sink x*
$E_{x,t}$ = *Emission or removal estimate of source or sink x in year t*
$\sum_y E_{y,0}$ = *Total inventory estimates in year 0*

Total Trend Uncertainty in the Inventory:

$$U_{trend} = \sqrt{\sum_x U_{trend,x'}}$$

where: $U_{trend,EF,x} = S_{A,x} \cdot U_{EF,x}$, $U_{trend,AD,x} = S_{B,x} \cdot U_{AD,x} \cdot \sqrt{2}$, and $U_{trend,x} = U_{trend,AD,x}{}^2 + U_{trend,EF,x}{}^2$

Where:

$U_{trend,EF,x}$ = *Uncertainty in trend in national emissions introduced by emission factor uncertainty*
$S_{A,x}$ = *Type A sensitivity for source or sink x*
$S_{B,x}$ = *Type B sensitivity for source or sink x*
$U_{EF,x} = Emission\ factor\ uncertainty$
$U_{AD,x} = Activity\ data\ uncertainty$
$U_{trend,AD,x}$ = *Uncertainty in trend in national emissions introduced by activity data uncertainty*
$U_{trend,x}$ = *Uncertainty introduced into the trend in total national emissions by category x*
U_{trend} = *Trend uncertainty*

Uncertainty calculations performed for the inventory as a whole are presented in Table 2.14, whereby the uncertainty on the level has been estimated for the base year (1990) and the last inventory year (2022), and the trend between these two years. Results indicate an 81.27% uncertainty for 2022 and a trend uncertainty of 22.30% between 1990 and 2022. Except for emission factors for Category 3B, the source of all the uncertainty values are the default uncertainty values selected among the ranges provided by the IPCC 2006 Guidelines and 2019 Refinement, for which the selection criteria have been based on the conservative principle, using the upper values of the ranges by default. For Category 3B, country-specific uncertainty values were obtained from data available through Guyana´s REDD+ MRVS.

Table 2.14. Uncertainty calculations for the GHG inventory of Guyana.

IPCC category	Gas	Base year emissions (1990)	2022 emissions	AD uncertainty	EF uncertainty	Combined uncertainty	Contribution to variance by category in year 2022	Type A sensitivity	Type B sensitivity	Uncertainty in trend by EF	Uncertainty in trend by AD	Uncertainty introduced into the trend in total national emissions
		Gg of CO2-eq		%	%	%		%	%	%	%	%
1A1 – Energy Industries	CO_2	332.98	838.97	10	7	12	0.006	-0.004	0.006	-0.026	0.060	0.004
1A1 – Energy Industries	CH_4	1.10	1.45	10	100	100	0.000	0.000	0.000	0.000	0.000	0.000
1A1 – Energy Industries	N_2O	1.61	2.41	10	100	100	0.000	0.000	0.000	-0.001	0.000	0.000
1A2 – Manufacturing Industries and Construction	CO_2	301.18	76.54	20	7	21	0.000	0.001	0.001	0.010	0.011	0.000
1A2 – Manufacturing Industries and Construction	CH_4	12.46	5.30	20	100	102	0.000	0.000	0.000	0.005	0.001	0.000
1A2 – Manufacturing Industries and Construction	N_2O	15.91	6.73	20	100	102	0.000	0.000	0.000	0.006	0.001	0.000
1A3a – Domestic Aviation	CO_2	34.56	37.39	10	7	12	0.000	0.000	0.000	0.000	0.003	0.000
1A3a – Domestic Aviation	CH_4	0.01	0.01	10	100	100	0.000	0.000	0.000	0.000	0.000	0.000
1A3a – Domestic Aviation	N_2O	0.26	0.28	10	100	100	0.000	0.000	0.000	0.000	0.000	0.000
1A3b – Road Transport	CO_2	231.33	1094.72	10	7	12	0.010	-0.006	0.008	-0.043	0.078	0.008
1A3b – Road Transport	CH_4	2.09	9.71	10	100	100	0.000	0.000	0.000	-0.005	0.001	0.000
1A3b – Road Transport	N_2O	2.97	14.10	10	100	100	0.000	0.000	0.000	-0.008	0.001	0.000
1A4 – Other Sectors	CO_2	242.31	878.97	25	7	26	0.029	-0.005	0.006	-0.032	0.156	0.025
1A4 – Other Sectors	CH_4	76.20	11.79	25	100	103	0.000	0.000	0.000	0.043	0.002	0.002
1A4 – Other Sectors	N_2O	9.99	2.83	25	100	103	0.000	0.000	0.000	0.005	0.001	0.000
1A5 – Other	CO_2	0.92	33.78	10	7	12	0.000	0.000	0.000	-0.002	0.002	0.000

1A5 – Other	CH_4	0.00	0.05	10	100	100	0.000	0.000	0.000	0.000	0.000	0.000
1A5 – Other	N_2O	0.00	0.06	10	100	100	0.000	0.000	0.000	0.000	0.000	0.000
1B1 – Solid Fuels	CH_4	0.00	0.00	25	121	124	0.000	0.000	0.000	0.000	0.000	0.000
1B1 – Solid Fuels	N_2O	0.00	0.00	25	163	165	0.000	0.000	0.000	0.000	0.000	0.000
1B2a - Oil	CO_2	0.00	873.44	15	40	43	0.078	-0.006	0.006	-0.248	0.093	0.070
1B2a - Oil	CH_4	0.00	1540.15	15	40	43	0.241	-0.011	0.011	-0.437	0.164	0.218
1B2a - Oil	N_2O	0.00	0.93	15	100	101	0.000	0.000	0.000	-0.001	0.000	0.000
1B2b – Natural Gas	CO_2	0.00	37.81	15	20	25	0.000	0.000	0.000	-0.005	0.004	0.000
1B2b – Natural Gas	CH_4	0.00	648.52	15	20	25	0.015	-0.005	0.005	-0.092	0.069	0.013
1B2b – Natural Gas	N_2O	0.00	0.17	15	100	101	0.000	0.000	0.000	0.000	0.000	0.000
3A1 – Enteric fermentation	CH_4	381.22	535.68	20	40	45	0.032	-0.001	0.004	-0.049	0.076	0.008
3A2 – Manure management	CH_4	36.75	65.51	20	30	36	0.000	0.000	0.000	-0.007	0.009	0.000
3A2 – Manure management	N_2O	0.01	0.02	54	116	128	0.000	0.000	0.000	0.000	0.000	0.000
3B1a – Forest Land Remaining Forest Land	CO_2	-152319.30	-148875.77	21	70	73	6600.630	0.029	1.056	2.055	22.177	496.020
3B2b –Land Converted to Cropland	CO_2	564.80	476.21	21	35	41	0.021	0.000	0.003	0.015	0.071	0.005
3B5B –Land Converted to Settlements	CO_2	320.02	457.89	21	61	65	0.049	-0.001	0.003	-0.067	0.068	0.009
3B6B –Land Converted to Other Land	CO_2	7716.75	5534.47	21	35	41	2.845	0.013	0.039	0.446	0.824	0.879
3C1 – Emissions from biomass burning	CH_4	63.16	111.48	28	161	163	0.019	0.000	0.001	-0.059	0.022	0.004
3C1 – Emissions from biomass burning	N_2O	16.26	28.04	28	161	163	0.001	0.000	0.000	-0.014	0.006	0.000
3C2 – Liming	CO_2	11.35	15.11	60	50	78	0.000	0.000	0.000	-0.002	0.006	0.000
3C3 – Urea application	CO_2	6.98	11.56	100	50	112	0.000	0.000	0.000	-0.002	0.008	0.000
3C4 – Direct N2O emissions from managed soil	N_2O	269.75	299.92	101	447	458	1.053	0.000	0.002	-0.138	0.215	0.065

3C5 – Indirect N2O emissions from managed soil	N_2O	103.71	139.06	20	121	123	0.016	0.000	0.001	-0.035	0.020	0.002
3C6 – Indirect N2O emissions from manure management	N_2O	6.89	12.02	54	110	123	0.000	0.000	0.000	-0.004	0.005	0.000
3C7 – Rice cultivations	CH_4	227.31	708.62	10	52	53	0.079	-0.003	0.005	-0.182	0.050	0.036
4A1– Managed Waste Disposal Sites	CH_4	0.00	147.73	52	52	73	0.007	-0.001	0.001	-0.054	0.054	0.006
4A3 – Uncategorized Waste Disposal Sites	CH_4	215.51	159.25	52	75	91	0.012	0.000	0.001	0.024	0.059	0.004
4C2 – Open Burning of Waste	CO_2	8.05	6.62	52	40	66	0.000	0.000	0.000	0.000	0.002	0.000
4C2 – Open Burning of Waste	CH_4	12.00	9.86	52	100	113	0.000	0.000	0.000	0.001	0.004	0.000
4C2 – Open Burning of Waste	N_2O	1.67	1.37	52	100	113	0.000	0.000	0.000	0.000	0.001	0.000
4D1 – Domestic Wastewater Treatment and Discharge	CH_4	108.28	110.44	59	58	83	0.005	0.000	0.001	-0.003	0.046	0.002
4D1 – Domestic Wastewater Treatment and Discharge	N_2O	5.54	9.68	58	497	500	0.001	0.000	0.000	-0.016	0.004	0.000
		-140977	-133919				81.27					22.30
		Total 1990 emissions	**Total 2022 emissions**				**2022 inventory uncertainty (%)**					**1990-2022 trend uncertainty (%)**

3.4. Key Category Analysis

A key category is one that is prioritised within the national inventory system because its estimate has a significant influence on a country's total inventory of greenhouse gases in terms of the absolute level, the trend, or the uncertainty in emissions and removals. Whenever the term key category is used, it includes both source and sink categories. Through the identification of these categories in the national inventory, Guyana can utilise the results as a foundation for making methodological choices. This enables the prioritisation of efforts toward these specific key categories, leading to enhancements in the overall accuracy of estimates.

The key category analysis of the national GHG inventory of Guyana is conducted in a systematic and objective manner by performing a quantitative analysis of the relationships between the level and the trend of each category's emissions and removals and total national emissions and removals.

The 2006 IPCC Approach 1 has been used to conduct the key category analysis for both the level and the trend analysis, considering the base year 1990 and the latest inventory year 2022. Furthermore, key categories were identified both including and excluding emissions and removals from Forestry and Other Land Use (FOLU). In Approach 1, key categories are determined based on a pre-established cumulative emissions threshold. These categories, when summed in descending order of magnitude, constitute 95% of the total level. The undertaken analysis has adhered, to the extent possible, to the recommended aggregation level for Approach 1 outlined in the 2006 IPCC Guidelines.

A description of the main equations for the level and trend assessment used is as follows.

Level Assessment

The contribution of each source or sink category to the total national inventory level is calculated according to the following equation:

$$L_{x,t} = \frac{|E_{x,t}|}{\sum_y |E_{y,t}|}$$

Where:

$L_{x,t} = \textit{level assessment for source or sink } x \textit{ in latest inventory year}$

$|E_{x,t}| = \textit{absolute value of emission or removal estimate of source or sink category } x \textit{ in year } t$

$\sum_y |E_{y,t}| = \textit{total contribution in year } t \textit{ (sum of the absolute values of emissions and removals)}$

Under the level assessment, key categories are therefore those that, when aggregated in descending order of magnitude, collectively constitute 95% of the overall contribution from all source and sink categories to the national inventory level.

Trend Assessment

The contribution of the trends of each source or sink category to the total national inventory trends is calculated according to the following equation:

$$T_{x,t} = \frac{|E_{x,0}|}{\sum_y |E_{y,0}|} \cdot \left| \frac{|E_{x,t} - E_{x,0}|}{|E_{x,0}|} - \frac{(\sum_y E_{y,t} - \sum_y E_{y,0})}{|\sum_y E_{y,0}|} \right|$$

Where:

$T_{x,t}$ = *trend assessment for source or sink x in year t as compared to the base year (year 0)*
$|E_{x,0}|$ = *absolute value of emission or removal estimate of source or sink category x in base year*
$E_{x,t}$ and $E_{x,0}$ = *real values of estimate of source or sink category X in years t and base year, respectively.*
$\sum_y E_{y,t}$ and $\sum_y E_{y,0}$ = *total inventory estimates in years t and base year, respectively.*

It is important to note that both that both ascending and descending trends are considered. In the assessment of trends, key categories are those that, when aggregated in descending order of magnitude, account for 95% of the collective contribution from all source and sink categories to the national total inventory trend.

Table 2.15 provides a summary of the key categories identified in both level and trend assessments for the base year 1990 and the latest inventory year 2022, both including and excluding FOLU. For a more detailed examination of the results of the key category analysis in both level and trend assessments, with and without the contributions of FOLU, refer to Annex I of the BUR.

It is important to note the categories 1B2a – Oil and 1B2b – Natural Gas were not occurring in 1990. However, to be able to conduct the key category analysis, a value of 0 has been assigned to these two categories for the year 1990.

Table 2.15. Summary of identified key categories.

IPCC category	Gas	With FOLU			Without FOLU		
		L2022	L1990	Trend	L2022	L1990	Trend
1A1 – Energy Industries	CO_2				X	X	X
1A2 – Manufacturing Industries and Construction	CO_2					X	X
1A3a – Domestic Aviation	CO_2					X	X
1A3b – Road Transport	CO_2				X	X	X
1A4 – Other Sectors	CO_2				X	X	X
1A4 – Other Sectors	CH_4					X	X
1B2a – Oil	CO_2				X		X
1B2a – Oil	CH_4	X			X		X
1B2b – Natural Gas	CH_4				X		X
3A1 – Enteric Fermentation	CH_4				X	X	X
3A2 – Manure Management	CH_4					X	
3B1a – Forest Land Remaining Forest Land	CO_2	X	X	X			
3B6B – Land Converted to Other Land	CO_2	X	X	X			
3C1 – Biomass Burning	CH_4				X	X	X
3C4 – Direct N_2O Emissions from Managed soils	N_2O				X	X	X
3C5 – Indirect N_2O Emissions from Managed soils	N_2O				X	X	X
3C7 – Rice Cultivations	CH_4				X	X	
4A1 – Managed Waste Disposal Sites	CH_4				X		X
4A3 – Uncategorized Waste Disposal Sites	CH_4				X	X	X
4D1 – Domestic Wastewater Treatment and Discharge	CH_4				X	X	X

4. Summary of GHG Emissions

4.1. National GHG Emissions Profile

Guyana is a net carbon sink, with its lush managed forest cover removing up to 10 times more GHGs than the emissions produced in the country up to the year 2022, as illustrated in Figure 2.2.

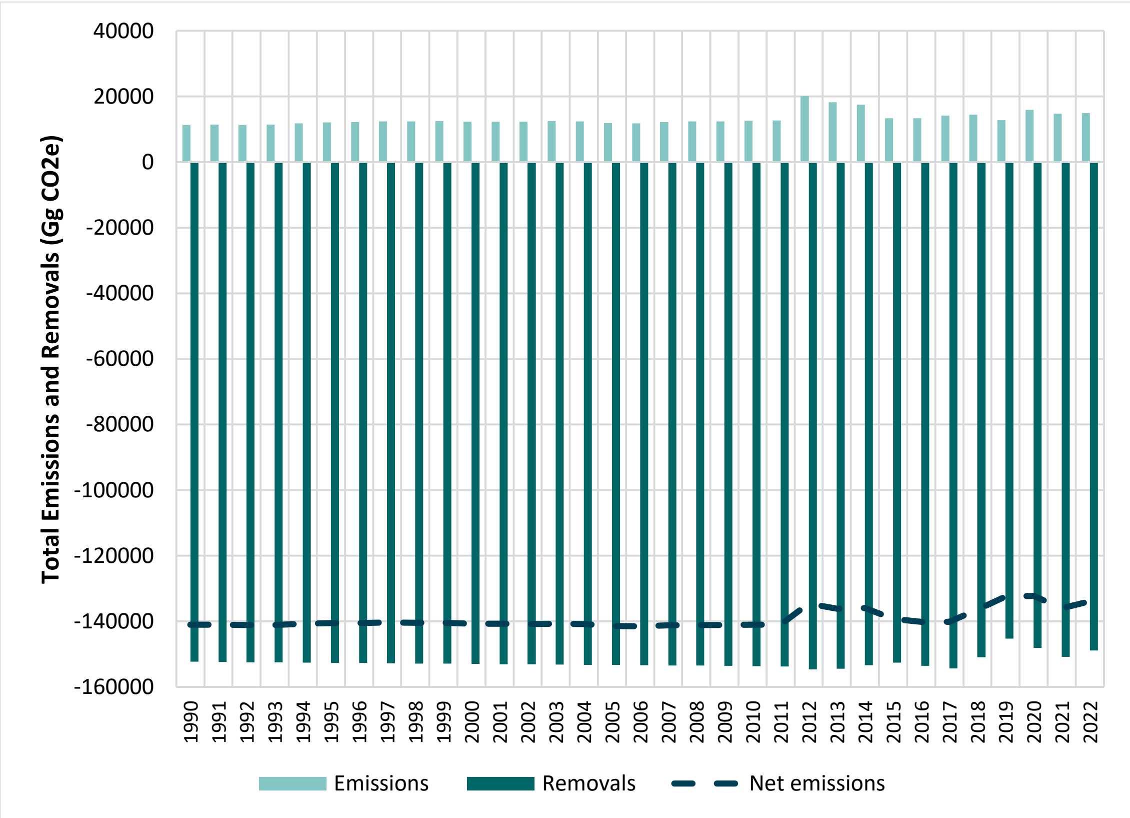

Figure 2.2. Total emissions and removals in Guyana.

Between 1990 and 2022, total GHG removals for managed forests remained stable, amounting to 152,319 Gg CO_2e and 148,876 Gg CO_2e, respectively. A 31.87% increase in total national emissions is observed from 11,342 Gg CO_2e in 1990 to 14,957 Gg CO_2e in 2022. Such growth in emissions is attributed primarily to an expansion in the oil and gas industry, as well as population and economic growth contributing to more emissions from agriculture, waste management, and land conversion to settlements, cropland, and other lands.

When combined, Guyana contributed to a net 140,977 Gg CO_2e removal in 1990, slowly decreasing by 5% to a net 133,919 Gg CO_2e removal by 2022.

The following Figure 2.3 presents the sectoral contribution to total GHG emissions.

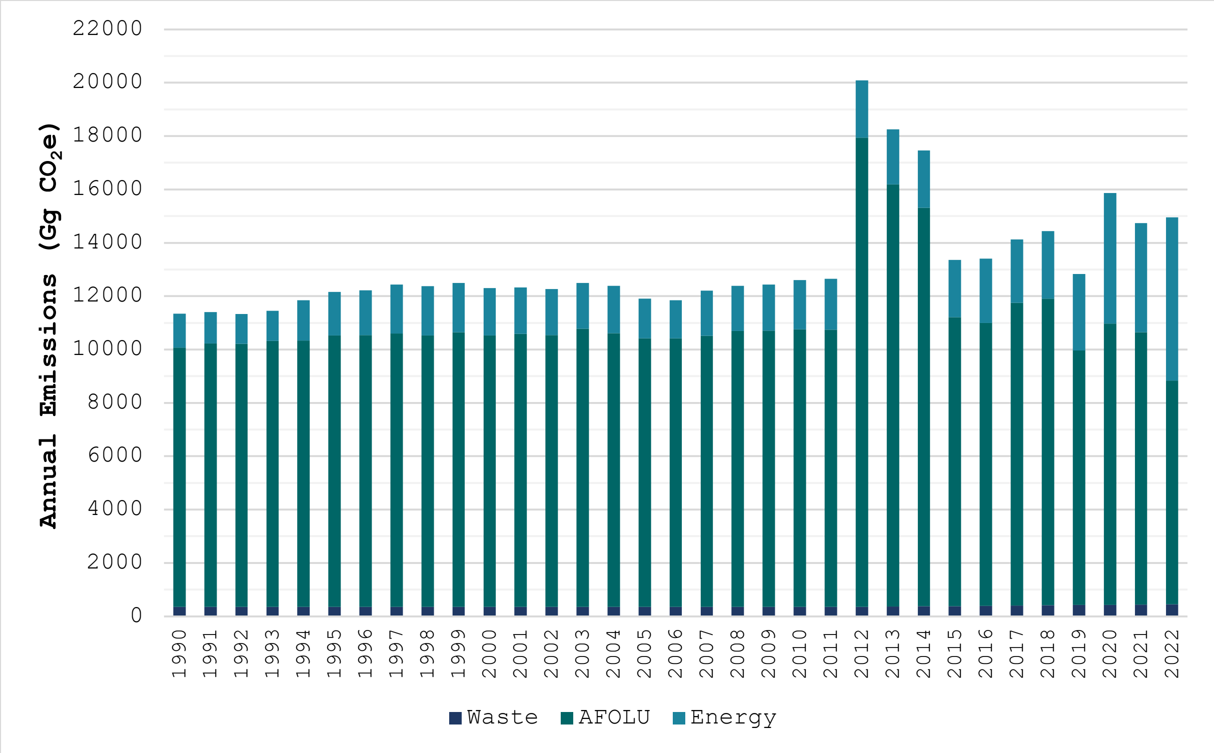

Figure 2.3. Sectoral contribution to total emissions in Guyana.

4.2. Reporting Tables

The UNFCCC biennial update reporting guidelines for Parties not included in Annex I to the Convention (BUR Guidelines) specify that the inventory section of the BUR should incorporate Tables 1 and 2 from Decision 17/CP.8. However, these tables utilise nomenclature from the 1996 IPCC Guidelines. Since Guyana has conducted its inventory estimation in accordance with the 2006 IPCC Guidelines, the mentioned tables are not applicable. The 2006 IPCC Guidelines offer an equivalent summary reporting table in Chapter 8, Volume 1. These are presented in Tables 2.16 and 2.17 and provide a summary of the emissions in the inventory of Guyana in 2022

Table 2.16. Reporting tables – summary table A of Guyana's 2022 GHG inventory.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2	CH_4	N_2O	HFC	PFC	SF6	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
	Gg			CO_2 equivalents (Gg)					Gg			
Total NET national emissions and removals	**-138,502.30**	**145.20**	**1.95**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NA, NE**	**NO, NA, NE**	**NO, NA, NE**	**NO, NA, NE**
1. Energy	**3,871.61**	**79.18**	**0.10**						**NE**	**NE**	**NE**	**NE**
1A. Fuel combustion (sectoral approach)	2,960.36	1.01	0.10						NE	NE	NE	NE
1A1. Energy industries	838.97	0.05	0.01						NE	NE	NE	NE
1A2. Manufacturing industries and construction	76.54	0.19	0.03						NE	NE	NE	NE
1A3. Transport	1,132.11	0.35	0.05						NE	NE	NE	NE
1A4. Other sectors	878.97	0.42	0.01						NE	NE	NE	NE

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2	CH_4	N_2O	HFC	PFC	SF6	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
	Gg			CO_2 equivalents (Gg)					Gg			
1A5. Non specified	33.78	0.002	0.000						NE	NE	NE	NE
1B. Fugitive emissions from fuels	911.25	78.17	0.004						NO	NO	22.59	NO
1B1. Solid fuels	IE	0.00006	0.0000001						NO	NO	NO	NO
1B2. Oil and natural gas	911.25	78.17	0.004						NO	NO	22.59	NO
1B3. Other emissions from energy production	NO	NO	NO						NO	NO	NO	NO
1C Carbon Dioxide Transport and Storage	NO								NO	NO	NO	NO
1C1. Transport of CO_2	NO								NO	NO	NO	NO
1C2. Injection and Storage	NO								NO	NO	NO	NO
2. Industrial processes	**NO, NA, NE**	**NO, NA, NE**	**NO, NA, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NA, NE**	**NO, NA, NE**	**NO, NA, NE**	**NO, NA, NE**
2A. Mineral products	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
2A1 Cement Production	NO	NO	NO						NO	NO	NO	NO
2A2 Lime Production	NO	NO	NO						NO	NO	NO	NO
2A3 Glass Production	NO	NO	NO						NO	NO	NO	NO
2A4 Other Process Uses of Carbonates	NO	NO	NO						NO	NO	NO	NO
2A5 Other (please specify)	NO	NO	NO						NO	NO	NO	NO
2B. Chemical industry	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
2B1. Ammonia production	NO	NO	NO						NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2	CH_4	N_2O	HFC	PFC	SF6	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
	Gg			CO_2 equivalents (Gg)					Gg			
2B2. Nitric acid production	NO	NO	NO						NO	NO	NO	NO
2B3. Adipic acid production	NO	NO	NO						NO	NO	NO	NO
2B4. Caprolactam, glyoxal and glyoxylic acid production	NO	NO	NO						NO	NO	NO	NO
2B5. Carbide production	NO	NO	NO						NO	NO	NO	NO
2B6. Titanium dioxide production	NO	NO	NO						NO	NO	NO	NO
2B7. Soda ash production	NO	NO	NO						NO	NO	NO	NO
2B8. Petrochemical and carbon black production	NO	NO	NO						NO	NO	NO	NO
2B9. Fluorochemical production				NO	NO	NO	NO	NO	NO	NO	NO	NO
2B10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2C. Metal industry	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
2C1. Iron and steel production	NO	NO	NO						NO	NO	NO	NO
2C2. Ferroalloys production	NO	NO	NO						NO	NO	NO	NO
2C3. Aluminium production	NO	NO	NO		NO				NO	NO	NO	NO
2C4. Magnesium production	NO			NO	NO	NO	NO	NO	NO	NO	NO	NO
2C5. Lead production	NO								NO	NO	NO	NO
2C6. Zinc production	NO								NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2	CH_4	N_2O	HFC	PFC	SF6	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
	Gg			CO_2 equivalents (Gg)					Gg			
2C7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2D. Non-energy products from fuels and solvent use	**NE**	**NE**	**NE**						**NE, NA**	**NE, NA**	**0.97**	**NE, NA**
2D1. Lubricant use	NE								NE	NE	NE	NE
2D2. Paraffin wax use	NE	NE	NE						NE	NE	NE	NE
2D3. Other									NA	NA	0.97	NA
2E. Electronics industry	NO		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E1. Integrated circuit or semiconductor	NO		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2E2. TFT flat panel display				NO	NO	NO	NO	NO	NO	NO	NO	NO
2E3. Photovoltaics				NO	NO	NO	NO	NO	NO	NO	NO	NO
2E4. Heat transfer fluid							NO	NO	NO	NO	NO	NO
2E5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F. Product uses as substitutes for ODS	**NO, NA**	**NO, NA**	**NO, NA**	**NE, NO**	**NE, NO**		**NE, NO**	**NE, NO**	**NA, NO**	**NA, NO**	**NA, NO**	**NA, NO**
2F1. Refrigeration and air conditioning	NA	NA	NA	NE	NE		NE	NE	NA	NA	NA	NA
2F2. Foam blowing agents	NA			NE	NE		NE	NE	NA	NA	NA	NA
2F3. Fire protection	NA			NE	NE		NE	NE	NA	NA	NA	NA
2F4. Aerosols				NE	NE		NE	NE	NA	NA	NA	NA
2F5. Solvents				NO	NO		NO	NO	NO	NO	NO	NO
2F6. Other applications	NO	NO	NO	NO	NO		NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2	CH_4	N_2O	HFC	PFC	SF6	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
	Gg			CO_2 equivalents (Gg)					Gg			
2G. Other product manufacture and use	**NO**	**NO**	**NE**	**NO**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NA, NO**	**NA, NO**	**NA, NO**	**NA, NO**
2G1. Electrical equipment					NE	NE	NE	NE	NA	NA	NA	NA
2G2. SF6 and PFCs from other product use					NO	NO	NO	NO	NO	NO	NO	NO
2G3. N_2O from product uses			NE						NA	NA	NA	NA
2G4. Other	NO	NO		NO			NO	NO	NO	NO	NO	NO
2H. Other	**NA, NO**	**NA, NO**	**NO**						**NE, NO**	**NE, NO**	**NE, NO**	**NE, NO**
2H1. Pulp and Paper Industry	NA	NA							NE	NE	NE	NE
2H2. Food and Beverages Industry	NA	NA							NE	NE	NE	NE
2H3. Other (please specify)	NO	NO	NO						NO	NO	NO	NO
3. AGRICULTURE, FORESTRY AND OTHER LAND USE	**-142,380.53**	**50.76**	**1.81**						**NA, NO**	**NA, NO**	**NA, NO**	**NA, NO**
3A. Livestock		21.47	0.0000796						**NA**	**NA**	**NA**	**NA**
3A1. Enteric Fermentation		19.13							NA	NA	NA	NA
3A2. Manure Management		2.34	8.0E-05						NA	NA	NA	NA
3B. Land	**-142,407.20**		**NE**						**NA**	**NA**	**NA**	**NA**
3B1. Forest Land	-148,875.77								NA	NA	NA	NA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2	CH_4	N_2O	HFC	PFC	SF6	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
	Gg			CO_2 equivalents (Gg)					Gg			
3B2 Cropland	476,21								NA	NA	NA	NA
3B3. Grassland	NE								NA	NA	NA	NA
3B4. Wetlands	NE		NE						NA	NA	NA	NA
3B5. Settlements	457.89								NA	NA	NA	NA
3B6. Other Land	5534.47								NA	NA	NA	NA
3C. Aggregate Sources and Non-CO_2 Emissions Sources on Land	**26.67**	**29.29**	**1.81**						**NA, NO**	**NA, NO**	**NA, NO**	**NA, NO**
3C1. Biomass Burning	IE	3.98	0.11						NA	NA	NA	NA
3C2. Liming	15.11								NA	NA	NA	NA
3C3. Urea Application	11.56								NA	NA	NA	NA
3C4. Direct N_2O Emissions from Managed Soils			1.13						NA	NA	NA	NA
3C5. Indirect N_2O Emissions from Managed Soils			0.52						NA	NA	NA	NA
3C6. Indirect N_2O Emissions from Manure Management			0.05						NA	NA	NA	NA
3C7. Rice Cultivations		25.31	NA						NA	NA	NA	NA
3C8 Other (please specify)	NO	NO	NO						NO	NO	NO	NO
3D. Other	**IE, NO**			**NA, NO**	**NA, NO**	**NA, NO**	**NA, NO**	**NA, NO**	**NA, NO**	**NA, NO**	**NA, NO**	**NA, NO**
3D1. Harvested Wood Products	IE								NA	NA	NA	NA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2	CH_4	N_2O	HFC	PFC	SF6	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
	Gg			CO_2 equivalents (Gg)					Gg			
3D2. Other (please specify)	NO								NO	NO	NO	NO
4. WASTE	**6.62**	**15.26**	**0.04**						**NE, NO**	**NE, NO**	**NE, NO**	**NE, NO**
4A. Solid Waste Disposal		10.96	NE						NE	NE	NE	NE
4B. Biological Treatment of Solid Waste		NE	NE						NE	NE	NE	NE
4C. Incineration and Open Burning of Waste	6.62	0.35	0.01						NE	NE	NE	NE
4D. Wastewater Treatment and Discharge		3.94	0.04						NE	NE	NE	NE
4E. Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. OTHER	**NO**	**NO**	**NE, NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NE, NO**	**NE, NO**	**NE, NO**	**NE, NO**
5A. Indirect N_2O Emissions from the Atmospheric Deposition of Nitrogen in NOx and NH3			NE						NE	NE	NE	NE
5B. Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo items (5)	**NE**	**NE**	**NE**						**NE**	**NE**	**NE**	**NE**
International Bunkers	**NE**	**NE**	**NE**						**NE**	**NE**	**NE**	**NE**
International Aviation (International Bunkers)	NE	NE	NE						NE	NE	NE	NE

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2	CH_4	N_2O	HFC	PFC	SF6	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
	Gg			CO_2 equivalents (Gg)					Gg			
International Water-borne Transport (International Bunkers)	NE	NE	NE						NE	NE	NE	NE
Multilateral Operations	NE	NE	NE						NE	NE	NE	NE

Table 2.17. Reporting tables – summary table B of Guyana's 2022 GHG inventory.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2	CH_4	N_2O	HFC	PFC	SF6	Other halogenated gases with CO_2 equivalent conversion factors (3)	Other halogenated gases without CO_2 equivalent conversion factors (4	NOx	CO	NMVOCs	SO2
	Gg			CO_2 equivalents (Gg)					Gg			
Total national emissions and removals	**-138,502.30**	**145.20**	**1.95**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NA, NE**	**NO, NA, NE**	**NO, NA, NE**	**NO, NA, NE**
1. Energy	**3,871.61**	**79.18**	**0.10**						**NE**	**NE**	**NE**	**NE**
1A. Fuel combustion (sectoral approach)	2,960.36	1.01	0.10						NE	NE	NE	NE
1B. Fugitive emissions from fuels	911.25	78.17	0.004						NE	NE	NE	NE
1C Carbon Dioxide Transport and Storage	NO								NO	NO	NO	NO
2. Industrial processes	**NO, NA, NE**	**NO, NA, NE**	**NO, NA, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NA, NE**	**NO, NA, NE**	**NO, NA, NE**	**NO, NA, NE**
2A. Mineral products	NO	NO	NO						NO	NO	NO	NO
2B. Chemical industry	NO	NO	NO						NO	NO	NO	NO
2C. Metal industry	NO	NO	NO						NO	NO	NO	NO
2D. Non-energy products from fuels and solvent use	NE	NE	NE						NE, NA	NE, NA	0.97	NE, NA
2E. Electronics industry	NO		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2F. Product uses as substitutes for ODS	NA, NO	NA, NO	NA, NO	NE, NO	NE, NO		NE, NO	NE, NO	NA, NO	NA, NO	NA, NO	NA, NO
2G. Other product manufacture and use	NO	NO	NE	NO	NO, NE	NO, NE	NO, NE	NO, NE	NA, NO	NA, NO	NA, NO	NA, NO
2H. Other	NA, NO	NA, NO	NO						NE, NO	NE, NO	NE, NO	NE, NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2	CH_4	N_2O	HFC	PFC	SF6	Other halogenated gases with CO_2 equivalent conversion factors (3)	Other halogenated gases without CO_2 equivalent conversion factors (4	NOx	CO	NMVOCs	SO2
	Gg			CO_2 equivalents (Gg)					Gg			
3. AGRICULTURE, FORESTRY AND OTHER LAND USE	**-142,380.53**	**50.76**	**1.81**						**NA, NO**	**NA, NO**	**NA, NO**	**NA, NO**
3A. Livestock		21.47	0.0000796						NA	NA	NA	NA
3B. Land	-142,407.20	NA	NE						NA	NA	NA	NA
3C. Aggregate Sources and Non-CO_2 Emissions Sources on Land	26.67	29.29	1.81						NA, NO	NA, NO	NA, NO	NA, NO
3D. Other	IE, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
4. WASTE	**6.62**	**15.26**	**0.04**						**NE**	**NE**	**NE**	**NE**
4A. Solid Waste Disposal		10.96	NE						NE	NE	NE	NE
4B. Biological Treatment of Solid Waste		NE	NE						NE	NE	NE	NE
4C. Incineration and Open Burning of Waste	6.62	0.35	0.01						NE	NE	NE	NE
4D. Wastewater Treatment and Discharge		3.94	0.04						NE	NE	NE	NE
4E. Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. OTHER	**NO**	**NO**	**NE, NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NE, NO**	**NE, NO**	**NE, NO**	**NE, NO**
5A. Indirect N_2O Emissions from the Atmospheric			NE						NE	NE	NE	NE

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2	CH_4	N_2O	HFC	PFC	SF6	Other halogenated gases with CO_2 equivalent conversion factors (3)	Other halogenated gases without CO_2 equivalent conversion factors (4	NOx	CO	NMVOCs	SO2
	Gg			CO_2 equivalents (Gg)					Gg			
Deposition of Nitrogen in NOx and NH3												
5B. Other (please specify)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo items (5)	**NE**	**NE**	**NE**						**NE**	**NE**	**NE**	**NE**
International Bunkers	NE	NE	NE						NE	NE	NE	NE
International Aviation (International Bunkers)	NE	NE	NE						NE	NE	NE	NE
International Water-borne Transport (International Bunkers)	NE	NE	NE						NE	NE	NE	NE
Multilateral Operations	NE	NE	NE						NE	NE	NE	NE

4.3. Comparison With Previous National GHG Inventories

In compliance with its commitments under the UNFCCC, Guyana has thus far completed three national GHG inventories according to the Revised 1996 IPCC Guidelines as follows:

- Period 1990-1998 reported in the first NC.
- Period 1990-2004 reported in the second NC.
- Period 1990-2016 reported in the third NC (in draft).

For the first time, the current edition of the national GHG emissions inventory of Guyana for the period 1990-2022 utilizes the 2006 IPCC Guidelines and the 2019 Refinement. Furthermore, the development of sectoral monitoring, reporting, and verification systems have permitted access to much more accurate and complete country-specific data since the previous inventory compilation. For these two principal reasons, the entire time series 1990-2016 has been recalculated and the time series 2017-2022 has been calculated using the most updated methodologies and data. It is for this reason that the current edition of the 1990-2022 GHG inventory of Guyana is not comparable to values reported previously.

Table 2.18 provides an overview of the methodological differences between the current and previous editions of the Guyana national GHG emission inventory.

Table 2.18. Changes in inventory compared to previous editions.

Sector	Description of changes and recalculations
Cross-cutting	• Methodologies, default parameters, and default emission factors from the 2006 IPCC Guidelines and 2019 Refinement were now adopted for the inventory as a whole, as opposed to the 1996 IPCC Guidelines from the previous inventory.
Energy Sector	• Category 1B1 Solid Fuels has been introduced for the first time in the current inventory to account for the fugitive emissions during the transformation of fuel for charcoal production. • Category 1B2 Oil and Natural Gas has been introduced for the first time in the current inventory to account for fugitive emissions originating from oil and natural gas systems.
IPPU Sector	• Improved information for all entries through the use of qualitative notation keys and supporting information to ensure the completeness of each individual emission estimate.
AFOLU Sector	• Country specific parameters and emissions factors have been used for the estimation of emissions and removals from Category 3B based on the calculations from the workbook to determine the emissions reductions of Guyana's REDD+ program, for submission to the Architecture for REDD+ Transactions under TREES 2.0 standards.

Sector	Description of changes and recalculations
	• Emissions from urea application, Category 3C3, have been calculated using national urea imports data from 2020 to 2022 and surrogating data from FAO for the rest of the timeline. • Emissions from the Category 3C5: Indirect N2O Emissions from Managed Soils have been calculated using default values and emissions factors from the 2019 Refinements.
Waste Sector	• The waste sector now encompasses the entire geographical scope of Guyana, as opposed to only the geographical scope of Georgetown and its vicinity. • Category 4A now accounts for emissions from the Haags Bosch Sanitary Landfill under Category 4A1 (managed solid waste disposal sites) and the remaining emissions under Category 4A3 (uncategorized solid waste disposal sites), whereas the previous inventory grouped all solid waste disposal emissions under Category 4A3. • Category 4C2 (open burning of waste) has been introduced for the first time in the current inventory to account for emissions from open burning of waste. • CH_4 emissions under Category 4D1 (domestic wastewater treatment and discharge) were recalculated on the basis of updated country-specific information on the historical evolution of wastewater treatment methods including sewerage, latrines, and septic systems, available from the Guyana Bureau of Statistics Census. N_2O emissions were recalculated on the basis of updated information on the historical evolution on nitrogen consumption available from FAO statistics.

5. Emission Trends by GHG

In Guyana, CO_2 is the predominant gas in national GHG emissions throughout the time series (Figure 2.4). Whilst CO_2 is the most influential gas, its proportional contribution has evolved over time. CO_2 contributed to 86% of total GHG emissions in 1990, slowly increasing to a peak 89% by 2012, and subsequently decreasing to 69% by 2022. To a much lower extent, CH_4 is the second most important gas that is increasing in importance, growing from a 10% contribution to national total GHG emissions in 1990 to a 27% contribution in 2022. Lastly, N_2O is the third most important gas, with a fairly stable contribution to national GHG emission totals, ranging from 3-5% across the time series.

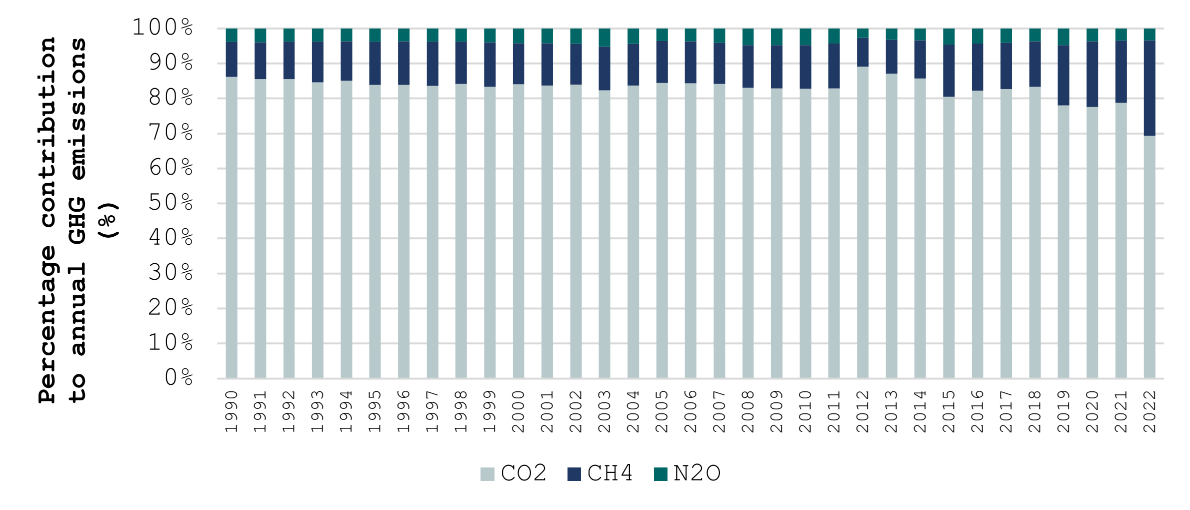

Figure 2.4. GHG contribution to total emissions in Guyana.

6. Emission Trends by Sector

6.1. Energy

The energy sector covers GHG emissions arising from the combustion and as fugitive emissions or escape without combustion through several activities, including the exploration and exploitation of primary energy sources, the conversion of primary energy sources into more useable energy forms in refineries and power plants, and the use of fuels in stationary and mobile applications. This section presents the GHG emissions in Guyana associated with the energy sector.

6.1.1. Description of Sector

According to the 2006 IPCC Guidelines, GHG emissions in the energy sector are split into three main categories: 1A Fuel Combustion Activities, 1B Fugitive emissions from fuels and 1C CO_2 transport and storage. Fuel combustion activities concern emissions from the intentional oxidation of materials within an apparatus that is designed to raise heat and provide it either as heat or as mechanical work to a process or for use away from the apparatus. Fugitive emissions from fuels include all intentional and unintentional emissions from the extraction, processing, storage, and transport of fuel to the point of final use. CO_2 transport and storage involves the capture of CO_2, its transport to a storage location and its long-term isolation from the atmosphere.

In Guyana, energy sector GHG emissions are related to the emissions from fuel combustion activities and fugitive emissions from extraction, transformation, and transportation of primary energy carriers. As such, CO_2 transport and storage is currently not occurring in Guyana.

Fuel Combustion Activities

Emissions within the energy industry of Guyana primarily stem from the combustion of fuels utilised for electricity generation. This category holds significant importance in the country's overall GHG emissions profile within the energy sector. Notably, although petroleum refining does not occur in the country, emissions in the energy sector do encompass combustion emissions arising from electricity generation.

In addition to energy industry emissions, Guyana experiences GHG emissions from the manufacturing industry and construction sector, albeit constituting a relatively small portion of the overall energy sector emissions. These emissions result from fuels combusted in industries, including fuel combustion for the generation of electricity and heat for own use in these industries. Emissions from the industry sector should be specified by sub-categories that correspond to the International Standard Industrial Classification of all Economic Activities (ISIC).

Transport emissions form another substantial component of Guyana's energy sector GHG emissions, originating from the combustion and evaporation of fuel across various transportation activities. The transport sector's emissions contribute significantly to the overall GHG emissions within the energy sector. Notably, road transport serves as the primary mode of transportation in Guyana, while rail transport is not occurring. The Cheddi Jagan International Airport in Georgetown, complemented by numerous smaller airports nationwide contributes to the emissions associated with aviation. Moreover, domestic navigation, primarily involving logistical vessels servicing FPSOs, further adds to the transport-related emissions.

Fuel combustion emissions in Guyana also occur in households and commercial and institutional buildings, and in the agriculture, forestry, fishing, and fishing industries, which are all accounted for in the national GHG emissions inventory.

Fugitive emissions from fuels

Fugitive emissions are the intentional or unintentional release of GHG occurring during extraction, processing, and delivery of fossil fuels to the point of final use. In the case of Guyana, there is a limited occurrence of charcoal production. However, in 2020, the country initiated offshore oil production in the Stabroek Block through the Liza Phase 1 Project, leading to the emergence of fugitive emissions from oil and natural gas systems.

Subsequently, Guyana has expanded its oil production activities within the Stabroek Block, initiating a second FPSO vessel under the Liza Phase 2 Project. Anticipated developments indicate the commencement of two additional oil production projects in the Stabroek Block in the upcoming years. **Coverage of Sector**

In line with the 2006 IPCC Guidelines, Figure 2.5 presents the categories that are covered in the energy sector of Guyana. It delineates the estimated categories and provides indications for those that have not been estimated or cannot be reported in the tables, using notation keys.

Figure 2.5. Coverage of the energy sector in Guyana.

Category 1A1 Energy Industries comprises emissions from fuels combusted by the fuel extraction or energy-producing industries. This category is not further disaggregated between the different sub-categories as part of Guyana's GHG emissions inventory. Although petroleum refining does not occur in the country, other emissions within the energy industries include the combustion emissions arising from the electricity generation on the Liza Phase 1 and Liza Phase 2 Projects, ExxonMobil's FPSO vessels.

Category 1A2 Manufacturing Industries and Construction relates to fuels combusted in industries, including fuel combustion for the generation of electricity and heat for own use in these industries. These GHG emissions occur in Guyana but are not further disaggregated by ISIC sub-categories as part of Guyana's GHG emissions inventory.

Category 1A3 Transport covers GHG emissions from the combustion and evaporation of fuel for all transport activities. Road transport is the main contributor to the transport sector while railways are not occurring. Furthermore, regarding domestic navigation, any fuel consumption and related emissions that is occurring under this sub-category are included in the other sector fuel consumption. Emissions from international aviation and navigation are not estimated due to information not being available. All fuel consumption is assumed to be domestic for aviation and navigation. Ascertaining the amount of fuel consumption linked to international aviation and navigation is incorporated into the improvement plan.

Category 1A4 Other Sectors refers to fuel combustion emissions in households and commercial and institutional buildings and in the agriculture, forestry, fishing, and fishing industries. The agriculture, forestry, fishing, and fishing industries sub-categories not further disaggregated.

Category 1B1 Solid Fuels includes all intentional and unintentional emissions from the extraction, processing, storage, and transport of solid fuel to the point of final use. In Guyana, this only relates to the production of charcoal, which is reflected in the national GHG emissions inventory.

Category 1B2 Oil and Natural Gas relates to fugitive emissions from oil and natural gas systems. As previously mentioned, Guyana recently commenced with oil and natural gas production, which is all being conducted offshore. Offshore exploration emissions data are unavailable, and these emissions are thought to be negligible. Furthermore, only sub-categories oil production and upgrading and oil transport, and gas production and gathering are assumed to be occurring in Guyana, while the other sub-categories are not occurring as the production is directly loaded onto tanker ships and not brought to shore.

Category 1C CO_2 Capture and Storage involves the capture of CO_2, its transport to a storage location and its long-term isolation from the atmosphere. This category is not occurring in Guyana.

6.1.2. Summary of Sector Emissions

In 2022, the energy sector represented 40.89% of total emissions in Guyana, being the second largest source of GHG emissions in the country following the AFOLU sector, as illustrated in Figure 2.6. The energy sector accounts for 37.32% of the total national CO_2 emissions, 54.53% of the total national CH_4 emissions, and 5.31% of the total national N_2O emissions.

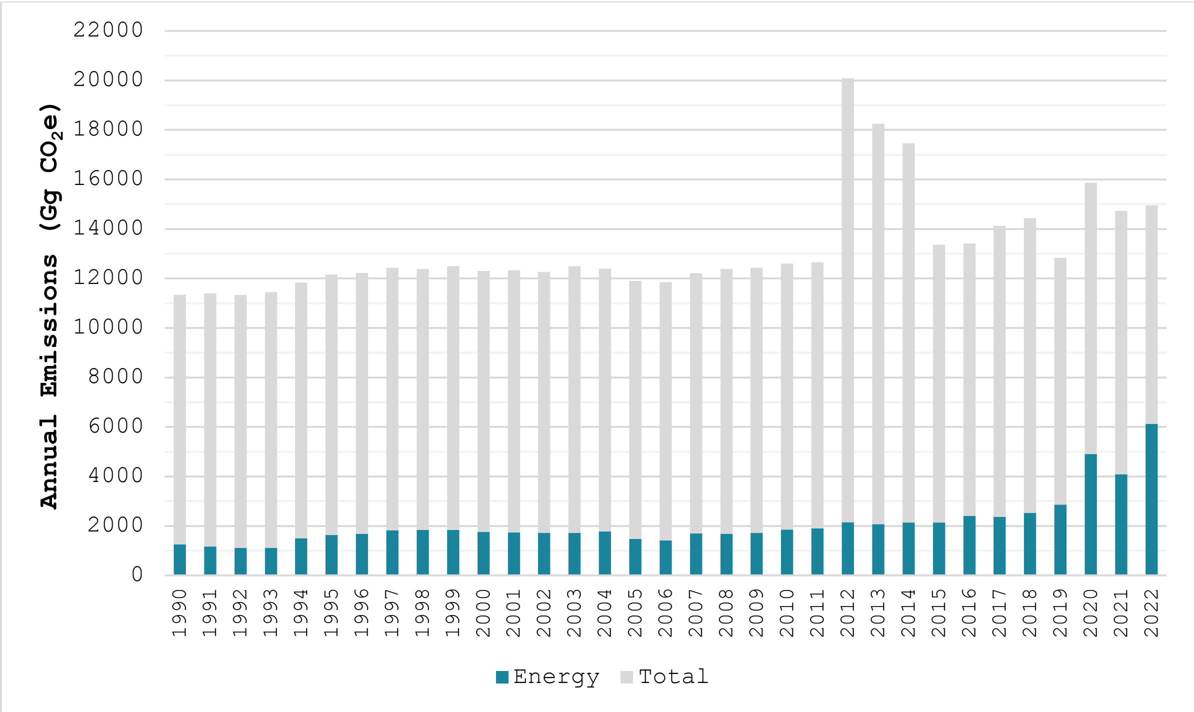

Figure 2.6. Contribution of energy sector emissions to national emission totals.

Figure 2.7 and 2.8 and Table 2.19 summarise sectoral emission trends by category and gas.

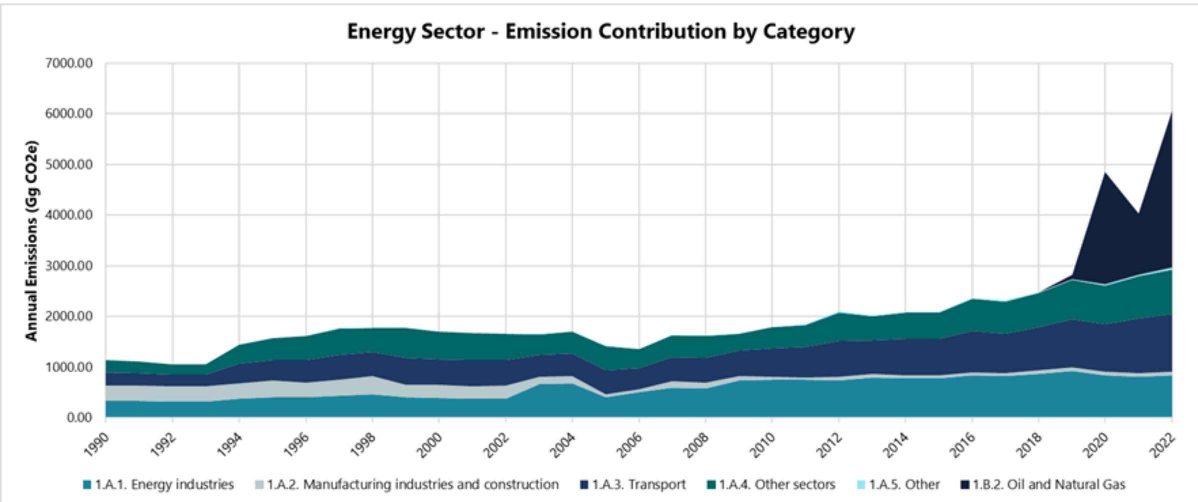

Figure 2.7. Total GHG emissions from the energy sector by category.

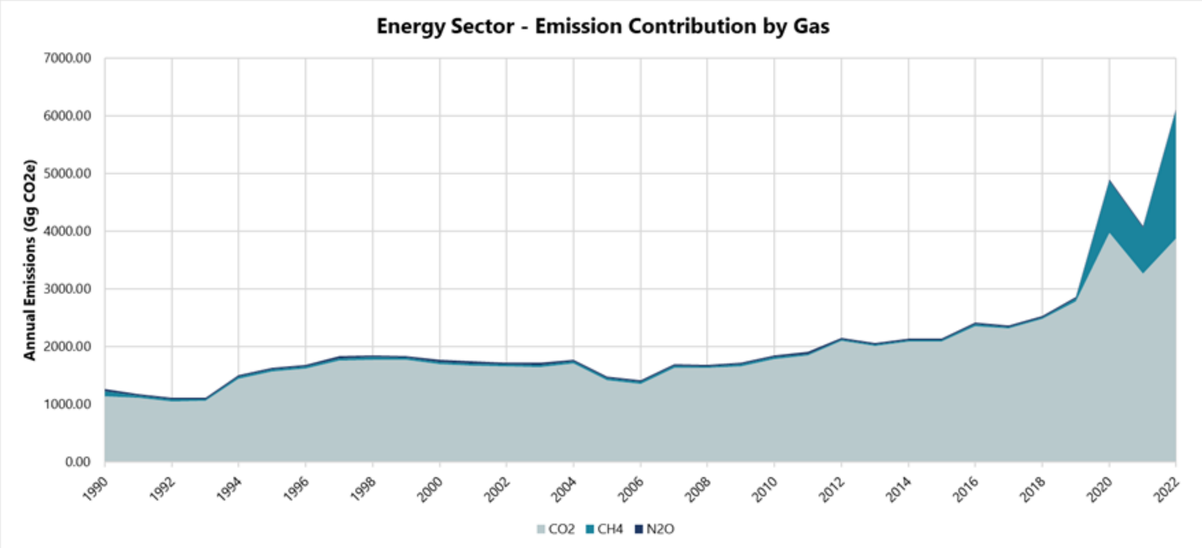

Figure 2.8. Total GHG emissions from the energy sector by gas.

Total emissions from the energy sector have increased by 383.15% from 1,265.88 Gg CO_2e in 1990 to 6,116.10 Gg CO_2e in 2022. In 2022, emissions from this category reached 3,101.02 Gg CO_2e, constituting 50.70% of the total GHG emissions within the energy sector. Other noteworthy contributors include the transport sector, energy industries, as well as emissions from households, commercial and institutional buildings, and the agriculture, forestry, fishing, and fishing industries.

The transport sector has experienced a noteworthy surge, increasing from 271.22 Gg CO_2e in 1990 to 1,156.21 Gg CO_2e in 2022, currently representing 18.90% of the total energy sector emissions. Energy industries have similarly increased from 335.69 Gg CO_2e in 1990 to 842.83 Gg CO_2e in 2022, accounting for 13.78% of the total energy sector emissions. This growth trend is also observed in emissions from households, commercial and institutional buildings, and the agriculture, forestry, fishing, and fishing industries, collectively witnessing a 172.02% surge from 1990 to 2022, reaching 893.59 Gg CO_2e.

Contrastingly, manufacturing industries and construction have observed a decrease in emissions, declining from 329.55 Gg CO_2e in 1990 to 88.57 Gg CO_2e in 2022. Emissions from solid fuels, particularly in the context of charcoal production in Guyana, have remained relatively stable, fluctuating between 0.0010 Gg CO_2e and 0.0020 Gg CO_2e during the period spanning 1990 to 2022.

In terms of GHG composition, CO_2 emissions hold paramount significance within the energy sector. In 2022, the sector emitted a total of 3,871.61 Gg CO_2e CO_2, 2,216.97 Gg CO_2e CH_4, and 27.51 Gg CO_2e N_2O, representing 63.30%, 36.25%, and 0.45% of the overall sectoral emissions, respectively.

Table 2.19. Total GHG emissions from the energy sector by category and gas.

Category	Gas	Annual emissions in Gg CO_2e															
		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1 Energy	CO_2	1143.27	1115.94	1052.45	1058.92	1447.48	1567.50	1616.56	1765.86	1779.84	1773.66	1703.27	1678.64	1658.80	1653.66	1708.19	1422.67
	CH_4	91.86	36.55	36.36	36.26	37.76	37.83	38.23	38.72	38.78	39.20	37.69	37.85	39.46	37.59	38.84	35.23
	N_2O	30.75	23.45	23.28	23.38	25.87	26.40	27.17	28.18	28.28	29.17	27.32	28.11	30.78	28.50	30.75	26.72
	Total	1265.88	1175.94	1112.09	1118.56	1511.11	1631.73	1681.96	1832.76	1846.90	1842.02	1768.28	1744.60	1729.04	1719.74	1777.78	1484.62
1A1 Energy industries	CO_2	332.98	335.96	321.59	320.72	378.42	410.46	399.61	436.71	467.28	398.77	388.69	377.11	380.40	671.83	682.79	407.32
	CH_4	1.10	0.92	0.90	0.90	0.97	1.01	1.00	1.05	1.09	1.02	0.97	0.97	1.05	1.35	1.41	1.01
	N_2O	1.61	1.39	1.36	1.36	1.49	1.55	1.54	1.63	1.70	1.57	1.50	1.48	1.60	2.18	2.26	1.56
	Total	335.69	338.27	323.86	322.99	380.88	413.02	402.15	439.40	470.07	401.36	391.16	379.56	383.05	675.36	686.46	409.89
1A2 Manufacturing industries and construction	CO_2	301.18	306.11	300.93	299.39	299.66	319.26	287.23	310.25	357.16	248.92	255.11	238.67	250.55	135.42	133.52	61.33
	CH_4	12.46	12.59	12.65	12.70	12.76	12.81	12.94	13.22	13.44	13.48	12.43	13.04	15.35	14.11	15.63	12.78
	N_2O	15.91	16.07	16.14	16.21	16.29	16.37	16.51	16.88	17.18	17.17	15.84	16.61	19.53	17.88	19.81	16.16
	Total	329.55	334.76	329.72	328.30	328.71	348.44	316.68	340.36	387.78	279.57	283.39	268.32	285.43	167.41	168.96	90.27
1A3 Transport	CO_2	265.89	243.55	234.32	237.98	385.59	410.87	450.81	486.53	473.64	538.09	515.19	519.95	501.89	438.88	455.71	473.94
	CH_4	2.10	1.87	1.97	1.99	2.87	2.86	3.13	3.27	3.44	3.66	3.59	3.71	3.59	3.58	3.62	3.57
	N_2O	3.23	2.97	2.85	2.89	4.82	5.12	5.69	6.14	6.00	6.84	6.50	6.61	6.37	5.48	5.72	5.99
	Total	271.22	248.39	239.14	242.85	393.27	418.85	459.63	495.94	483.07	548.59	525.28	530.27	511.84	447.94	465.05	483.50
1A4 Other Sectors	CO_2	242.31	229.43	194.88	200.09	382.12	424.99	476.69	529.89	479.50	585.10	541.76	540.33	523.51	398.10	425.71	468.08
	CH_4	76.20	21.18	20.84	20.67	21.16	21.15	21.16	21.19	20.81	21.02	20.69	20.13	19.46	18.53	18.16	17.86
	N_2O	9.99	3.02	2.93	2.92	3.27	3.35	3.43	3.52	3.40	3.58	3.48	3.40	3.28	2.94	2.95	2.98
	Total	328.50	253.63	218.65	223.68	406.56	449.50	501.28	554.59	503.71	609.71	565.93	563.86	546.25	419.58	446.82	488.92
1A5 Other	CO_2	0.92	0.89	0.73	0.74	1.68	1.90	2.21	2.47	2.26	2.78	2.52	2.58	2.46	9.42	10.46	12.00
	CH_4	0.001	0.001	0.001	0.001	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.011	0.012	0.014
	N_2O	0.002	0.002	0.002	0.002	0.004	0.004	0.005	0.005	0.005	0.006	0.005	0.006	0.005	0.020	0.022	0.026
	Total	0.92	0.89	0.73	0.74	1.69	1.91	2.22	2.48	2.27	2.79	2.53	2.59	2.47	9.45	10.49	12.04
1B1 Solid Fuels	CO_2	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
	CH_4	0.0011	0.0016	0.0016	0.0015	0.0015	0.0015	0.0015	0.0014	0.0014	0.0014	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011
	N_2O	0.00002	0.00004	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00002	0.00002	0.00002	0.00002	0.00002
	Total	0.0011	0.0016	0.0016	0.0016	0.0015	0.0015	0.0015	0.0015	0.0014	0.0014	0.0014	0.0013	0.0013	0.0013	0.0012	0.0012
1B2 Oil and Natural Gas	CO_2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	CH_4	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	N_2O	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	Total	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1B3 Other Emissions from Energy Production	CO_2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	CH_4	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	N_2O	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	Total	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1C CO_2 Transport and storage	CO_2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	CH_4	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	N_2O	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	Total	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Category	Gas	Annual emissions in Gg CO_2e																
		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1 Energy	CO_2	1359.85	1636.06	1630.88	1663.27	1790.57	1844.51	2097.33	2015.17	2089.10	2089.18	2361.84	2314.32	2479.50	2789.90	3980.70	3265.02	3871.61
	CH_4	34.57	34.89	33.86	33.24	32.98	35.34	32.92	29.78	29.29	29.67	28.60	27.83	26.53	53.66	899.92	800.67	2216.98
	N_2O	26.08	27.26	26.28	25.92	26.15	29.83	28.44	25.55	25.28	26.18	26.71	26.14	23.75	22.26	23.91	25.72	27.51
	Total	1420.51	1698.21	1691.02	1722.43	1849.70	1909.68	2158.68	2070.50	2143.67	2145.04	2417.15	2368.29	2529.78	2865.82	4904.53	4091.41	6116.10
1A1 Energy industries	CO_2	508.39	593.59	579.14	742.32	756.08	745.75	741.38	799.14	773.56	779.99	836.01	818.05	869.66	917.47	844.12	801.63	838.97
	CH_4	1.12	1.25	1.15	1.33	1.36	1.39	1.63	1.84	1.76	2.01	1.76	1.74	1.57	1.42	1.38	1.39	1.45
	N_2O	1.77	1.99	1.86	2.20	2.24	2.27	2.57	2.88	2.76	3.07	2.80	2.76	2.59	2.43	2.32	2.31	2.41
	Total	511.29	596.82	582.15	745.85	759.67	749.42	745.58	803.86	778.08	785.06	840.57	822.54	873.82	921.32	847.82	805.32	842.83
1A2 Manufacturing industries and construction	CO_2	50.68	129.55	120.79	74.75	59.20	55.10	65.41	62.70	61.59	58.53	63.53	63.06	67.08	73.88	71.22	73.14	76.54
	CH_4	12.90	13.03	12.24	11.86	11.39	13.90	11.32	9.53	8.79	9.33	8.93	8.87	6.28	3.90	4.44	5.06	5.30
	N_2O	16.31	16.52	15.51	15.00	14.39	17.56	14.32	12.07	11.12	11.80	11.29	11.22	7.96	4.96	5.64	6.43	6.73
	Total	79.89	159.09	148.54	101.62	84.98	86.57	91.05	84.30	81.49	79.66	83.75	83.15	81.32	82.75	81.30	84.63	88.57
1A3 Transport	CO_2	419.89	470.60	488.47	511.50	559.70	594.67	709.54	659.92	715.67	719.51	816.12	779.24	850.01	953.95	934.12	1081.73	1132.11
	CH_4	3.49	3.77	4.05	4.82	5.12	5.26	5.89	5.87	6.35	6.35	6.80	6.21	6.96	7.76	7.79	9.28	9.72
	N_2O	5.27	5.93	6.15	6.32	7.00	7.46	8.89	8.28	9.02	9.00	10.22	9.76	10.66	12.03	11.90	13.74	14.38
	Total	428.64	480.29	498.67	522.64	571.83	607.39	724.32	674.07	731.05	734.85	833.14	795.20	867.63	973.73	953.81	1104.75	1156.21
1A4 Other Sectors	CO_2	371.88	431.40	431.77	326.74	405.45	437.36	565.85	480.63	523.95	517.29	628.91	636.43	674.02	770.87	759.80	839.85	878.97
	CH_4	17.05	16.84	16.41	15.22	15.10	14.77	14.05	12.52	12.36	11.97	11.09	11.00	11.69	12.24	10.95	11.27	11.79
	N_2O	2.72	2.80	2.74	2.39	2.50	2.51	2.63	2.29	2.34	2.29	2.36	2.36	2.51	2.74	2.55	2.70	2.83
	Total	391.64	451.04	450.92	344.35	423.05	454.64	582.54	495.44	538.66	531.55	642.35	649.78	688.22	785.85	773.30	853.82	893.59
1A5 Other	CO_2	9.01	10.93	10.71	7.94	10.14	11.62	15.14	12.78	14.34	13.87	17.28	17.55	18.73	22.62	24.51	32.27	33.78
	CH_4	0.010	0.012	0.012	0.009	0.011	0.013	0.017	0.014	0.016	0.016	0.020	0.020	0.021	0.027	0.031	0.048	0.050
	N_2O	0.019	0.023	0.023	0.017	0.022	0.025	0.032	0.027	0.031	0.030	0.037	0.038	0.040	0.047	0.048	0.055	0.058
	Total	9.04	10.96	10.74	7.97	10.18	11.66	15.19	12.83	14.38	13.91	17.33	17.61	18.79	22.70	24.59	32.38	33.88
1B1 Solid Fuels	CO_2	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
	CH_4	0.0011	0.0011	0.0010	0.0019	0.0022	0.0019	0.0019	0.0018	0.0019	0.0018	0.0017	0.0017	0.0016	0.0016	0.0016	0.0016	0.0016
	N_2O	0.00002	0.00002	0.00002	0.00004	0.00004	0.00004	0.00003	0.00003	0.00004	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003
	Total	0.0011	0.0011	0.0010	0.0020	0.0022	0.0019	0.0019	0.0018	0.0019	0.0018	0.0017	0.0017	0.0016	0.0016	0.0016	0.0016	0.0017
1B2 Oil and Natural Gas	CO_2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	51.11	1346.93	436.41	911.25
	CH_4	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	28.30	875.33	773.61	2188.66
	N_2O	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.05	1.45	0.49	1.10
	Total	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	79.47	2223.71	1210.51	3101.02
1B3 Other Emissions from Energy Production	CO_2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	CH_4	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	N_2O	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	Total	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1C CO_2 Transport and storage	CO_2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	CH_4	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	N_2O	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	Total	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

6.1.3. Description of Emissions by Category

Energy Industries (1A1)

This category encompasses emissions arising from fuels combusted by the fuel extraction or energy-producing industries. Diesel, fuel oil, and gasoline constitute the principal imports, predominantly utilised by the transportation and electricity sectors.

This dependence on petroleum imports is mirrored in the greenhouse gas (GHG) emissions originating from energy industries, which have demonstrated a consistent upward trend over the period spanning 1990 to 2022, as illustrated in Figure 2.9 and detailed in Table 2.20.

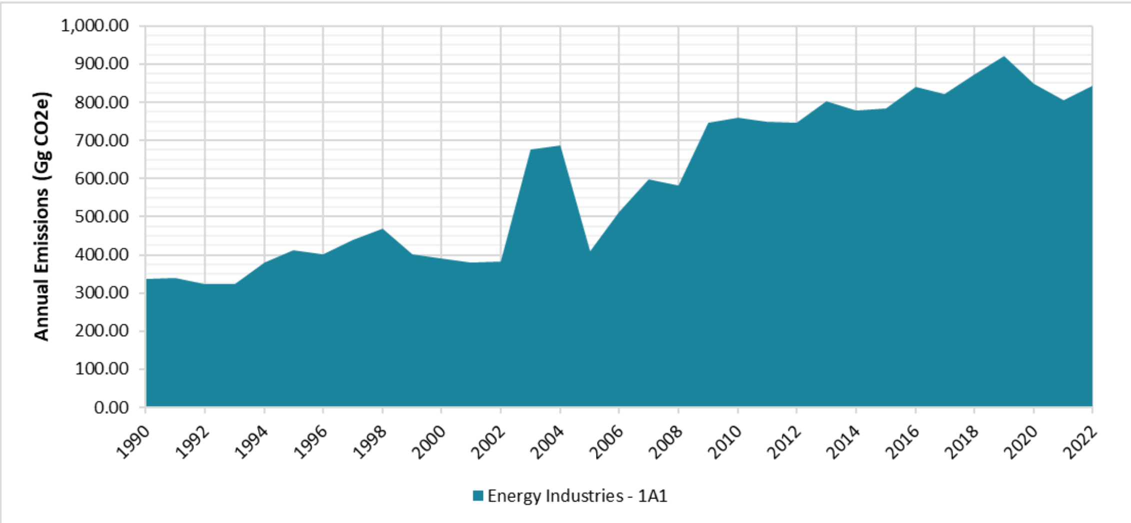

Figure 2.9. Category 1A1 GHG emissions.

Table 2.20. Summary of GHG emissions from Category 1A1 – Energy Industries.

	Annual Emissions in Gg CO_2e										
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Energy Industries – 1A1	335.69	338.27	323.86	322.99	380.88	413.02	402.15	439.40	470.07	401.36	391.16
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Energy Industries – 1A1	379.56	383.05	675.36	686.46	409.89	511.29	596.82	582.15	745.85	759.67	749.42
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Energy Industries – 1A1	745.58	803.86	778.08	785.06	840.57	822.54	873.82	921.32	847.82	805.32	842.83

The uncertainty associated with activity data and emission factors in category 1A1 is sourced from Chapter 2, Volume 2 of the 2006 IPCC Guidelines.

Regarding activity data uncertainty, the higher value of the range for 'extrapolation' under less developed statistical systems for main activity electricity and heat production has been used considering that the sectoral consumption has been calculated based on the growth of the supply data.

Regarding emission factor uncertainty, expert judgment has been employed to select the midpoint value within the range for CH_4 and N_2O. Meanwhile, for CO_2, the suggested overall uncertainty has been applied. Table 2.21 depicts the levels of uncertainty for energy industries based on these considerations.

Table 2.21. Level of uncertainty for energy industries category.

IPCC category	Gas	Base year emissions (1990)	Year 2022 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty
		Gg of CO_2-eq		%	%	%
1A1 – Energy Industries	CO_2	332.98	838.97	10	7	12
1A1 – Energy Industries	CH_4	1.10	1.45	10	100	100
1A1 – Energy Industries	N_2O	1.61	2.41	10	100	100

Manufacturing industries (1A2)

This category includes emissions resulting from the combustion of fuels in industry and the combustion for the generation of electricity and heat for own use in these industries. Notably, there was a decline in emissions within this category from 1990 to 2009. Subsequently, the emissions have exhibited a period of relative stability

Table 2.22. Summary of GHG emissions from Category 1A2 – Manufacturing industries.

Annual Emissions in Gg CO_2e											
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Manufacturing industries – 1A2	329.55	334.76	329.72	328.30	328.71	348.44	316.68	340.36	387.78	279.57	283.39
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Manufacturing industries – 1A2	268.32	285.43	167.41	168.96	90.27	79.89	159.09	148.54	101.62	84.98	86.57
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Manufacturing industries – 1A2	91.05	84.30	81.49	79.66	83.75	83.15	81.32	82.75	81.30	84.63	88.57

The uncertainty associated with activity data and emission factors in category 1A2 is sourced from Chapter 2, Volume 2 of the 2006 IPCC Guidelines.

Concerning activity data uncertainty, the higher value of the range for 'extrapolation' under less developed statistical systems for other industrial combustion has been used considering that the sectoral consumption has been calculated based on the growth of the supply data.

Regarding emission factor uncertainty, expert judgment has been employed to select the midpoint value within the range for CH_4 and N_2O. Meanwhile, for CO_2, the suggested overall uncertainty has been applied. Table 2.23 depicts the levels of uncertainty for manufacturing industries and construction based on these considerations.

Table 2.23. Level of uncertainty in the manufacturing industries and construction category.

IPCC category	Gas	Base year emissions (1990)	Year 2022 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty
		Gg of CO_2-eq		%	%	%
1A2 – Manufacturing Industries and Construction	CO_2	301.18	76.54	20	7	21
1A2 – Manufacturing Industries and Construction	CH_4	12.46	5.30	20	100	102
1A2 – Manufacturing Industries and Construction	N_2O	15.91	6.73	20	100	102

Transport (1A3)

Encompassing emissions arising from the combustion and evaporation of fuel across all transportation activities (excluding military transport), this category is intricately tied to the developmental trajectory of Guyana. The predominant driving force behind this category's emissions is the substantial contribution of road transport. The surge in commuting within the transport sector linked with population growth and economic development serves as a key factor influencing the heightened fuel consumption, establishing it as one of the leading consumers of imported fuel products in Guyana and a substantial source of GHG emissions within the energy sector, as illustrated in Figure 2.11 and detailed in Table 2.24.

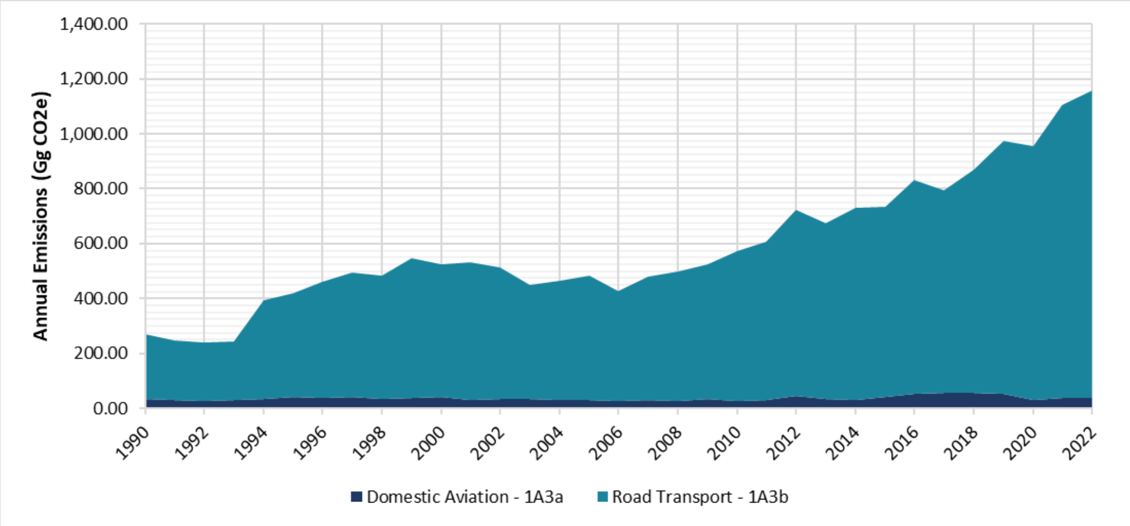

Figure 2.11. Category 1A3 GHG emissions.

Table 2.24. Summary of GHG emissions from Category 1A3 – Transport.

Annual Emissions in Gg CO_2e											
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Domestic Aviation - 1A3a	34.83	31.57	27.83	29.62	34.40	42.23	36.80	41.24	32.35	37.72	41.55
Road Transport - 1A3b	236.39	216.82	211.31	213.23	358.87	376.62	422.83	454.70	450.72	510.87	483.74
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Domestic Aviation - 1A3a	32.06	33.31	32.71	31.33	30.99	26.59	28.40	27.96	34.39	27.60	29.96
Road Transport - 1A3b	498.21	478.53	415.23	433.72	452.51	402.05	451.90	470.71	488.25	544.23	577.44
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Domestic Aviation - 1A3a	46.57	32.60	29.55	40.92	53.56	57.23	55.75	54.30	30.01	36.00	37.67
Road Transport - 1A3b	677.75	641.48	701.49	693.93	779.58	737.97	811.88	919.43	923.80	1,068.76	1,118.54

The uncertainty associated with activity data and emission factors in category 1A3 is sourced from Chapter 3, Volume 2 of the 2006 IPCC Guidelines.

For domestic aviation, activity data uncertainty is allocated using expert judgement considering that the sectoral consumption has been calculated based on the growth of the supply data.

Concerning emission factor uncertainty, expert judgment is applied to opt for the higher value for CH_4 and the midpoint value for N_2O. For CO_2, a value is selected based on expert judgment, taking into account the suggested ±5% uncertainty. Given the similarity in data quality to that used in energy industries and manufacturing industries and construction, and with the aim of maintaining consistency in the inventory, identical uncertainty values have been applied across the various transport categories.

Table 2.25 depicts the levels of uncertainty for the transport categories based on these considerations.

Table 2.25. Level of uncertainty in the transport categories.

IPCC category	Gas	Base year emissions (1990)	Year 2022 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty
		Gg of CO_2-eq		%	%	%
1A3a – Domestic Aviation	CO_2	34.56	37.39	10	7	12
1A3a – Domestic Aviation	CH_4	0.01	0.01	10	100	100
1A3a – Domestic Aviation	N_2O	0.26	0.28	10	100	100
1A3b – Road Transport	CO_2	231.33	1094.72	10	7	12
1A3b – Road Transport	CH_4	2.09	9.71	10	100	100
1A3b – Road Transport	N_2O	2.97	14.10	10	100	100

Other Sectors (1A4)

This category includes emissions from a variety of end-use sectors, including the residential, commercial, and institutional sectors, as well as the emissions from fuel combustion in agriculture, forestry, fishing and fishing industries such as fish farms. In Guyana, there is a noticeable upswing in emissions within this category, aligned with the heightened fuel consumption trends in the country, as illustrated in Figure 2.12 and outlined in Table 2.26.

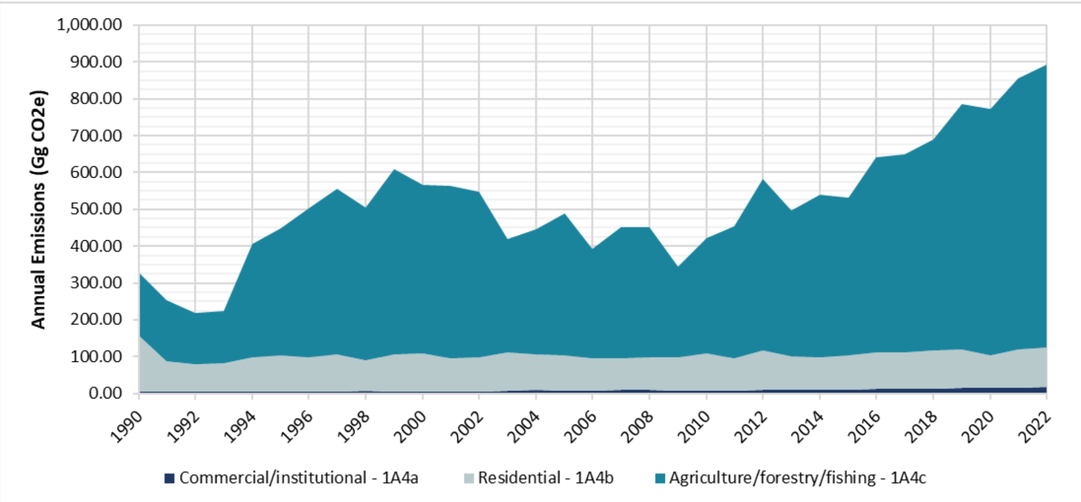

Figure 2.12. Category 1A4 GHG emissions.

Table 2.26. Summary of GHG emissions from Category 1A4 – Other Sectors.

Annual Emissions in Gg CO_2e

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Commercial/ institutional - 1A4a	5.85	5.85	5.66	5.67	5.92	5.85	5.54	5.95	6.64	5.14	5.06
Residential - 1A4b	150.58	81.97	73.56	76.83	91.62	96.66	93.89	101.35	84.25	101.67	103.10
Agriculture/ forestry/ fishing - 1A4c	172.07	165.81	139.42	141.18	309.02	346.99	401.84	447.29	412.82	502.90	457.77
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Commercial/ institutional - 1A4a	4.88	5.25	8.56	8.91	8.23	6.75	8.80	8.83	6.96	8.03	8.62
Residential - 1A4b	90.06	93.95	101.78	97.35	94.12	88.69	86.48	90.67	90.63	101.51	87.70
Agriculture/ forestry/ fishing - 1A4c	468.92	447.05	309.23	340.55	386.56	296.20	355.76	351.41	246.77	313.52	358.31
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Commercial/ institutional - 1A4a	10.67	9.57	10.31	10.03	11.84	11.81	12.63	14.33	14.52	16.11	16.86
Residential - 1A4b	106.73	91.62	86.63	93.97	99.46	99.51	103.41	105.06	88.52	104.37	109.23
Agriculture/ forestry/ fishing - 1A4c	465.13	394.26	441.72	427.56	531.06	538.46	572.18	666.46	670.25	733.34	767.50

The uncertainty associated with activity data and emission factors in category 1A4 is sourced from Chapter 2, Volume 2 of the 2006 IPCC Guidelines.

Concerning activity data uncertainty, the higher value of the range for 'extrapolation' under less developed statistical systems for commercial, institutional, residential combustion has been used considering that the sectoral consumption has been calculated based on the growth of the supply data.

Regarding emission factor uncertainty, expert judgment has been employed to select the midpoint value within the range for CH_4 and N_2O. Meanwhile, for CO_2, the suggested overall uncertainty has been applied. Table 2.27 depicts the levels of uncertainty for energy industries based on these considerations.

Table 2.27. Level of uncertainty for the other sectors category.

IPCC category	Gas	Base year emissions (1990)	Year 2022 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty
		Gg of CO_2-eq		%	%	%
1A4 – Other Sectors	CO_2	242.31	878.97	25	7	26
1A4 – Other Sectors	CH_4	76.20	11.79	25	100	103
1A4 – Other Sectors	N_2O	10.00	2.83	25	100	103

Other (1A5)

This category covers all remaining emissions from fuel combustion that are not specified elsewhere. It also incorporates emissions from fuel supplied to the military within the country and to the military of other nations not involved in multilateral operations. These details are visually represented in Figure 2.13 and elaborated in Table 2.28.

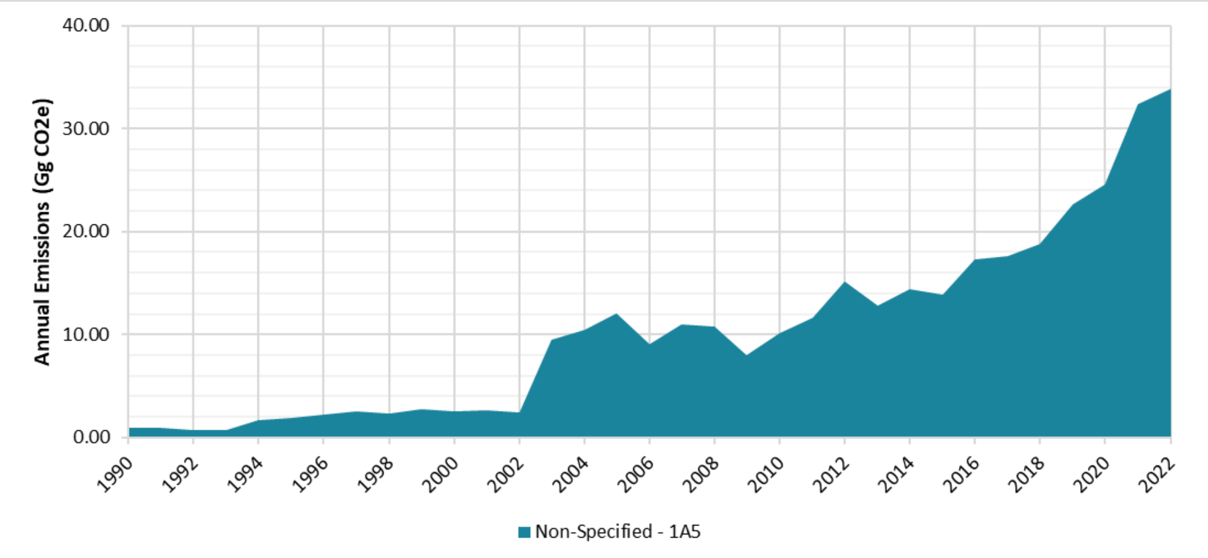

Figure 2.13. Category 1A5 GHG emissions.

Table 2.28. Summary of GHG emissions from Category 1A5 – Other.

Annual Emissions in Gg CO_2e											
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Non-Specified - 1A5	0.92	0.89	0.73	0.74	1.69	1.91	2.22	2.48	2.27	2.79	2.53
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Non-Specified - 1A5	2.59	2.47	9.45	10.49	12.04	9.04	10.96	10.74	7.97	10.18	11.66
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Non-Specified - 1A5	15.19	12.83	14.38	13.91	17.33	17.61	18.79	22.70	24.59	32.38	33.88

The uncertainty associated with activity data and emission factors in category 1A4 is sourced from Chapter 2, Volume 2 of the 2006 IPCC Guidelines.

Concerning activity data uncertainty, the higher value of the range for 'extrapolation' under less developed statistical systems for main activity electricity and heat production has been used considering that the sectoral consumption has been calculated based on the growth of the supply data.

Regarding emission factor uncertainty, expert judgment has been employed to select the midpoint value within the range for CH_4 and N_2O. Meanwhile, for CO_2, the suggested overall uncertainty has been applied. Table 2.29 depicts the levels of uncertainty for the non-specified category based on these considerations.

Table 2.29. Level of uncertainty for non-specified category.

IPCC category	Gas	Base year emissions (1990)	Year 2022 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty
		Gg of CO_2-eq		%	%	%
1A5 – Other	CO_2	0.92	33.78	10	7	12
1A5 – Other	CH_4	0.001	0.05	10	100	100
1A5 – Other	N_2O	0.002	0.06	10	100	100

Fuel Transformation (1B1c)

Intentional or unintentional release of greenhouse gases may occur during the extraction, processing, transformation, and delivery of fossil fuels to the point of final use, constituting what is known as fugitive emissions. Transformation occurs by physical or chemical conversion into a product whose intrinsic properties differ from those of the original product.

Specifically, this category addresses fugitive emissions during the transformation of fuel for charcoal production. CO_2 emissions are reported as memo items since carbon released from charcoal (or biochar) production is biogenic in origin. In the context of Guyana, where charcoal production is exceedingly limited, emissions from this category are minimal, as depicted in Figure 2.14 and detailed in Table 2.30.

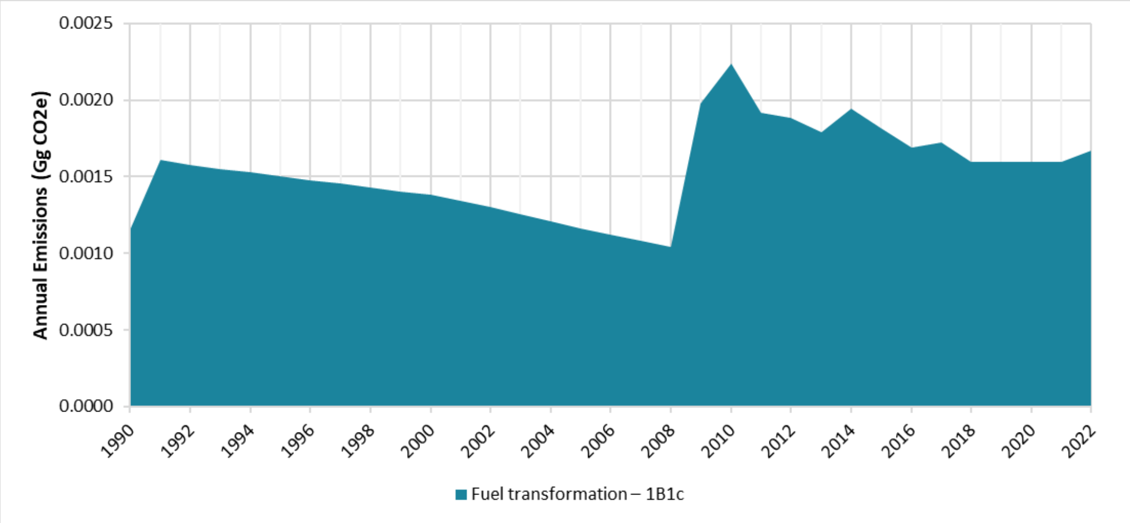

Figure 2.14. Category 1B1c GHG emissions.

Table 2.30. Summary of GHG emissions from Category 1B1c – Fuel transformation.

Annual Emissions in Gg CO_2e											
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Fuel transformation – 1B1c	0.0011	0.0016	0.0016	0.0016	0.0015	0.0015	0.0015	0.0015	0.0014	0.0014	0.0014
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Fuel transformation – 1B1c	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0010	0.0020	0.0022	0.0019
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Fuel transformation – 1B1c	0.0019	0.0018	0.0019	0.0018	0.0017	0.0017	0.0016	0.0016	0.0016	0.0016	0.0017

The uncertainty associated with activity data and emission factors in category 1B1c is based on the information provided in Chapter 4, Volume 2 of the 2019 Refinement to the 2006 IPCC Guidelines.

Concerning activity data uncertainty, expert judgement is used to select the uncertainty value. Regarding emission factor uncertainty, expert judgement has been employed to select the high value of the uncertainty ranges provided in Table 4.3.3 of Chapter 4, Volume 2 of the 2019 Refinement to the 2006 IPCC Guidelines.

Table 2.31 depicts the levels of uncertainty for the fuel transformation category based on these considerations.

Table 2.31. Level of uncertainty for fuel transformation category.

IPCC category	Gas	Base year emissions (1990)	Year 2022 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty
		Gg of CO_2-eq		%	%	%
1B1 – Solid Fuels	CO_2	IE	IE	25	60	65
1B1 – Solid Fuels	CH_4	0.00113	0.00164	25	121	124
1B1 – Solid Fuels	N_2O	0.00002	0.00003	25	163	165

Oil and Natural Gas (1B2)

This category encompasses fugitive emissions originating from oil and natural gas systems. As previously mentioned, Guyana has recently embarked on oil and natural gas production, with all operations taking place offshore. In 2020, the country initiated offshore oil production in the Stabroek Block through the Liza Phase 1 Project, marking the onset of fugitive emissions from oil and natural gas systems. Following this, Guyana has extended its oil production activities within the Stabroek Block, launching a second FPSO vessel under the Liza Phase 2 Project. This and the related impacts are illustrated in Figure 2.15 and outlined in Table 2.32.

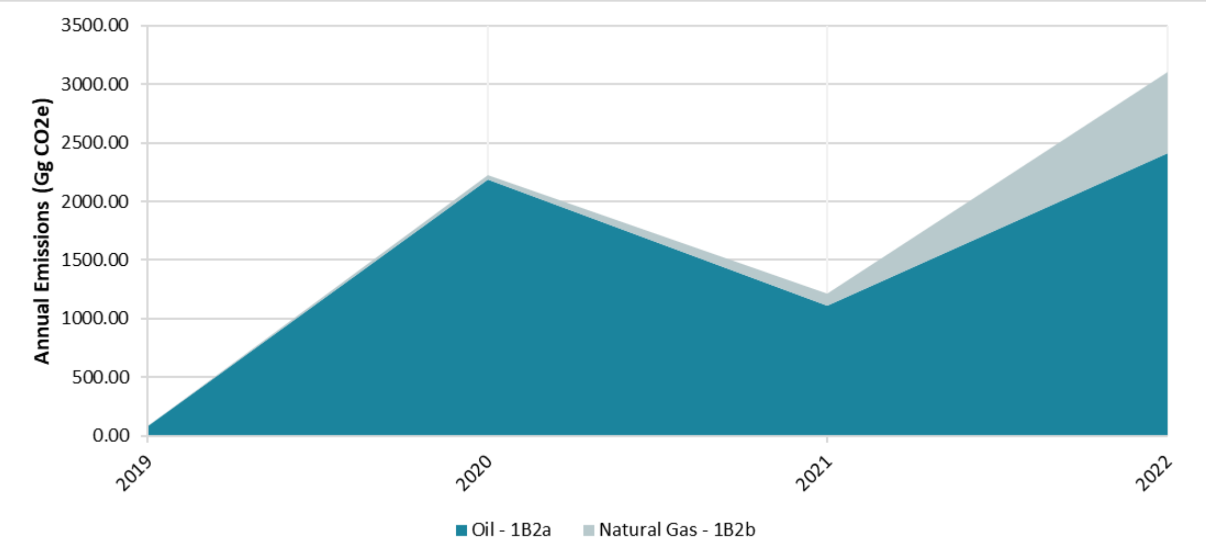

Figure 2.15. Category 1B2 GHG emissions.

Table 2.32. Summary of GHG emissions from Category 1B2 – Oil and Natural Gas.

Annual Emissions in Gg CO_2e				
	2019	2020	2021	2022
Oil - 1B2a	79.47	2188.38	1108.44	2414.52
Natural Gas - 1B2b	0.00	35.33	102.07	686.50

The uncertainty associated with activity data and emission factors in category 1B2 is based on the information provided in Chapter 4, Volume 2 of the 2019 Refinement to the 2006 IPCC Guidelines.

Concerning activity data uncertainty, expert judgement is used to select the value associated with the sales volumes.

For the emission factor uncertainty, expert judgement has been employed to select an average value of the default uncertainties provided in Tables 4.2.4 through 4.2.4k considering the relevant oil and natural gas segments in Guyana.

Table 2.33 depicts the levels of uncertainty for the oil and natural gas categories based on these considerations.

Table 2.33. Level of uncertainty for the oil and natural gas categories.

IPCC category	Gas	Base year emissions (1990)	Year 2022 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty
		Gg of CO_2e		%	%	%
1B2a - Oil	CO_2	NO	873.44	15	40	43
1B2a - Oil	CH_4	NO	1540.15	15	40	43
1B2a - Oil	N_2O	NO	0.93	15	100	101
1B2b – Natural Gas	CO_2	NO	37.81	15	20	25
1B2b – Natural Gas	CH_4	NO	648.52	15	20	25
1B2b – Natural Gas	N_2O	NO	0.17	15	100	101

Additionally, the oil and natural gas category generate NMVOC emissions, as depicted in Figure 2.16 and detailed in Table 2.34.

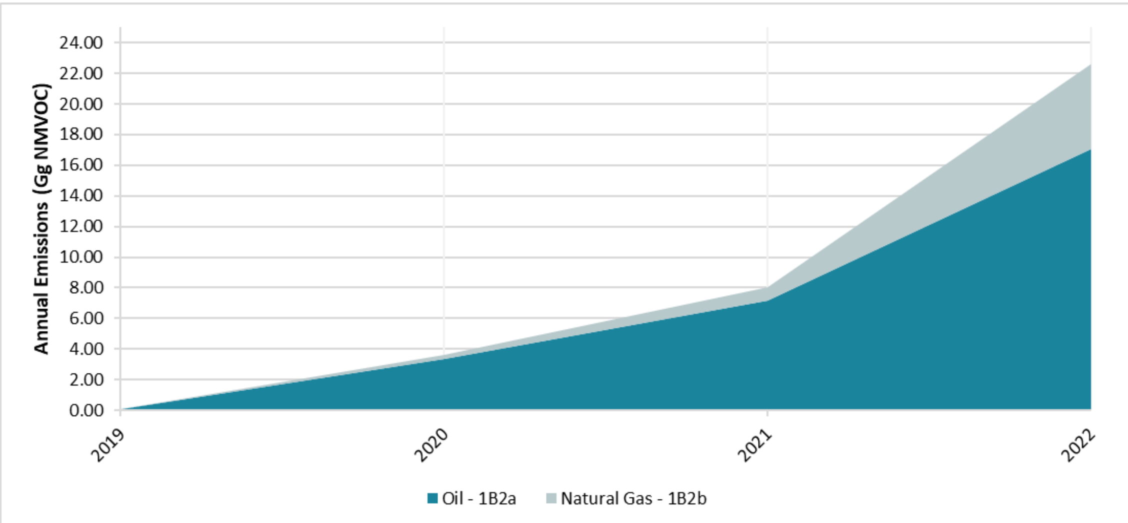

Figure 2.16. Category 1B2 NMVOC emissions.

Table 2.34. Summary of NMVOC emissions from Category 1B2 – Oil and Natural Gas.

Annual Emissions in Gg NMVOC				
	2019	2020	2021	2022
Oil - 1B2a	0.07	3.35	7.19	17.08
Natural Gas - 1B2b	0.00	0.28	0.82	5.51

6.1.4. Comparison Between Reference and Sectoral Approach

The 2006 IPPC guidelines recommend employing both a sectoral approach and a reference approach to estimate a country's CO_2 emissions resulting from fuel combustion, facilitating a comparison of results derived from these two independent methods.

The sectoral approach involves utilizing values specific to each category, collectively summing up to the national total within the energy sector. On the other hand, the reference approach is a top-down methodology, relying on a country's energy supply data to compute CO_2 emissions primarily from the combustion of fossil fuels. This approach serves as an independent check on the sectoral method and can offer a preliminary estimate of national GHG emissions, especially in scenarios with limited resources and data structures.

The reference approach is estimated using following the tier 1 approach from 2006 IPCC Guidelines, using the energy balance of the country, and considering the considering the apparent consumption of fuels and the excluded carbon following 5 steps:

- Step 1: Estimate apparent fuel consumption in original units
- Step 2: Convert to a common energy unit
- Step 3: Multiply by carbon content to compute the total carbon
- Step 4: Compute the excluded carbon
- Step 5: Correct for carbon unoxidized and convert to CO_2 emissions

In the case of Guyana, the sectoral consumption has been calculated based on the growth of the supply data. As such, the percentage difference between the sectoral and the reference approach is going to be the same for the years 2017-2022. The comparison between the CO_2 emissions calculated with the reference and sectoral approaches is provided in Table 2.35.

Table 2.35. Comparison between the reference and sectoral approach (Gg CO_2).

	1990	1991	1992	1993	1994	1995	1996	1997	1998
CO_2 emissions reference approach	1296	1267	1254	1410	1401	1596	1637	1796	1810
CO_2 emissions sectoral approach	1143	1116	1052	1059	1447	1567	1617	1766	1780
% Difference	13.36	13.54	19.15	33.15	-3.21	1.82	1.26	1.71	1.69
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
CO_2 emissions reference approach	1798	1612	1547	1592	1705	1564	1446	1274	1645
CO_2 emissions sectoral approach	1774	1703	1679	1659	1654	1708	1423	1360	1636
% Difference	1.37	-5.36	-7.84	-4.03	3.10	-8.44	1.64	-6.31	0.55
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
CO_2 emissions reference approach	1482	1591	1665	1725	1962	1928	2010	2050	2252
CO_2 emissions sectoral approach	1631	1663	1791	1845	2097	2015	2089	2089	2362
% Difference	-9.13	-4.34	-7.01	-6.48	-6.45	-4.33	-3.79	-1.88	-4.65

6.1.5. International Bunkers

National energy statistics allocate all fuel consumption in the aviation industry to domestic aviation. Similarly, for national navigation, the entirety of fuel consumption is attributed to the domestic sector. However, the potential fuel consumption associated with international aviation and navigation remains indeterminate. In this edition of the inventory, all fuel consumption is assumed to be domestic for aviation and navigation. Ascertaining the amount of fuel consumption linked to international aviation and navigation is incorporated into the improvement plan.

6.2. Industrial Processes and Product Use (IPPU)

The Industrial Processes and Product Use (IPPU) sector covers GHG emissions occurring from industrial processes, from the use of GHGs in products, and from non-energy use of fossil fuel carbon. As such, GHG emissions associated with the IPPU sector can be produced from a wide variety of industrial activities and originate from the use of various types of product applications, both in industry and by end-consumers. This section presents the GHG emissions in Guyana associated with the IPPU sector.

6.2.1. Description of Sector

The IPPU sector in Guyana is limited, with no ongoing industrial activities in the country. The activities within this sector are solely associated with the use of products.

Emissions arising from the mineral industry, associated with the utilisation of carbonate raw materials in the manufacturing and use of various mineral industry products, are absent within the country, as all materials are imported. Although liming is used in Guyana to reduce soil acidity and improve plant growth, the emissions resulting from these activities are accounted for in Category 3C2 Liming. Additionally, Guyana does not engage in chemical, metal, or electronic production, importing all chemicals, metals, and electronic industry components from other countries.

However, emissions do occur in Guyana related to the first use of fossil fuels as a product for primary purposes other than combustion for energy purposes and use as feedstock or reducing agent. This includes products such as lubricants, paraffin waxes, bitumen/asphalt, and solvents. Guyana employs lubricants and grease for various industrial and transportation applications, while solvents find usage in areas such as paints, cosmetics, household products, and pesticides, among others.

Furthermore, HFCs and PFCs are used in Guyana as substitutes for phasing out CFCs, halons, carbon tetrachloride, methyl chloroform, and, ultimately, HCFCs under the Montreal Protocol. Guyana acceded to the Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer on August 12, 1993 and subsequently ratified the London Amendment, Copenhagen Amendment and Montreal Amendment on July 23, 1999. The National Ozone Action Unit (NOAU) within the Hydrometeorological Service is responsible for coordinating and monitoring all activities towards the smooth phase-out of man-made Ozone Depleting Substances (ODS) in Guyana.

Emissions from the manufacture and use of electrical equipment and several other products also occur in Guyana. This is predominantly associated with the use of sulphur hexafluoride (SF_6) for electrical insulation and interruption in equipment utilised in electricity transmission and distribution. Additionally, N_2O emissions arise from product usage in various applications, including medical services throughout the healthcare sector.

Finally, other industries which have not been accounted for elsewhere in the IPPU sector also occur in Guyana. These encompass the pulp and paper industry, as well as the food and beverage industry.

6.2.2. Coverage of Sector

In line with the 2006 IPCC Guidelines, Figure 2.17 depicts the categories that are covered in the IPPU sector of Guyana. It delineates the estimated categories and provides indications for those that have not been estimated or cannot be reported in the tables, using notation keys.

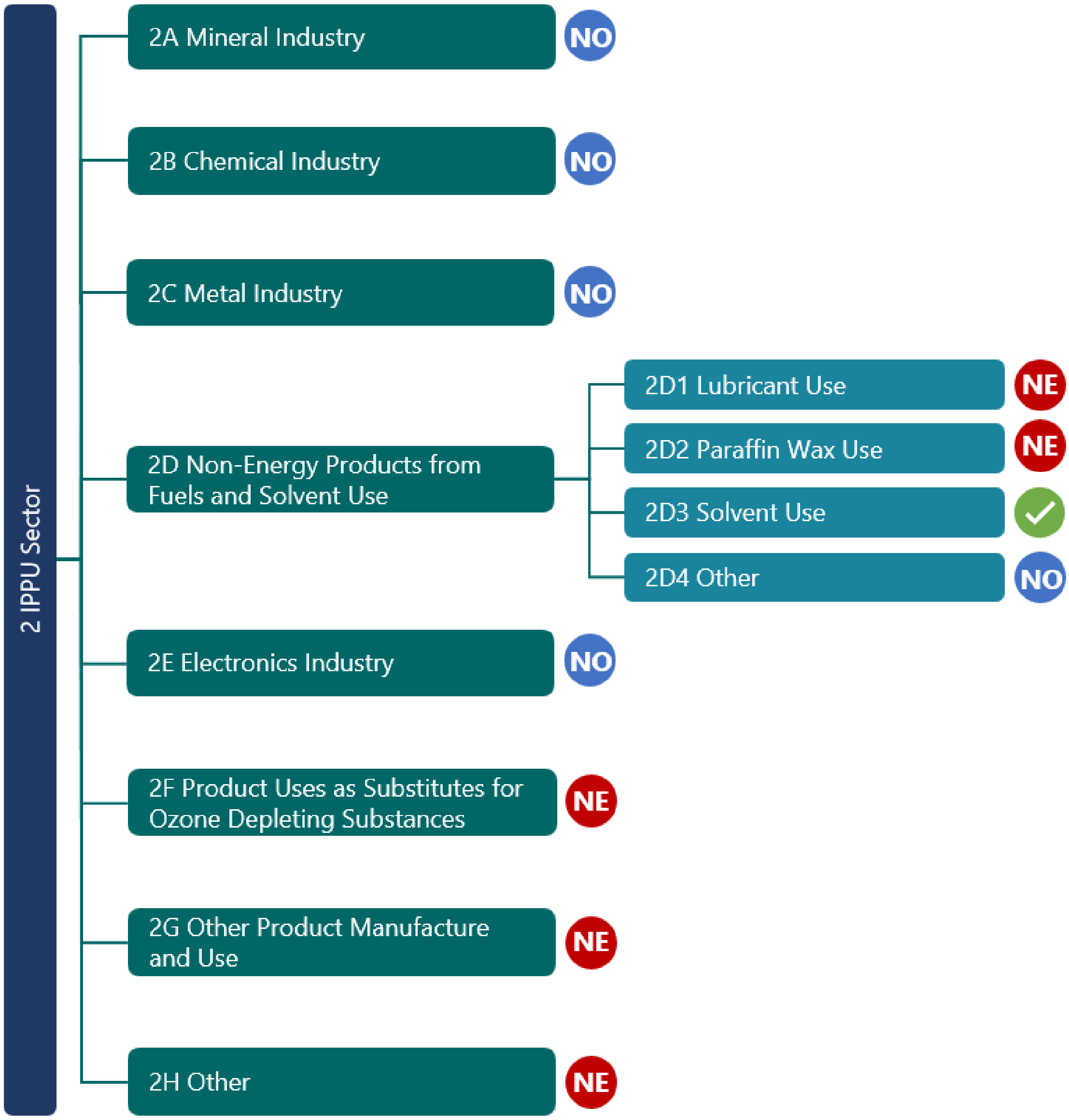

Figure 2.17. Coverage of the IPPU sector in Guyana.

The national GHG inventories in Guyana's initial NC, second NC, and the currently drafted third NC indicated that GHG emissions in the industrial sector were primarily limited to NMVOC emissions. However, as evident in the preceding figure, emissions are occurring across various sectors in the country, extending beyond NMVOC emissions. These emissions will be primarily associated with product uses serving as substitutes for ODS. Due to data unavailability, emissions from these categories have not been estimated. This poses a significant constraint on the IPPU sector, especially given that emissions from product uses as substitutes for ODS are anticipated to be substantial and will have a notable impact on the overall national GHG emissions of Guyana.

6.2.3. Summary of Sector Emissions

GHG emissions associated with categories within the IPPU sector occurring in Guyana have not been estimated due to data being unavailable. As such, within this national GHG inventory as part of Guyana's first BUR, the IPPU sector emissions represent 0% of the national total GHG emissions of the country.

However, as previously stated, HFCs and PFCs emissions, which have high GWPs, are anticipated to have a some impact on the overall national GHG emissions of Guyana once estimated.

In this national GHG inventory as part of Guyana's first BUR, only NMVOC emissions are estimated for category 2D3a related to domestic solvent use including fungicides.

6.2.4. Description of Emissions by Category

Non-energy Products from Fuels and Solvent Use (2D) – Domestic Solvent Use Including Fungicides (2D3a)

Non-energy products from fuels and solvent use refers to emissions from the first use of fossil fuels as a product for primary purposes other than combustion for energy purposes and use as feedstock or reducing agent.

The use of solvents manufactured using fossil fuels as feedstocks can lead to evaporative emissions of various NMVOC, which are subsequently further oxidised in the atmosphere.

The methodologies for estimating the NMVOC emissions from solvent use (2D3) are reported in the EMEP/CORINAR Emission Inventory Guidebook. It is treated as a separate category because the nature of this source requires a slightly different approach to emissions estimation than that used for calculating other emission categories in the 2006 IPCC Guidelines. Nonetheless, the identical overarching methodology is employed, wherein NMVOC emissions are estimated by applying default emission factors to the overall solvent activity data.

This subcategory addresses NMVOC emissions from the domestic use of solvent-containing products, with the total NMVOC emissions from domestic solvent use in Guyana illustrated in Figure 2.18 and detailed in Table 2.36.

Emissions from this category amounted to 0.90 Gg NMVOC in the base year of 1990 and increased slightly to 0.97 Gg NMVOC in 2022. This marginal increase is linked to the ongoing population growth in Guyana, upon which the estimations are grounded, and which has been steadily rising over time.

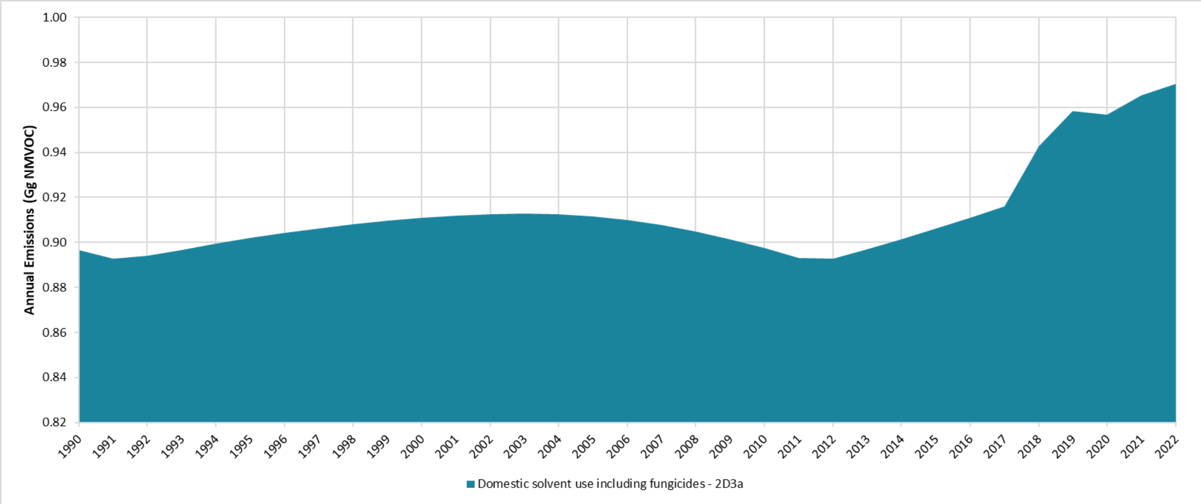

Figure 2.18. Category 2D3a NMVOC emissions.

Table 2.36. Summary of NMVOC emissions from Category 2D3a – Domestic Solvent Use Including Fungicides.

Annual Emissions in Gg NMVOC											
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Domestic Solvent Use – 2D3a	0.90	0.89	0.89	0.90	0.90	0.90	0.90	0.91	0.91	0.91	0.91
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Domestic Solvent Use – 2D3a	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.90	0.90	0.90	0.89
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Domestic Solvent Use – 2D3a	0.89	0.90	0.90	0.91	0.91	0.92	0.94	0.96	0.96	0.97	0.97

6.3. Agriculture, Forestry, and Other Land Use (AFOLU)

The Agriculture, Forestry, and Other Land Use (AFOLU) sector covers GHG emissions and removals occurring in managed ecosystems that concern the key greenhouse gases CO_2, N_2O and CH_4. As described in the 2006 IPCC Guidelines, CO_2 fluxes between the atmosphere and ecosystems are primarily controlled by uptake through plant photosynthesis and releases via respiration, decomposition and combustion of organic matter. N_2O is primarily emitted from ecosystems as a by-product of nitrification and denitrification, while CH_4 is emitted through methanogenesis under anaerobic conditions in soils and manure storage, through enteric fermentation, and during incomplete combustion while burning organic matter. Indirect emissions from precursor gases are also considered in this category, including the ones associated with leaching or runoff of nitrogen compounds. This section presents the GHG emissions in Guyana associated with the AFOLU sector.

6.3.1. Description of Sector

The Agriculture, Forestry, and Other Land Use (AFOLU) sector holds substantial economic significance in Guyana. In 2022, the Gross Domestic Product (GDP) of Agriculture, forestry and fishing reached the 307,794 G$ millions [28]. AFOLU serves as a primary economic contributor to the country's economy, it is a source of employment for a considerable portion of the population, and it plays a crucial role in the country's exports and trade, enhancing economic stability. As such, this sector helps stimulating rural development, it contributes to economic diversification by supporting various subsectors and, additionally, forestry and agriculture contribute to the maintenance of ecosystem services, such as water regulation, provision of food and materials, and biodiversity.

AFOLU stands out as a crucial sector contributing significantly to greenhouse gas emissions and removals in the country. The CH_4 emissions, especially when expressed as CO2e, derive mainly from the Agriculture sector, principally from the rice cultivation and domestic animals' subsectors. On the other hand, the CO_2 removals derive exclusively from the Forestry and Land Use Change and sector [29].

The 2006 IPCC Guidelines - Volume 4 addresses the GHG emissions/removals for the AFOLU sector: Agriculture, Forestry and Other Land Uses. The three subsectors under the AFOLU sector and their codes are Livestock (3A), Land (3B) and Aggregated and Non-CO2 Emissions Sources (3C). GHG emissions/removals are divided in the different subsectors, emissions/removals sources/sinks, categories, and subcategories. Greenhouse gas fluxes in the AFOLU sector can be estimated in two ways: 1) as net changes in C stocks over time (used for most CO_2 fluxes) and 2) directly as gas flux rates to and from the atmosphere (used for estimating non-CO_2 emissions and some CO_2 emissions and removals). [30]

Agriculture

Agriculture is one of the main economic sectors in Guyana. It generates around 15% of total national GDP and covers less than 2% of the country. It also accounts for 33% of employment in the country and plays a significant role in export earnings.

Approximately 8.53% of Guyana's land is currently used for agricultural activities and is projected to grow in the medium term. Most of the agricultural activities are carried out on the Coastal Plain in Regions 2, 3, 4, 5, and 6. An estimated 1.74 million hectares are under agrarian production with rice, sugar, and coconut (90,000, 48,000, and 25,000 hectares, respectively). Non-traditional crops (crops other than rice and sugarcane) occupy 40,000 hectares. [31]

One of the most important agricultural industries in Guyana is the rice industry. The Guyana Rice Development Board (GRDB) is part of the Ministry of Agriculture in Guyana and seeks to develop the rice industry in Guyana, conducting the export trade of the product and the research to provide a better quality and higher volume of grain, as well as greater resistance to pests, diseases, and weather fluctuations. The paddy production in 2020 was 1,057,752 tonnes. [32]

Sugar production has also been a significant contributor to the national economy historically, although the sector has faced challenges, including fluctuating international prices and changes in the global sugar market. The Guyana Sugar Corporation (GUYSUCO), owned by the Government of Guyana, is the largest cultivator and producer of pure cane sugar in Guyana. In 2020, the sugar production from the Corporation was 88,868 mt and which was extracted from 1,217,154 mt of canes. [33]

In recent years, there has been a growing interest in diversifying the agricultural sector and promoting non-traditional crops. Additionally, efforts have been made to improve infrastructure, technology adoption, and sustainable farming practices. The National Agricultural Research & Extension Institute (NAREI) is the premier organisation responsible for spearheading agricultural research and extension activities for productivity enhancement and diversification of the non- traditional crops sector (fruits and vegetables), biofuel development, as well as for plant quarantine services. [34]

Livestock activities in the country are dominated by poultry and non-dairy cattle and, to a lesser extent, swine, sheep and goats. [31] They take place along the Coastal Plain and in the Intermediate and Rupununi Savannahs and is largely self-sufficient [35]. The Guyana Livestock Development Authority (GLDA), under the Ministry of Agriculture, delivers public services related to animal production, animal health, animal genetics, marketing, training and extension services, as well as regulatory services. [34]

CH_4 and N_2O emissions in Guyana are primarily originated from the livestock related activities and agricultural soil management activities. In 2016, emissions from the agricultural sector were about 1119 Gg CO_2e, which equal 32% of the total national greenhouse gas emissions (excluding FOLU). Enteric fermentation from livestock and rice cultivation were the largest sources of emissions in 2016 for the agriculture sector, responsible for 360 Gg CO_2e and 631 Gg CO_2e respectively. [31]

Forestry and Other Land Use

Guyana's land area covers approximately 21.1 million hectares for which 18.39 million hectares are covered by tropical rainforests, mangrove forests, swamp and marsh forests, savannah grasslands and shrubs. Guyana is considered to be a high forest cover, low deforestation country with a total forest area estimated at 18 million hectares and a historic deforestation rate of less than 1% (0.02-0.079%) for the past twenty years. [31] There is a total of 1.1 million ha designated as Protected Areas [36].

In 2009 Guyana developed a framework for a national Monitoring Reporting and Verification System (MRVS) for REDD+. The MRVS was established by Guyana Forestry Commission to provide a national system to monitor, report and verify forest carbon emissions from deforestation and forest degradation in the country. The largest emissions in this sector are due to removal from soil. For the year 2022, CO_2 Forest management related emissions were 10664.46 Gg CO_2.

In 2022, the country had an annualised deforestation rate of 0.036%, corresponding to 6,470 ha. 82% of deforestation is associated with mining and mining infrastructure, 14% with agriculture and 3.5% with road infrastructure. The primary sources of degradation include forest management-related losses (including selective harvesting of timber, logging damage and illegal harvesting) and forest degradation surrounding mining sites and road infrastructure [36].

The FOLU sector generates significant annual removals in Guyana. The largest removals of CO_2 occur in forest land, totalling -153,071.66 Gg CO_2 in 2022. The net emissions in 2022 were -140,480.18 Gg CO_2e.

6.3.2. Coverage of Sector

Figure 2.19 illustrates the coverage of the Guyana AFOLU sector GHG emissions inventory.

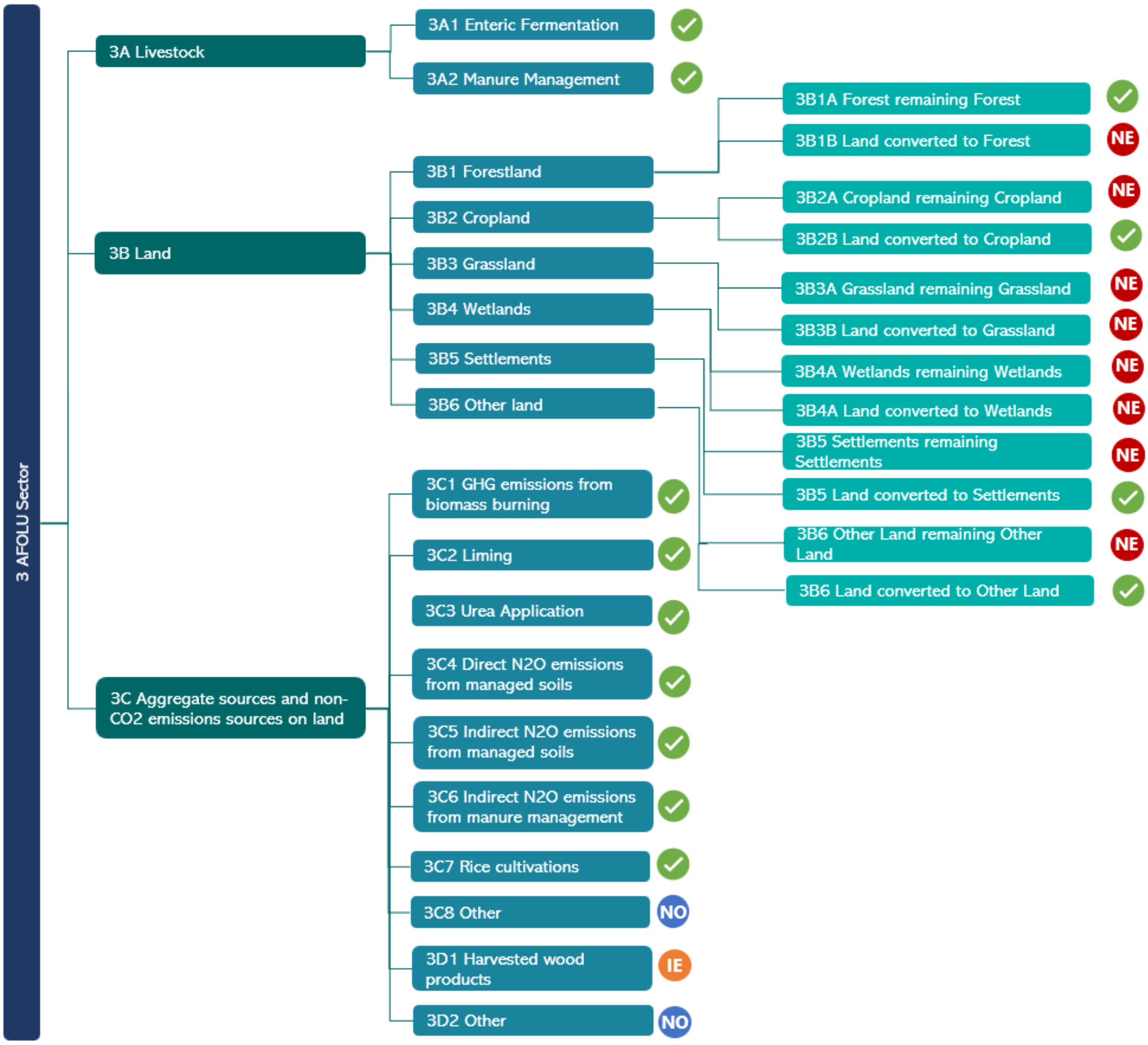

Figure 2.19. Coverage of the Guyana AFOLU sector GHG emissions inventory. NE – not Estimated; NO – not occurring; IE – included elsewhere; NA – not applicable.

Categories not estimated "NE" are due to the approach followed to estimate the emissions of the category 3B, detailed in the REDD+ technical Annex. The transition periods from these sub-categories do not meet the transition period criteria of the inventory and/or their emissions could be considered negligible.

Category 3A - Livestock covers the N_2O and CH_4 emissions associated to livestock and the management practice. **Category 3A1 – Enteric Fermentation** covers the CH_4 emission from livestock. **Category 3A2 – Manure management** covers the N_2O and CH_4 emissions from manure management systems.

Category 3B - Land covers the CO_2 caused by losses of organic matter from terrestrial ecosystems, and CO_2 removals from the atmosphere as uptake by vegetation and stored in the organic matter. The category also covers non-CO2 emissions from burning and, depending on the land-use category, emissions from other specific sources (e.g. CH4 emissions from rice).

Carbon stock changes and emission/removal estimations can involve five carbon pools: Above-ground biomass, below-ground biomass, deadwood, litter, soil organic matter.

Category 3B1a – Forest Land Remaining Forest Land covers CO2 emissions and non-CO2 emissions (CH4, CO, N2O, NOX) due to changes in biomass, dead organic matter and soil organic carbon on Forest Land remaining Forest Land. The subcategory Forest Land remaining Forest Land also includes emissions from forest degradation from logging, mining and forestry infrastructure. Afforestation and reforestation data are not available thus Land converted to Forest Land has not been estimated.

Category 3B2b – Land Converted to Cropland covers CO2 emissions due to changes in biomass, dead organic matter and soil organic carbon on Forest Land converted to Cropland.

Category 3B5b – Land Converted to Settlements covers CO2 emissions from above-ground and below-ground biomass, dead organic matter, and soils on Forest Land converted to Settlements.

Category 3B6b – Land Converted to Other Land covers CO2 emissions and non-CO2 emissions from changes in carbon stocks from the three main pools (biomass, dead organic matter and soil organic carbon). Other Land includes bare soil, rock, ice, and all land areas that do not fall into any of the other five land-use categories. In the case of Guyana, the category considers Forest Land converted to bare soil for mining.

Category 3C – Aggregated and non-CO_2 Emissions Sources regroups several categories linked to Agriculture but not counted for in Livestock (3A) nor in Cropland (3B2). It covers the CO_2, N_2O and CH_4 emissions associated to various activities described as follows.

Category 3C1 – Emissions from Biomass Burning covers the N_2O and CH_4 emissions due to biomass burning occurring in both cropland (sugarcane and rice crops were considered) and forestland. The CO_2 emissions are reported in the category 3B (see above).

Category 3C2 – Liming covers the CO_2 emissions from the lime application as fertilizer to the soil. Only lime applied to sugarcane crops was considered due to lack of data on other crops.

Category 3C3 – Urea application covers the CO_2 emissions from the urea application as fertilizer to the soil.

Category 3C4 – Direct N2O Emissions from Managed Soils covers the addition of nitrogen enhancing the two processes responsible for N_2O emissions: nitrification and denitrification. The nitrogen (N) sources included in the methodology for estimating direct N2O emissions from managed soils are the synthetic N fertilisers (F_{SN}), the organic N applied as fertiliser (only the animal manure was considered due to lack of data on other types of organic fertilizers) (F_{ON}), the urine and dung N deposited on pasture, range and paddock by grazing animals

(F_{PRP}) and the N in crop residues (above-ground and below-ground), including various crops in the country (F_{CR}).

Category 3C5 – Indirect N2O Emissions from Managed Soils covers volatilisation of NH3 and NOx and leaching and runoff of nitrogen. The parameters considered equal the ones in Category 3C4.

Category 3C6 – Indirect N2O Emissions from Manure Management covers the N_2O emissions from volatile nitrogen losses that occur primarily in the forms of ammonia (NH_3) and nitric oxide (NOx).

Category 3C7 – Rice cultivations covers the CH_4 emissions from rice cultivations in Guyana.

6.3.3. Summary of Sector Emissions

In 2022, the AFOLU sector represented 56.13% of total emissions in Guyana, being the largest source of GHG emissions in the country, as illustrated in Figure 2.20. The AFOLU sector accounts for 34.96% of the total national CH_4 emissions, 92.55% of the total national N_2O emissions, and 62.61% of the total national CO_2 emissions. That being said, however, GHG removals from forest lands remaining forest lands are approximately 10 times greater than national GHG emission totals, contributing to Guyana being a net carbon sink.

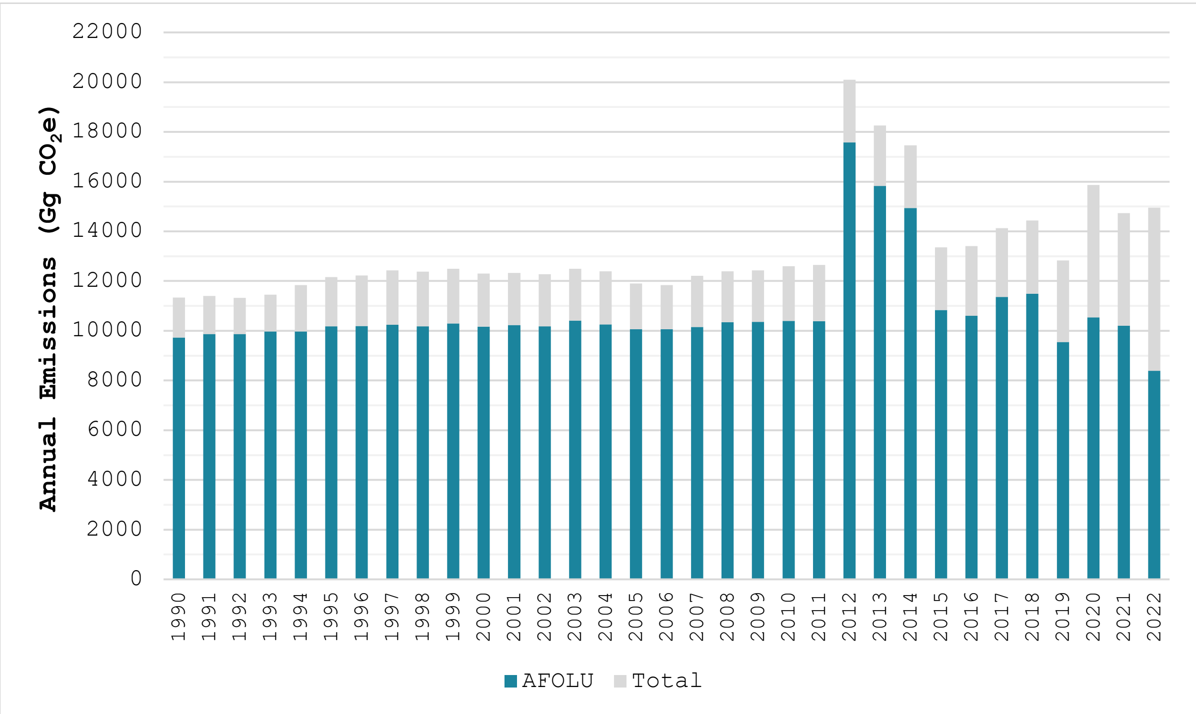

Figure 2.20. Contribution of AFOLU sector emissions to national emission totals.

Figure 2.21 depicts the emissions from the sector by category, while figure 2.22 shows total removals. Furthermore, Table 2.37 provide further details on sectoral emission trends by category and gas.

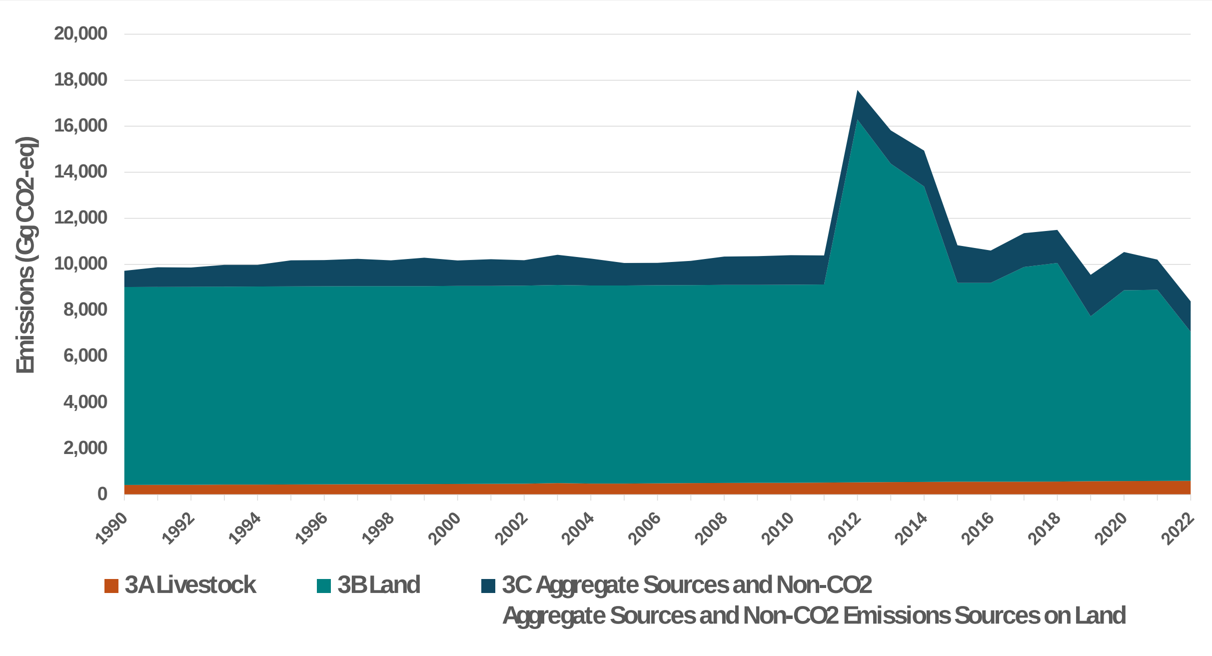

Figure 2.21. Total GHG emissions from the AFOLU sector by category.

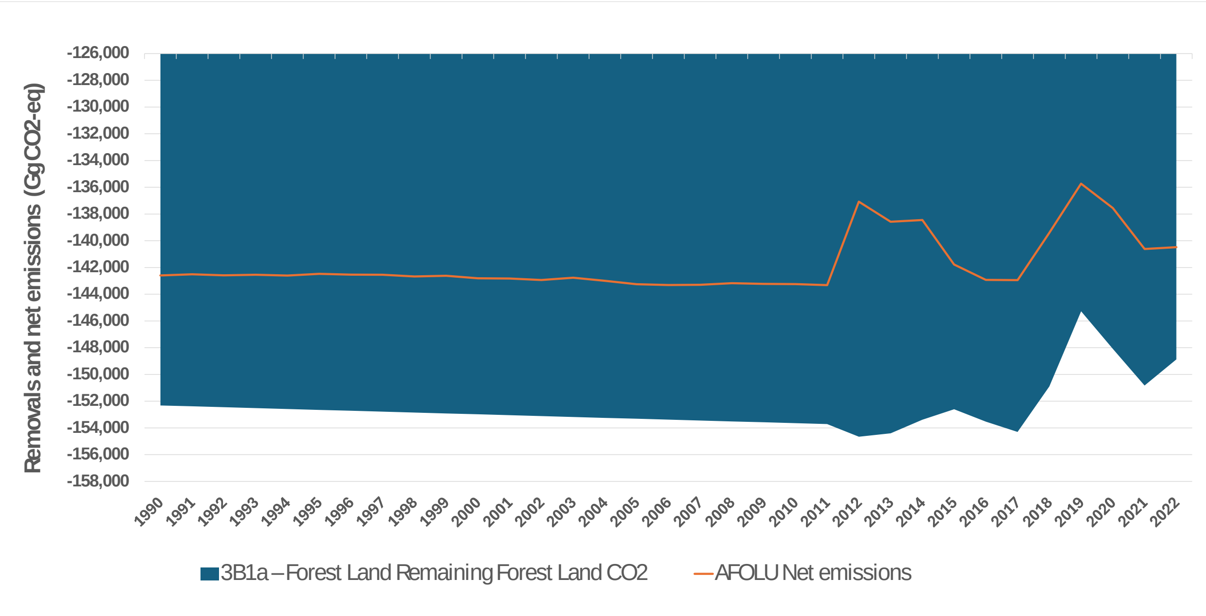

Figure 2.22. Total removals from the AFOLU sector.

Figure 2.37. Total GHG emissions from the AFOLU sector by gas and category.

Category	Gas	Annual emissions in Gg CO_2e															
		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
3 AFOLU	CO_2	-143699,39	-143761,00	-143828,77	-143895,77	-143963,44	-144029,70	-144096,33	-144163,10	-144226,63	-144290,75	-144360,74	-144425,16	-144481,98	-144555,62	-144590,76	-144691,56
	CH_4	708,44	834,01	845,43	951,90	955,83	1126,62	1146,40	1187,94	1123,33	1214,63	1069,89	1116,54	1043,35	1165,25	1090,09	1043,86
	N_2O	396,62	417,90	397,62	402,16	401,20	426,39	418,67	433,34	428,17	453,04	479,46	483,59	504,51	622,46	506,26	395,71
	Total	-142594,34	-142509,09	-142585,72	-142541,71	-142606,41	-142476,69	-142531,26	-142541,82	-142675,13	-142623,09	-142811,39	-142825,03	-142934,12	-142767,91	-142994,41	-143251,99
3A1 Enteric Fermentatio n	CO_2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	CH_4	381,22	385,26	389,35	395,05	398,98	401,10	404,85	409,59	409,87	412,79	418,56	422,81	429,77	453,91	435,02	433,95
	N_2O	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Total	381,22	385,26	389,35	395,05	398,98	401,10	404,85	409,59	409,87	412,79	418,56	422,81	429,77	453,91	435,02	433,95
3A2 Manure manageme nt	CO_2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	CH_4	36,75	37,42	38,10	38,87	39,57	40,19	40,90	41,67	42,25	42,96	43,81	44,61	45,54	47,28	47,04	47,65
	N_2O	0,014	0,014	0,014	0,015	0,015	0,015	0,015	0,015	0,014	0,014	0,014	0,015	0,015	0,021	0,015	0,013
	Total	36,76	37,43	38,12	38,89	39,58	40,21	40,92	41,69	42,26	42,97	43,83	44,62	45,55	47,30	47,06	47,66
3B1 Forest Land	CO_2	-152319,30	-152385,64	-152451,97	-152518,31	-152584,64	-152650,98	-152717,31	-152783,65	-152849,98	-152916,32	-152982,65	-153048,99	-153115,32	-153181,66	-153248,00	-153314,33
	CH_4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	N_2O	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Total	-152319,30	-152385,64	-152451,97	-152518,31	-152584,64	-152650,98	-152717,31	-152783,65	-152849,98	-152916,32	-152982,65	-153048,99	-153115,32	-153181,66	-153248,00	-153314,33
3B2 Cropland	CO_2	564,80	564,80	564,80	564,80	564,80	564,80	564,80	564,80	564,80	564,80	564,80	564,80	564,80	564,80	564,80	564,80
	CH_4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	N_2O	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Total	564,80	564,80	564,80	564,80	564,80	564,80	564,80	564,80	564,80	564,80	564,80	564,80	564,80	564,80	564,80	564,80
3B3 Grassland	CO_2	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
	CH_4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	N_2O	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Total	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
3B4 Wetland	CO_2	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
	CH_4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	N_2O	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
	Total	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
3B5 Settlements	CO_2	320,02	320,02	320,02	320,02	320,02	320,02	320,02	320,02	320,02	320,02	320,02	320,02	320,02	320,02	320,02	320,02
	CH_4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	N_2O	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Total	320,02	320,02	320,02	320,02	320,02	320,02	320,02	320,02	320,02	320,02	320,02	320,02	320,02	320,02	320,02	320,02
3B6 Other Land	CO_2	7716,75	7716,75	7716,75	7716,75	7716,75	7716,75	7716,75	7716,75	7716,75	7716,75	7716,75	7716,75	7716,75	7716,75	7716,75	7716,75
	CH_4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	N_2O	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Total	7716,75	7716,75	7716,75	7716,75	7716,75	7716,75	7716,75	7716,75	7716,75	7716,75	7716,75	7716,75	7716,75	7716,75	7716,75	7716,75
3C1 Emissions from Biomass Burning	CO_2	IE (3B1 & 3B2)	IE (3B1 & 3B2)	IE (3B1 & 3B2)	IE (3B1 & 3B2)	IE (3B1 & 3B2)	IE (3B1 & 3B2)	IE (3B1 & 3B2)	IE (3B1 & 3B2)	IE (3B1 & 3B2)	IE (3B1 & 3B2)	IE (3B1 & 3B2)	IE (3B1 & 3B2)	IE (3B1 & 3B2)	IE (3B1 & 3B2)	IE (3B1 & 3B2)	IE (3B1 & 3B2)
	CH_4	63,16	74,09	75,80	84,05	85,13	99,68	101,33	104,86	98,30	108,07	94,77	97,92	90,57	99,14	95,86	90,34
	N_2O	16,26	18,94	19,36	21,38	21,65	25,22	25,62	26,49	24,88	27,28	24,01	24,79	22,98	25,09	24,28	22,93
	Total	79,42	93,04	95,16	105,43	106,78	124,90	126,96	131,35	123,18	135,35	118,78	122,70	113,55	124,23	120,14	113,27
3C2 Liming	CO_2	11,35	11,72	12,46	12,24	12,99	13,07	13,29	13,58	12,96	14,44	14,24	13,96	13,71	13,93	14,94	13,89
	CH_4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	N_2O	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Total	11,35	11,72	12,46	12,24	12,99	13,07	13,29	13,58	12,96	14,44	14,24	13,96	13,71	13,93	14,94	13,89
3C3 Urea application	CO_2	6,98	11,34	9,16	8,72	6,63	6,63	6,11	5,39	8,81	9,54	6,10	8,29	18,06	10,54	40,72	7,30
	CH_4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	N_2O	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Total	6,98	11,34	9,16	8,72	6,63	6,63	6,11	5,39	8,81	9,54	6,10	8,29	18,06	10,54	40,72	7,30
3C4 Direct N2O Emissions from Managed Soils	CO_2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	CH_4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	N_2O	269,75	282,97	267,59	268,99	267,78	283,31	277,09	286,75	284,06	300,14	321,30	323,38	339,39	422,12	339,19	259,67
	Total	269,75	282,97	267,59	268,99	267,78	283,31	277,09	286,75	284,06	300,14	321,30	323,38	339,39	422,12	339,19	259,67
3C5 Indirect N2O Emissions from	CO_2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	CH_4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	N_2O	103,71	108,97	103,54	104,43	104,30	110,41	108,41	112,39	111,65	118,00	126,31	127,45	133,87	165,57	134,49	105,03
	Total	103,71	108,97	103,54	104,43	104,30	110,41	108,41	112,39	111,65	118,00	126,31	127,45	133,87	165,57	134,49	105,03

Category	Gas	Annual emissions in Gg CO_2e															
		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Managed Soils																	
3C6 Indirect N2O Emissions from Manure Management	CO_2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	CH_4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	N_2O	6,89	7,00	7,12	7,35	7,45	7,44	7,54	7,70	7,56	7,60	7,83	7,95	8,25	9,66	8,29	8,07
	Total	6,89	7,00	7,12	7,35	7,45	7,44	7,54	7,70	7,56	7,60	7,83	7,95	8,25	9,66	8,29	8,07
3C7 Rice Cultivations	CO_2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	CH_4	227,31	337,23	342,18	433,93	432,15	585,63	599,32	631,82	572,91	650,80	512,74	551,21	477,48	564,92	512,17	471,91
	N_2O	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	Total	227,31	337,23	342,18	433,93	432,15	585,63	599,32	631,82	572,91	650,80	512,74	551,21	477,48	564,92	512,17	471,91
3C8 Other	CO_2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	CH_4	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	N_2O	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	Total	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3D Harvested Wood Products	CO_2	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
	CH_4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	N_2O	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Total	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

Category	Gas	Annual emissions in Gg CO_2e																
		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
3 AFOLU	CO_2	-144755,65	-144821,87	-144866,58	-144951,89	-145008,44	-145086,59	-138865,42	-140531,81	-140521,10	-143943,86	-144864,38	-144948,23	-141350,72	-138062,91	-139763,76	-142494,47	-142380,53
	CH_4	1035,78	1056,37	1133,74	1162,10	1191,86	1252,26	1279,52	1388,97	1506,24	1594,38	1394,22	1457,55	1449,86	1755,71	1659,26	1399,57	1421,29
	N_2O	406,33	475,20	559,27	564,86	569,54	511,69	507,71	562,92	564,19	575,84	544,88	545,64	502,60	576,73	553,18	477,42	479,06
	Total	-143313,54	-143290,30	-143173,57	-143224,93	-143247,04	-143322,65	-137078,19	-138579,92	-138450,66	-141773,64	-142925,28	-142945,04	-139398,26	-135730,46	-137551,32	-140617,47	-140480,18
3A1 Enteric Fermentation	CO_2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	CH_4	442,57	449,50	456,37	459,56	459,95	469,70	477,86	487,64	496,48	503,45	500,98	504,26	508,37	518,92	524,44	530,03	535,68
	N_2O	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Total	442,57	449,50	456,37	459,56	459,95	469,70	477,86	487,64	496,48	503,45	500,98	504,26	508,37	518,92	524,44	530,03	535,68
3A2 Manure management	CO_2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	CH_4	48,71	49,71	50,71	51,55	52,28	53,45	54,56	55,77	56,94	58,05	58,74	59,71	60,74	62,07	63,20	64,35	65,51
	N_2O	0,015	0,015	0,016	0,016	0,015	0,016	0,017	0,019	0,020	0,021	0,019	0,019	0,019	0,020	0,021	0,021	0,021
	Total	48,73	49,73	50,72	51,56	52,29	53,46	54,58	55,79	56,97	58,07	58,76	59,73	60,75	62,09	63,22	64,37	65,53
3B1 Forest Land	CO_2	-153380,67	-153447,00	-153513,34	-153579,67	-153646,01	-153712,34	-154655,69	-154400,49	-153390,70	-152606,83	-153529,34	-154301,17	-150894,85	-145275,52	-148089,19	-150827,94	-148875,77
	CH_4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	N_2O	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Total	-153380,67	-153447,00	-153513,34	-153579,67	-153646,01	-153712,34	-154655,69	-154400,49	-153390,70	-152606,83	-153529,34	-154301,17	-150894,85	-145275,52	-148089,19	-150827,94	-148875,77
3B2 Cropland	CO_2	564,80	564,80	564,80	564,80	564,80	564,80	1007,85	990,08	1426,47	940,12	940,12	1048,93	1027,02	726,57	1125,86	653,06	476,21
	CH_4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	N_2O	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Total	564,80	564,80	564,80	564,80	564,80	564,80	1007,85	990,08	1426,47	940,12	940,12	1048,93	1027,02	726,57	1125,86	653,06	476,21
3B3 Grassland	CO_2	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
	CH_4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	N_2O	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Total	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
3B4 Wetland	CO_2	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
	CH_4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	N_2O	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
	Total	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
3B5 Settlements	CO_2	320,02	320,02	320,02	320,02	320,02	320,02	385,84	730,67	437,35	565,61	565,61	451,02	452,07	315,40	376,24	473,10	457,89
	CH_4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	N_2O	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Total	320,02	320,02	320,02	320,02	320,02	320,02	385,84	730,67	437,35	565,61	565,61	451,02	452,07	315,40	376,24	473,10	457,89
3B6 Other Land	CO_2	7716,75	7716,75	7716,75	7716,75	7716,75	7716,75	14365,35	12109,20	10969,56	7130,11	7130,11	7823,99	8015,33	6119,78	6783,28	7175,32	5534,47
	CH_4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	N_2O	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Total	7716,75	7716,75	7716,75	7716,75	7716,75	7716,75	14365,35	12109,20	10969,56	7130,11	7130,11	7823,99	8015,33	6119,78	6783,28	7175,32	5534,47
3C1 Emissions from Biomass Burning	CO_2	IE (3B1 & 3B2)	IE (3B1 & 3B2)	IE (3B1 & 3B2)	IE (3B1 & 3B2)	IE (3B1 & 3B2)	IE (3B1 & 3B2)	IE (3B1 & 3B2)	IE (3B1 & 3B2)	IE (3B1 & 3B2)	IE (3B1 & 3B2)	IE (3B1 & 3B2)	IE (3B1 & 3B2)	IE (3B1 & 3B2)	IE (3B1 & 3B2)	IE (3B1 & 3B2)	IE (3B1 & 3B2)	IE (3B1 & 3B2)
	CH_4	89,01	88,70	96,57	98,65	98,13	106,61	112,61	116,27	134,09	188,62	169,66	131,33	140,18	387,89	249,87	111,84	111,48
	N_2O	22,60	22,52	24,45	24,97	24,84	26,92	28,58	29,36	33,96	49,10	44,45	33,63	35,94	104,75	66,22	28,19	28,04
	Total	111,61	111,22	121,02	123,62	122,97	133,53	141,19	145,63	168,04	237,71	214,11	164,96	176,12	492,64	316,09	140,03	139,52
3C2 Liming	CO_2	14,01	13,09	14,34	14,34	12,37	15,17	14,55	13,65	15,14	14,43	13,16	14,71	14,79	14,87	14,95	15,03	15,11
	CH_4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	N_2O	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Total	14,01	13,09	14,34	14,34	12,37	15,17	14,55	13,65	15,14	14,43	13,16	14,71	14,79	14,87	14,95	15,03	15,11
3C3 Urea application	CO_2	9,42	10,46	30,84	11,87	23,62	9,00	16,67	25,07	21,08	12,70	15,95	14,29	34,93	35,99	25,12	16,97	11,56
	CH_4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	N_2O	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Total	9,42	10,46	30,84	11,87	23,62	9,00	16,67	25,07	21,08	12,70	15,95	14,29	34,93	35,99	25,12	16,97	11,56
3C4 Direct N2O Emissions from Managed Soils	CO_2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	CH_4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	N_2O	266,99	316,62	375,87	379,24	382,59	338,24	333,49	372,37	369,26	366,14	346,99	353,06	316,37	319,31	330,24	299,45	299,92
	Total	266,99	316,62	375,87	379,24	382,59	338,24	333,49	372,37	369,26	366,14	346,99	353,06	316,37	319,31	330,24	299,45	299,92
3C5 Indirect N2O Emissions from	CO_2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	CH_4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	N_2O	108,25	127,27	149,88	151,52	153,11	137,05	135,78	150,86	150,22	149,55	142,71	148,16	139,40	141,25	145,10	137,95	139,06
	Total	108,25	127,27	149,88	151,52	153,11	137,05	135,78	150,86	150,22	149,55	142,71	148,16	139,40	141,25	145,10	137,95	139,06

Category	Gas	Annual emissions in Gg CO_2e																
		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Managed Soils																		
3C6 Indirect N2O Emissions from Manure Management	**CO_2**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	CH_4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	N_2O	8,47	8,77	9,06	9,11	8,98	9,46	9,83	10,31	10,73	11,02	10,71	10,77	10,88	11,41	11,61	11,81	12,02
	Total	8,47	8,77	9,06	9,11	8,98	9,46	9,83	10,31	10,73	11,02	10,71	10,77	10,88	11,41	11,61	11,81	12,02
3C7 Rice Cultivations	**CO_2**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	CH_4	455,49	468,46	530,09	552,34	581,51	622,49	634,50	729,29	818,73	844,26	664,84	762,24	740,58	786,83	821,75	693,35	708,62
	N_2O	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	Total	455,49	468,46	530,09	552,34	581,51	622,49	634,50	729,29	818,73	844,26	664,84	762,24	740,58	786,83	821,75	693,35	708,62
3C8 Other	**CO_2**	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	CH_4	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	N_2O	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	Total	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3D Harvested Wood Products	**CO_2**	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
	CH_4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	N_2O	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Total	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

6.3.4. Description of Emissions by Category

The Volume 4: Agriculture, Forestry and Other Land Use of the IPCC Guidelines provide approaches, methodologies, and technical guidance for preparing a GHG inventory for the AFOLU sector, providing a default approach and default data if necessary.

Enteric Fermentation (3A1)

Enteric fermentation produces CH_4 as part of the digestion process in the alimentary canal of herbivores. Microbes in the animal's digestive system ferment feed ingested by the livestock which generates CH_4. CH_4 production is dependent on animal population, weight, and age of the animals as well as the quantity and quality of feed. The type and efficiency of the animals' digestive system also influence CH_4 production. The quantity of CH_4 production in ruminant livestock is more than that produced by non-ruminant livestock.

The main activity data for the Tier 1 method of this livestock category to estimate CH_4 emissions is the annual livestock population in number of heads for all the species and sub-groups of the country. Default emission factors are presented for each of the recommended population subgroups.

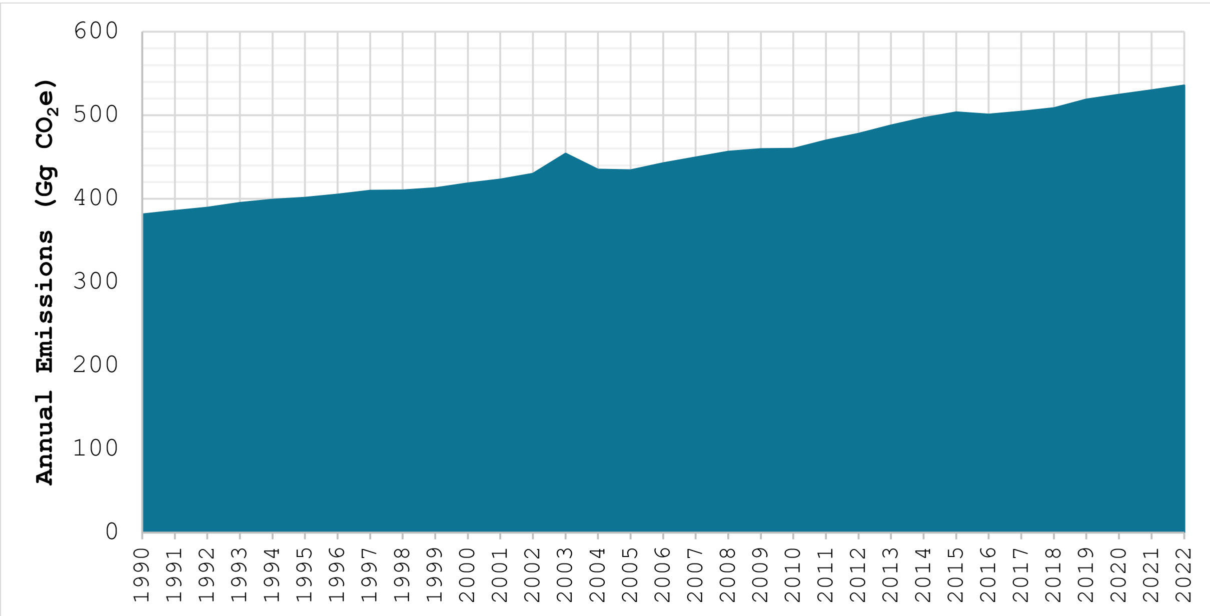

Figure 2.23. Category 3A1 GHG emissions.

Table 2.38. Summary of GHG emissions from Category 3A1 – Enteric Fermentation.

	Annual Emissions in Gg CO_2e										
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Enteric Fermentation – 3A1	381,22	385,26	389,35	395,05	398,98	401,10	404,85	409,59	409,87	412,79	418,56
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Enteric Fermentation – 3A1	422,81	429,77	453,91	435,02	433,95	442,57	449,50	456,37	459,56	459,95	469,70
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Enteric Fermentation – 3A1	477,86	487,64	496,48	503,45	500,98	504,26	508,37	518,92	524,44	530,03	535,68

The trends for the Category 3A1 – Enteric Fermentation reveal an increase of GHG emissions over the period 1990 to 2022 growing by about 40% or from 381,22 Gg CO_2 eq. to 535,68 Gg CO_2 eq., which makes this category a relevant source of CH_4 emissions for the AFOLU sector. With minor differences in the percentage increases by year, the trends show a relatively constant pattern, registering a small peak of emissions in 2003 followed by the only instances of a reduction of emissions in 2004 and 2005 between two consecutive years. Overall, the trend increase in GHG emissions is linked to the growing of the livestock population in Guyana between 1990 and 2022 as the key underlying factor.

Manure Management (3A2)

This section estimates the CH_4 produced during the storage and treatment of manure, and from manure deposited on pasture. The decomposition of manure under anaerobic conditions (i.e., in the absence of oxygen), during storage and treatment, produces CH_4. This category also estimates the N_2O produced directly during the storage and treatment of manure before it is applied to land or otherwise used for feed, fuel, or construction purposes. The indirect N_2O emissions from manure management are treated in Category 3C6. The term 'manure' is used here collectively to include both dung and urine (i.e., the solids and the liquids) produced by livestock.

The N_2O emissions generated by manure in the system 'pasture, range, and paddock' occur directly and indirectly from the soil and are therefore reported under the Categories 3C4 & 3C5 – Direct and Indirect N_2O Emissions from Managed Soils. The emissions associated with the burning of dung for fuel are to be reported under Volume 2 (Energy), or under Volume 5 (Waste) if burned without energy recovery.

In Guyana, the CH_4 emissions are estimated with the Tier 1 methodology from the 2019 Refinement of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. They are estimated by multiplying the livestock population by the emission factor for the defined livestock population.

The direct N_2O emissions from manure management in Guyana are estimated with the Tier 1 method. This method consists in multiplying the total amount of nitrogen (N) excretion (from all livestock species/categories) in each type of manure management system by an emission factor for that type of manure management system from the 2019 Refinement of the 2006 IPCC Guidelines. Emissions are then summed over all manure management systems. The Tier 1 method is applied using IPCC default N2O emission factors, default nitrogen excretion data, and default manure management system data.

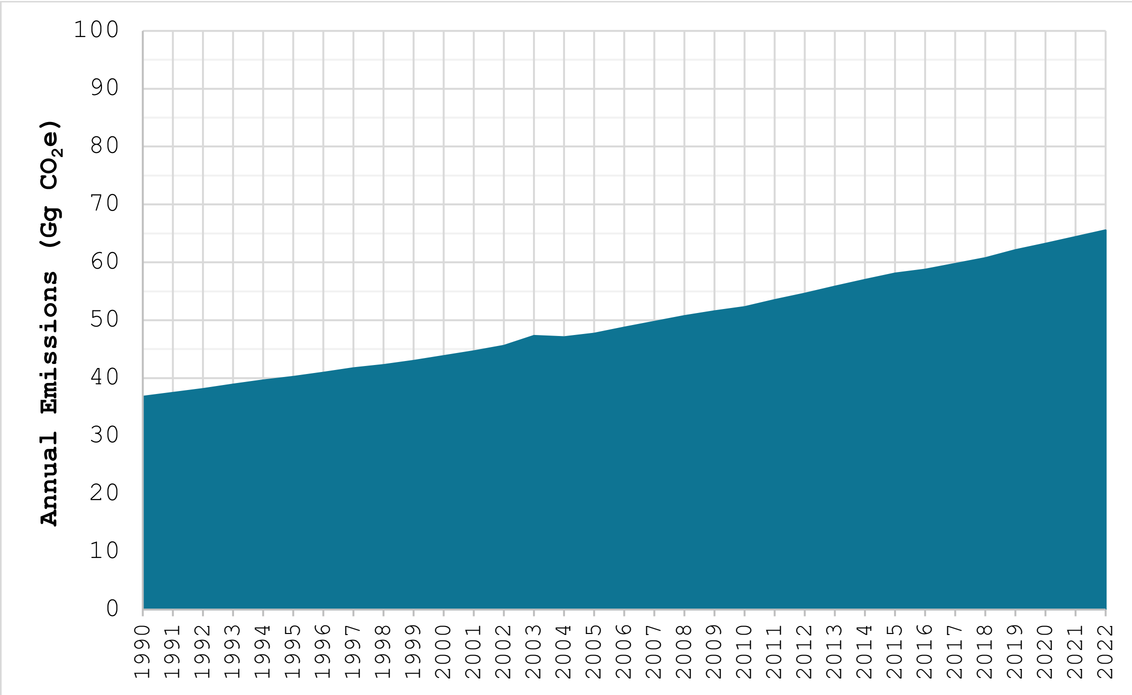

Figure 2.24. Category 3A2 GHG emissions.

Table 2.39. Summary of GHG emissions from Category 3A2 – Manure Management.

Annual Emissions in Gg CO_2e											
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Manure Management – 3A2	36,76	37,43	38,12	38,89	39,58	40,21	40,92	41,69	42,26	42,97	43,83
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Manure Management – 3A2	44,62	45,55	47,30	47,06	47,66	48,73	49,73	50,72	51,56	52,29	53,46
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Manure Management – 3A2	54,58	55,79	56,97	58,07	58,76	59,73	60,75	62,09	63,22	64,37	65,53

The GHG emissions of Category 3A2 – Manure Management have a relatively minor contribution to the country's emissions total. However, in the reported period the GHG emissions in this sector almost doubled from 36,76 Gg CO_2 eq. to 65,53 Gg CO_2 eq. between 1990 and 2022. The trend observed in this increase shows a constant growth pattern with GHG emissions increasing roughly by 1 Gg CO_2 eq. per year which is strongly aligned with the growing of the livestock population in Guyana over the analysed period. An exception is the year 2003 in which a slightly stronger increase was registered and after which emissions again marginally dropped, before resuming the stable growth pattern.

Table 2.40. Uncertainty in GHG Emissions from Category 3A – Livestock.

Parameter	Uncertainty
Enteric fermentation emission factor	40%
CH4 manure management emission factor	30%
Default values for N excretion rate (N_{rate})	50%
Default values for live weights for animal categories (TAM)	30%
Default emission factors for direct N2O emissions from manure management	100%

<u>Forest Land Remaining Forest Land (3B1a)</u>

In this category, the changes in carbon stocks from five carbon pools (i.e., above-ground biomass, belowground biomass, dead wood, litter, and soil organic matter) are estimated for managed forests that have been under the Forest Land category for over 20 years.

Gains in carbon stocks include total (above-ground and below-ground) biomass growth. Carbon losses have been estimated based on activity data on the drivers of forest degradation as presented in the REDD+ technical annex. The drivers that have been considered in this calculation are logging, skid trails for logging activities, buffer zones for mining, and fires. The buffer area is typically a zone surrounding a protected forest or conservation area, and it serves as a transitional zone where certain human activities may be allowed but are subject to specific regulations to minimize their impact on the core forest.

The CO_2 emissions are estimated following the equations provided by 2006 Guidelines for the Tier 1 methodology. However, the activity data and parameters are derived through an extensive monitoring reporting and verification system, as detailed in the REDD+ Technical Annex, with further details provided in Chapter 4 of the BUR. Therefore, the estimations for CO_2 could be considered a more advanced tier approach (T2/T3). Carbon gains or CO_2 removals are estimated by multiplying the total area remaining Forest Land by the average gross periodic annual increment (country specific factor). The carbon losses are estimated separately for each driver of degradation due to activity specific emission factors. Losses from logging have been estimated by multiplying the total volume harvested by the Logging Damage Factor (LDF), which is the country specific emission factor for this activity. The losses from logging skid trails have been calculated by multiplying the length of skid trails by the Logging Infrastructure Factor (LIF). The losses from mining infrastructure (buffer zones) were estimated by multiplying the buffer zone total area by the country specific emission factor.

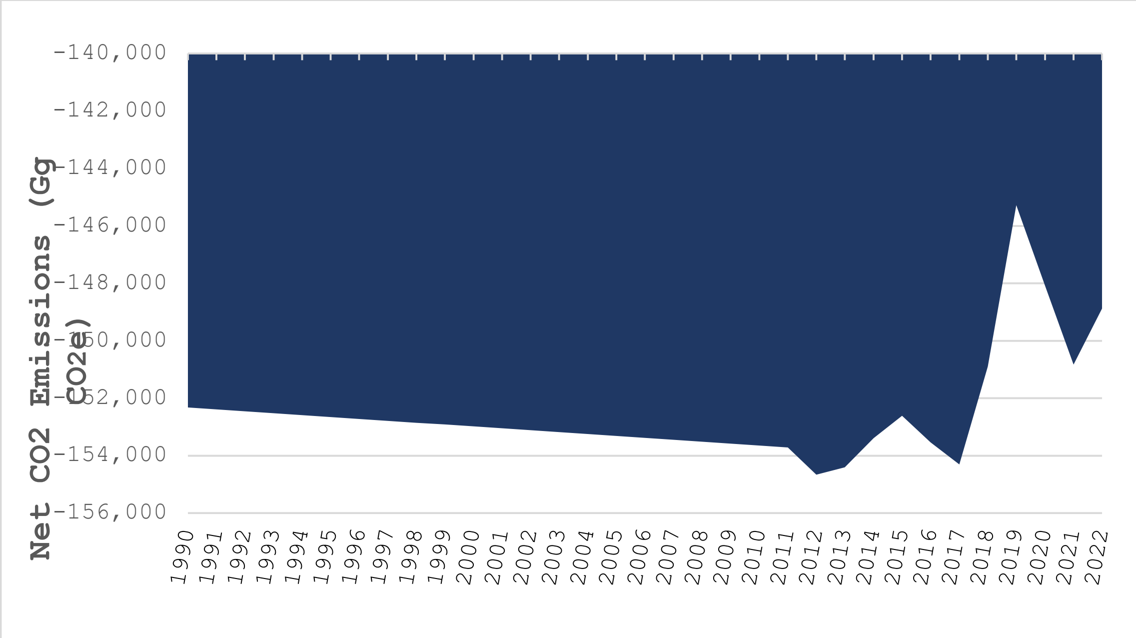

Figure 2.25. Category 3B1a GHG emissions.

Table 2.41. Summary of GHG emissions from Category 3B1a – Forest Land Remaining Forest Land.

	Annual Emissions in Gg CO_2e								
	1990	1991	1992	1993	1994	1995	1996	1997	1998
FL-FL 3B1a	-152319	-152385	-152451	-152518	-152584	-152650	-152717	-152783	-152849
	1999	2000	2001	2002	2003	2004	2005	2006	2007
FL-FL 3B1a	-152916	-152982	-153048	-153115	-153181	-153247	-153314	-153380	-153447
	2008	2009	2010	2011	2012	2013	2014	2015	2016
FL-FL 3B1a	-153513	-153579	-153646	-153712	-154655	-154400	-153390	-152606	-153529
	2017	2018	2019	2020	2021	2022			
FL-FL 3B1a	-154301	-150894	-145275	-148089	-150827	-148875			

Over the past 32 years, annual emissions consistently show a negative trend, indicating a persistent carbon sink. Sinks grew until 2017, with peaks in 2012, 2013, and 2017. Post-2017, there is increased fluctuation, hitting a low in 2019. The average annual emissions are -152,521.08 Gg CO_2, underscore the critical role of Guyana's forests as a significant carbon sink, highlighting their importance in mitigating climate change.

Forest Land Converted to Cropland (3B2b)

This category estimates the CO_2 emissions from Forest Land converted to Cropland. The estimations include annual changes in carbon stocks in all carbon pools. To calculate emissions from this category, the tier 1 methodology has been followed. Deforestation in Guyana due to permanent agriculture is assumed to result in the complete removal of all vegetation. On the other hand, pioneer shifting cultivation has a long-term post deforestation carbon stock. The carbon stocks have been estimated at the national level and an emission factor for deforestation from shifting cultivation has been developed. The calculation of emissions from these categories has been carried out separately, using the activity specific emission factors and the total forest area cleared.

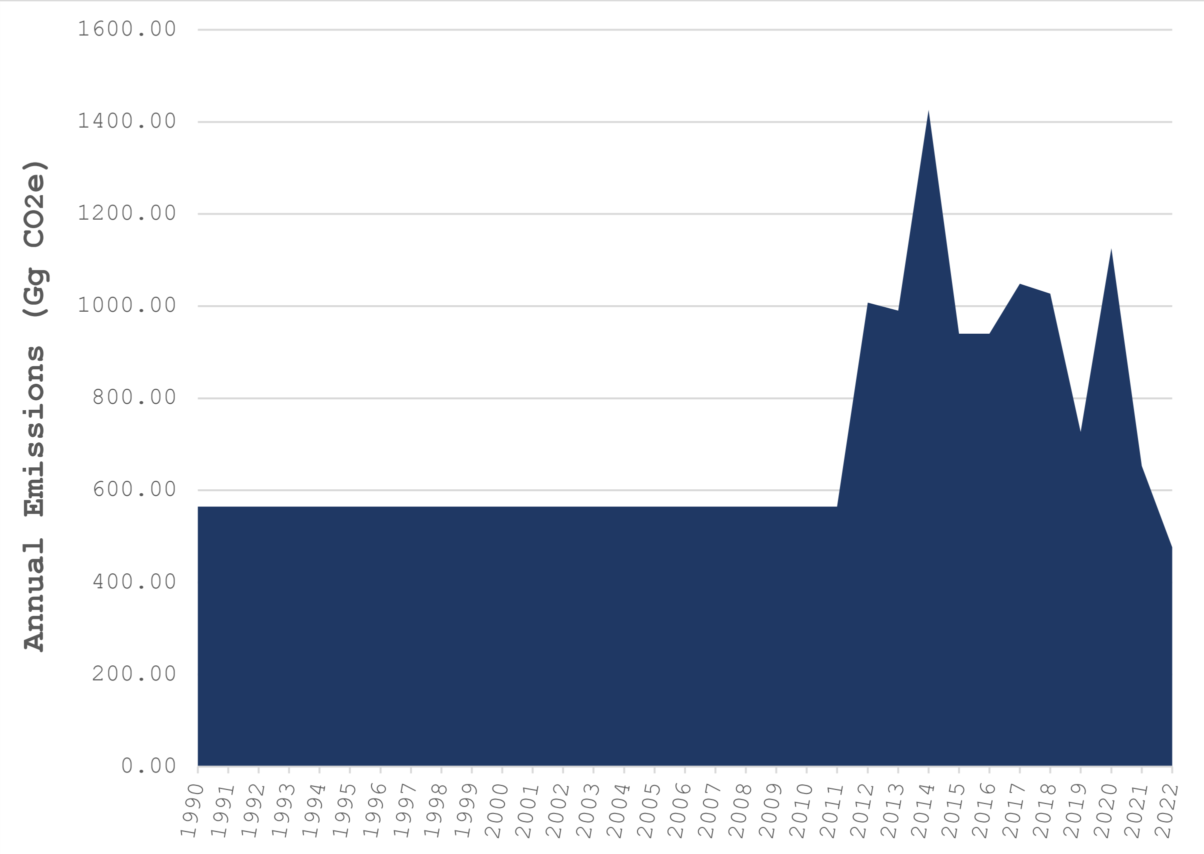

Figure 2.26. Category 3B2b GHG emissions.

Table 2.42. Summary of GHG emissions from Category 3B2b – Forest Land Converted to Cropland.

Annual Emissions in Gg CO_2e											
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Forest Land Converted to Cropland - 3B2b	564.80	564.80	564.80	564.80	564.80	564.80	564.80	564.80	564.80	564.80	564.80
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Forest Land Converted to Cropland - 3B2b	564.80	564.80	564.80	564.80	564.80	564.80	564.80	564.80	564.80	564.80	564.80
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Forest Land Converted to Cropland - 3B2b	1007.85	990.08	1426.47	940.12	940.12	1048.93	1027.02	726.57	1125.86	653.06	476.21

Annual emissions for this category reveal a positive trend, averaging 690.54 over the 32 years observed. The values remain steady until 2012, attributed to missing data that required backward gap-filling. In this case, the value calculated for 2011 was used for the years 1990-2010, leading to an adjusted average of 910.59 for the period from 2011 to 2022. In 2012, there's a notable surge in emissions, followed by an overall increase until the early years, peaking in 2014 at approximately 1.5 times the average.

Emissions decrease in 2019, likely influenced by COVID-19-related economic changes. They rebound in 2020 with economic recovery, but the last two years (2021 and 2022) witness a decline. In 2022, emissions drop below the reported historical value, reaching a minimum of 476.21.

Forest Land Converted to Settlements (3B5b)

This category estimates the CO_2 emissions from Forest Land converted to Settlements. The estimations include annual changes in carbon stocks in all carbon pools. To calculate emissions from this category, the tier 1 methodology has been followed. The calculations include emissions from three different drivers of deforestation, which are: forest land cleared for settlements, infrastructure and forestry infrastructure. Emissions from these drivers have been calculated separately due to specific emission factors for each activity.

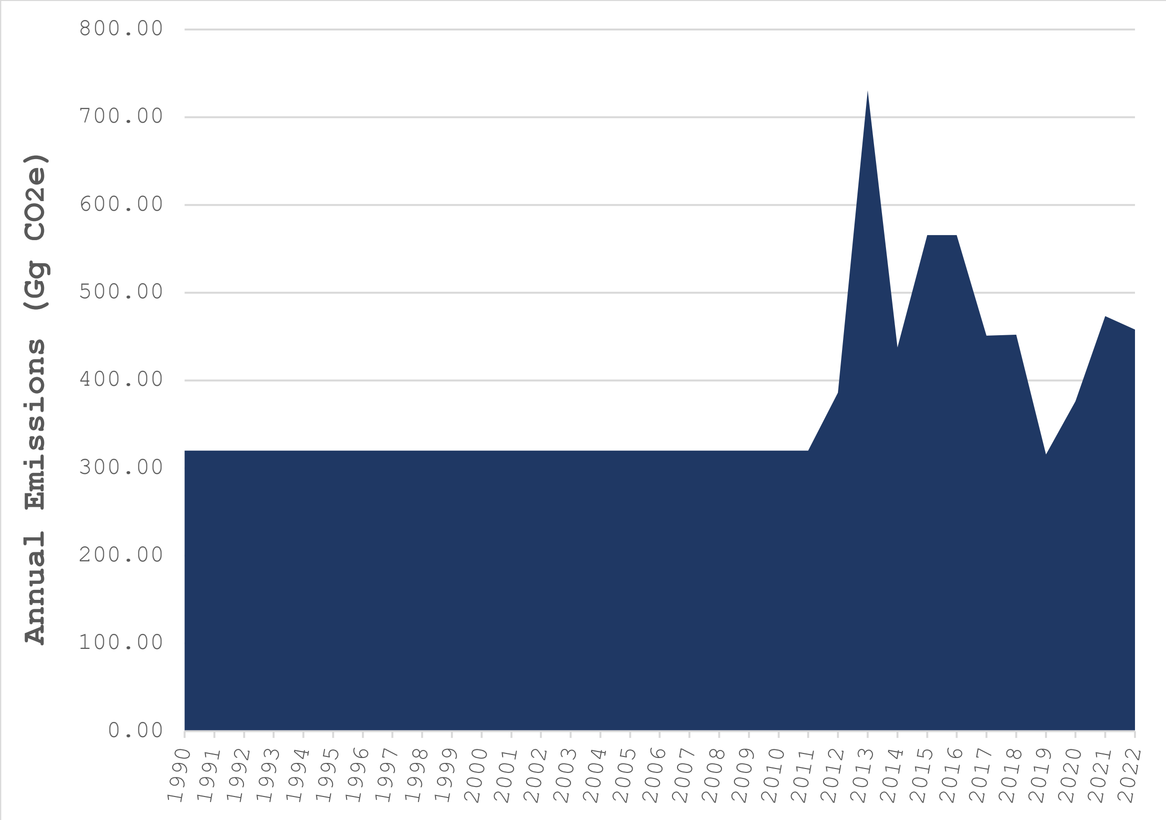

Figure 2.27. Category 3B5b GHG emissions.

Table 2.43. Summary of GHG emissions from Category 3B5b – Forest Land Converted to Settlements.

Annual Emissions in Gg CO_2e											
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Forest Land Converted to Settlements - 3B5b	320.024	320.024	320.024	320.024	320.024	320.024	320.024	320.024	320.024	320.024	320.024
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Forest Land Converted to Settlements - 3B5b	320.024	320.024	320.024	320.024	320.024	320.024	320.024	320.024	320.024	320.024	320.024
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Forest Land Converted to Settlements - 3B5b	385.838	730.673	437.353	565.615	565.615	451.020	452.071	315.399	376.236	473.098	457.891

Like the previous category, data gaps were filled using 2011 values for 1990-2010. From 2011 to 2022, the average emissions are 473.71 Gg CO2, significantly higher than the gap-filled 2011 value. The highest annual emissions occur in 2013, while the lowest is in 2019. Mirroring the sinks of the first category, the recent years show the most fluctuation, with the lowest emissions observed in the last five years.

Forest Land Converted to Other Land (3B6b)

This category estimates the CO_2 emissions from Forest Land converted to Other Land. The estimations include annual changes in carbon stocks in all carbon pools. To calculate emissions from this category, the tier 1 methodology has been followed. The category considers the deforestation caused by medium and large-scale mining activities.

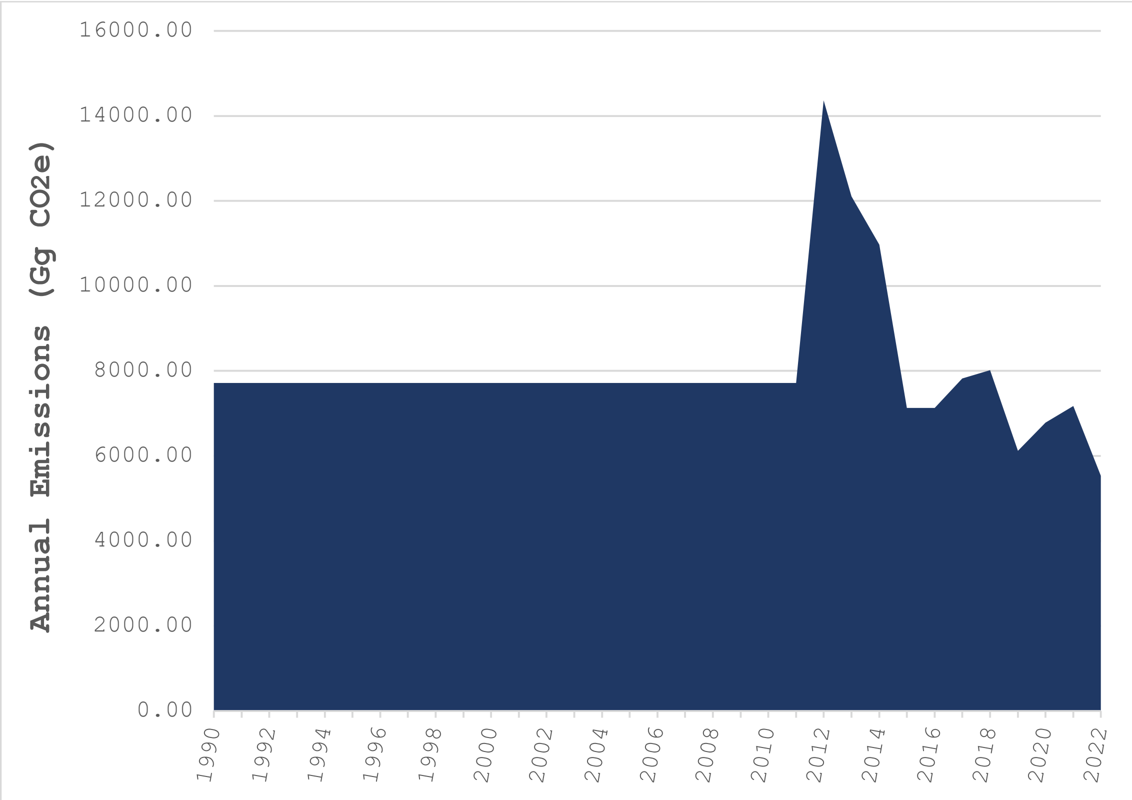

Figure 2.28. Category 3B6b GHG emissions.

Table 2.44. Summary of GHG emissions from Category 3B6b – Forest Land Converted to Other Land.

Annual Emissions in Gg CO_2e											
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Forest Land Converted to Other Land - 3B6b	7716.75	7716.75	7716.75	7716.75	7716.75	7716.75	7716.75	7716.75	7716.75	7716.75	7716.75
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Forest Land Converted to Other Land - 3B6b	7716.75	7716.75	7716.75	7716.75	7716.75	7716.75	7716.75	7716.75	7716.75	7716.75	7716.75
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Forest Land Converted to Other Land - 3B6b	14365.35	12109.20	10969.56	7130.11	7130.11	7823.99	8015.33	6119.78	6783.28	7175.32	5534.47

This category focuses on deforestation resulting from mining activities in Guyana. To address data gaps from 1990 to 2010, we utilized the 2011 value as a constant. From 2011 onwards, emissions display an erratic trajectory, averaging 8468.77 units annually. Notably, emissions surged in 2012, nearly doubling compared to 2011, and remained elevated until 2014. A decline ensued in 2015, persisting until a slight rise in 2016. In the most recent years (2019-2022), emissions show a downward trend, possibly influenced by the economic repercussions of the COVID-19 crisis. Particularly noteworthy is the significant deviation in 2022, with emissions 2934.30 units below the adjusted 2011-2022 average. It is important to highlight that this category represents the highest emissions related to land use and land-use change.

Table 2.45. Uncertainty in GHG Emissions from Category 3B – Land.

Parameter	Uncertainty
Forestry infrastructure Emission Factor	35.37%
Agriculture Emission Factor	35.37%
Mining (medium and large scale) Emission Factor	35.37%
Mining infrastructure Emission Factor	35.37%
Infrastructure Emission Factor	35.37%
Settlements Emission Factor	35.37%
Fire-Biomass burning Emission Factor	35.37%
Logging Damage Factor	0.29%
Wood Density of timber harvested Emission Factor	0.01%
LIF (Skid Trails)	5.87%
Gross PAI of aboveground carbon	48.72%

Emissions from Biomass Burning (3C1)

In this category, the CH_4 and N_2O emissions associated to biomass burning are estimated. It occurs in both cropland and forestland in Guyana. Burning of sugarcane and rice residues is common in Guyana and was considered for the calculation, as they represent the most important crops of the country. The rest of the crop biomass burning was not considered due to lack of data. On the other hand, CH_4 and N_2O emissions associated to biomass combustion due to wildfires was also calculated in this section. Therefore, while CO_2 emissions from biomass burning are included in the category Land 3B, the non-CO_2 emissions are included in the section 3C1.

For both cropland and forestland, the Tier 1 method is used for the estimation the GHG emissions (CH_4 and N_2O gases), where the area burnt is the activity data and the default values come from the 2006 IPCC Guidelines.

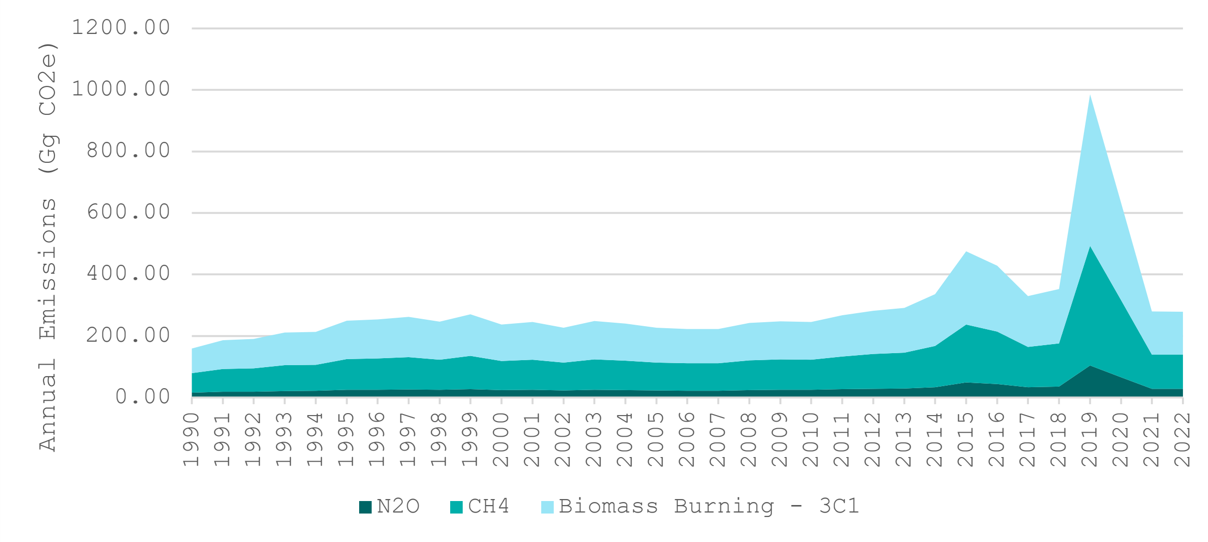

Figure 2.29. Category 3C1 GHG emissions.

Table 2.46. Summary of GHG emissions from Category 3C1 – Emissions from Biomass Burning.

	Annual Emissions in Gg CO_2e										
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Emissions from Biomass Burning – 3C1	79,42	93,04	95,16	105,43	106,78	124,90	126,96	131,35	123,18	135,35	118,78
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Emissions from Biomass Burning – 3C1	122,70	113,55	124,23	120,14	113,27	111,61	111,22	121,02	123,62	122,97	133,53
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Emissions from Biomass Burning – 3C1	141,19	145,63	168,04	237,71	214,11	164,96	176,12	492,64	316,09	140,03	139,52

Over the period 1990 to 2022, the GHG emissions in the category 3C1 – Emissions from Biomass Burning fluctuated substantially while overall showing an increase over the years that have shown a percentual increase of 75,67%. After a relatively constant growth period, the emissions fluctuated between 131,35 Gg CO_2 eq. in 1997 and 111,61 Gg CO_2 eq. in 2011 after which it, with some fluctuations increased steadily until 2016 reaching its highest value thus far of about 214,11 Gg CO_2 eq. This can be explained by a possible wildfire that caused that increase of burnt hectares. This was followed by a relatively stark drop in GHG emissions only then to almost triple from 176,12 Gg CO_2 eq. in 2018 to 492,64 Gg CO_2 eq. in 2019. Since then, however, the GHG emission rapidly declined again reaching 139,52 Gg CO_2 eq. in 2022.

Liming (3C2)

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 ($2HCO_3^-$), which evolves into CO_2 and water (H_2O).

The Tier 1 estimations for CO_2 emissions from lime addition to soils requires to know the amount of limestone and dolomite applied per year. In the case of Guyana, only the limestone applied in the sugarcane crops was considered, due to lack of data relating lime application on other crops. Default emission factors (EF) are 0.12 for limestone.

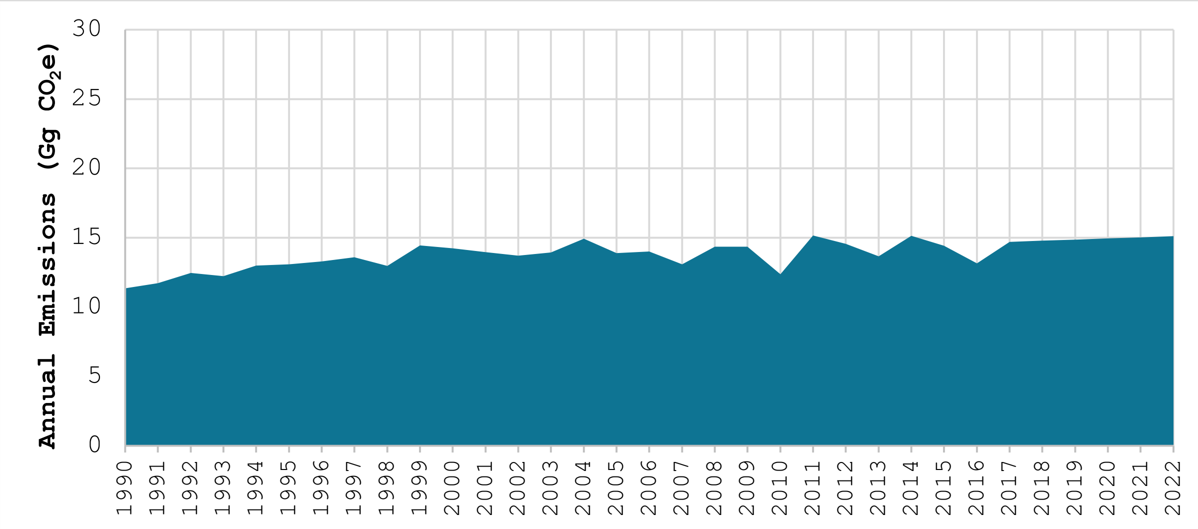

Figure 2.30. Category 3C2 GHG emissions.

Table 2.47. Summary of GHG emissions from Category 3C2 – Liming.

Annual Emissions in Gg CO_2e											
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Liming – 3C2	11,35	11,72	12,47	12,24	12,99	13,07	13,30	13,58	12,96	14,44	14,24
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Liming – 3C2	13,96	13,71	13,93	14,94	13,89	14,01	13,09	14,35	14,34	12,37	15,17
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Liming – 3C2	14,55	13,65	15,14	14,43	13,16	14,71	14,79	14,87	14,95	15,03	15,11

Category 3C2 – Liming only considers the lime applied to the sugarcane crops and that fact contributes to the minor emissions impact of this category in Guyana. The emissions trend reveals a slight increase over the period 1990 to 2022, with minor fluctuations marking in particular the period from 2004 to 2016. However, the relative differences in the GHG emissions over the years are small with the minimum being reported at 11,35 Gg CO_2 eq. in

1990, the maximum of 15,14 Gg CO_2 eq. in 2014 and with the most recent level estimated at around 15,11 Gg CO_2 eq. in 2022.

Urea application (3C3)

Urea is a form of nitrogen fertilizer used in agriculture that can cause CO_2 emissions when applied to the soil. During the manufacturing process of urea, CO_2 is removed from the atmosphere. This CO_2 is accounted for in the IPPU sector. Therefore, the emissions resulting from urea application are included in the emissions of the AFOLU sector. After the application of urea (CO(CH2)2) is converted to ammonium (NH4+), which is the fertilizing chemical, hydroxyl ion (OH-) and bicarbonate (HCO3-). Following soil chemical reactions, bicarbonate evolves into CO_2 and water.

The Tier 1 estimations for CO_2 emissions from urea requires to know the amount of urea fertilizer applied per year. Data on imported urea in Guyana was available from the Guyana Authority Revenue (GRA) for the period 2020-2022 of the inventory. Surrogate data from FAOSTAT was used to complete the time series back until 1990. For urea, the default emission factor estimates that 0.2 ton of carbon are lost as CO_2 emissions per ton of urea applied.

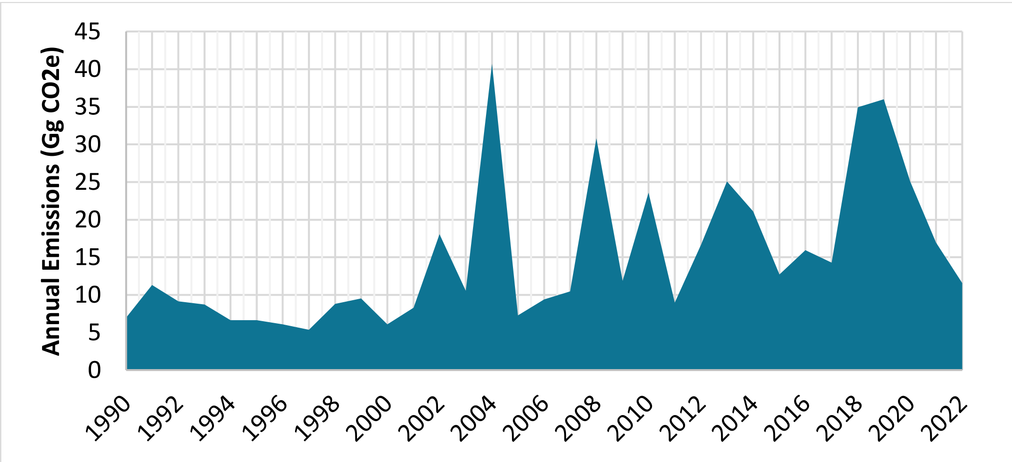

Figure 2.31. Category 3C3 GHG emissions.

Table 2.48. Summary of GHG emissions from Category 3C3 – Urea Application.

Annual Emissions in Gg CO_2e											
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Urea Application – 3C3	6,98	11,34	9,16	8,72	6,63	6,63	6,11	5,39	8,81	9,54	6,10
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Urea Application – 3C3	8,29	18,06	10,54	40,72	7,30	9,42	10,46	30,84	11,87	23,62	9,00
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Urea Application – 3C3	16,67	25,07	21,08	12,70	15,95	14,29	34,93	35,99	25,12	16,97	11,56

With levels estimated at 11,56 Gg CO_2 in 2022, the GHG emissions for category 3C3 – Urea Application currently represent a small fraction of Guyana´s GHG inventory. Nevertheless, the pattern over the time period 1990 to 2022 is marked by strong peaks and equally stark drops in GHG emissions as observed in 2004 where emissions rose by about 400% to 40,72 Gg CO_2 eq. compared to the previous year and after which a decrease to 7,30 Gg CO_2 is observed. Similar, albeit slightly less pronounced fluctuations, are again observed for the years 2008, 2010, and 2018 each marking a peak compared to the respective previous and subsequent years. While the emissions in 2022, are estimated at about 11 CO_2 eq. in 2019 they had been at almost 36 Gg CO_2.

The inconsistency in the observed trend can be attributed to the absence of national data on urea application in crops before the year 2020. To address this, there is a need to supplement the data by relying on international sources for fertilizer imports. Establishing a consistent and continuous collection of data on urea application or fertilizer imports at the national level is crucial. This proactive approach will contribute to minimizing significant fluctuations in emissions from this category in future inventories, ensuring more accurate and reliable assessments.

Direct N_2O Emissions from Managed Soils (3C4)

In most soils, the addition of nitrogen enhances the two processes responsible for N_2O emissions: nitrification and denitrification. The addition of nitrogen can come from several sources. The IPCC methodology includes the following:

- synthetic N fertilisers (F_{SN});
- organic N applied as fertiliser (e.g., animal manure, compost, sewage sludge, rendering waste) (F_{ON});
- urine and dung N deposited on pasture, range and paddock by grazing animals (F_{PRP});
- N in crop residues (above-ground and below-ground), including from N-fixing crops and from forages during pasture renewal (F_{CR});
- N mineralisation associated with loss of soil organic matter resulting from change of land use or management of mineral soils (F_{SOM});
- drainage/management of organic soils (F_{OS}).

In the case of Guyana, the Tier 1 methodology was used first to estimate the factors cited above (except the factors related to organic soils (F_{SOM} & F_{OS}), given the absence of data for that management system). The organic N applied as fertilizer (F_{ON}) was equivalent in this case to the amount of animal manure N applied to soils (F_{AM}), given the absence of data on total sewage N and total compost N applied to soils. The total direct N_2O emissions is the sum of emissions produced from nitrogen inputs and from urine and dung inputs to grazed soils.

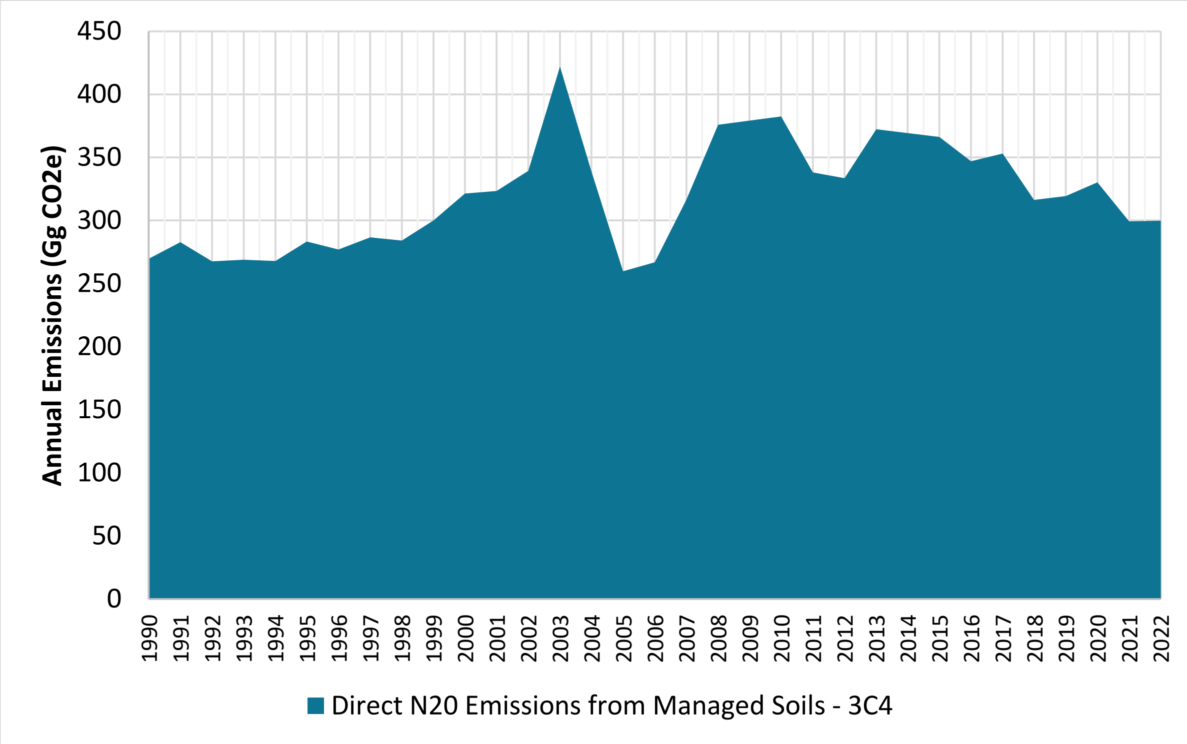

Figure 2.32. Category 3C4 GHG emissions.

Table 2.49. Summary of GHG emissions from Category 3C4 – Direct N2O Emissions from Managed Soils.

Annual Emissions in Gg CO_2e											
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Direct N2O Emissions from Managed Soils – 3C4	269,75	282,97	267,59	268,99	267,78	283,31	277,09	286,75	284,06	300,14	321,30
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Direct N2O Emissions from Managed Soils – 3C4	323,38	339,39	422,12	339,19	259,67	266,99	316,62	375,87	379,24	382,59	338,24
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Direct N2O Emissions from Managed Soils – 3C4	333,49	372,37	369,26	366,14	346,99	353,06	316,37	319,31	330,24	299,45	299,92

Over the period 1990 to 2003, GHG emissions in category 3C4 – Direct N20 Emissions from Managed Soils were increasing steadily with minor fluctuations until reaching its peak in 2003 with emissions estimated at 422,12 Gg CO_2 eq. Following this peak, emissions generally showed higher levels than in the pre 2000s period, but, with fluctuating levels between the years, are showing an overall decreasing trend since 2013. This category constitutes a relevant source of N20 emissions for the AFOLU sector.

Indirect N_2O Emissions from Managed Soils (3C5)

There are two paths for indirect emissions of N_2O from managed soils:

1. Following **volatilisation** of NH_3 and NOx from managed soils and from fossil fuel combustion and biomass burning, and the subsequent re-deposition of these gases and their products NH_4+ and NO_3- to soils and waters; and

2. After **leaching and runoff** of nitrogen from managed soils. The nitrification and denitrification processes transform some of the NH_4 + and NO_3 - to N_2O.

For Guyana, the estimations followed the Tier 1 methodology, in addition to the default emission factors provided from the 2006 IPPC Guidelines. The N sources of indirect N_2O emissions from managed soils are the same as for Category 3C4.

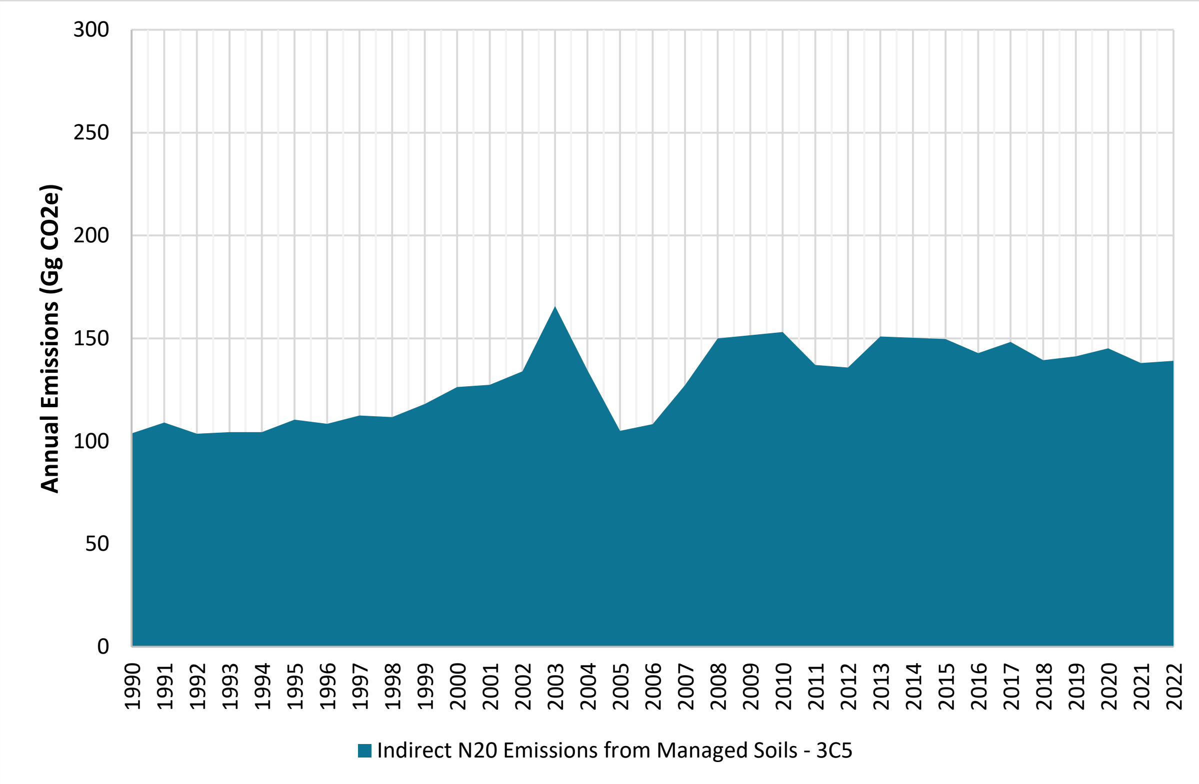

Figure 2.33. Category 3C5 GHG emissions.

Table 2.50. Summary of GHG emissions from Category 3C5 – Indirect N2O Emissions from Managed Soils.

Annual Emissions in Gg CO_2e											
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Indirect N2O Emissions from Managed Soils – 3C5	103,71	108,97	103,54	104,43	104,30	110,41	108,41	112,39	111,65	118,00	126,31
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Indirect N2O Emissions from Managed Soils – 3C5	127,45	133,87	165,57	134,49	105,03	108,25	127,27	149,88	151,52	153,11	137,05
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Indirect N2O Emissions from Managed Soils – 3C5	135,78	150,86	150,22	149,55	142,71	148,16	139,40	141,25	145,10	137,95	139,06

GHG emissions in Category 3C5 – Indirect N2O Emissions from Managed Soils hovered between the minimum 103,71 Gg CO_2 eq. in 1990 and the maximum of 165,57 Gg CO_2 eq. in 2003 over the course of the assessment period. The annual trends from the period 1990 to 2002 reveal a relatively steady increase until a stark rise in 2003, after which emissions dropped almost to 1990 levels in 2005. Between 2005 and 2022, the GHG emissions are estimated as relatively steady with somewhat stronger fluctuations observed between 2009 and 2013. In 2022, GHG emissions reached a level of 139,06 Gg CO_2 eq.

Indirect N_2O Emissions from Manure Management (3C6)

In addition to the emissions from manure management treated above, nitrogen losses can occur indirectly, primarily in the form of ammonia and NOx. During manure collection and storage, a fraction of excreted organic nitrogen is mineralized to ammonia nitrogen. The quantity depends on the time of storage and to a lesser degree on temperature. Ammonia nitrogen is however very volatile, meaning it easily diffuses in the air. This process, called volatilization, is the first cause of indirect N_2O emissions. The second process, through leaching or run-off, occurs when nitrogen is transported outside of the manure management system.

In the case of Guyana, the Tier 1 method was used for the calculation of N volatilisation in forms of NH3 and NOx from manure management systems. It is based on multiplication of the amount of nitrogen excreted (from all livestock categories) and managed in each manure management system by a fraction of volatilised nitrogen from the 2019 Refinement of the 2006 IPCC Guidelines. N losses are then summed over all manure management systems.

The Tier 1 calculation of N leached and runoff from manure management systems is based on multiplication of the amount of nitrogen excreted (from all livestock categories) and managed in each manure management system by a fraction of nitrogen leached, in analogy to the approach to estimate nitrogen volatilisation.

The Tier 1 method is applied using default nitrogen excretion data, default manure management system data and default fractions of N losses from manure management systems due to volatilisation from the 2019 Refinement of the 2006 IPCC Guidelines.

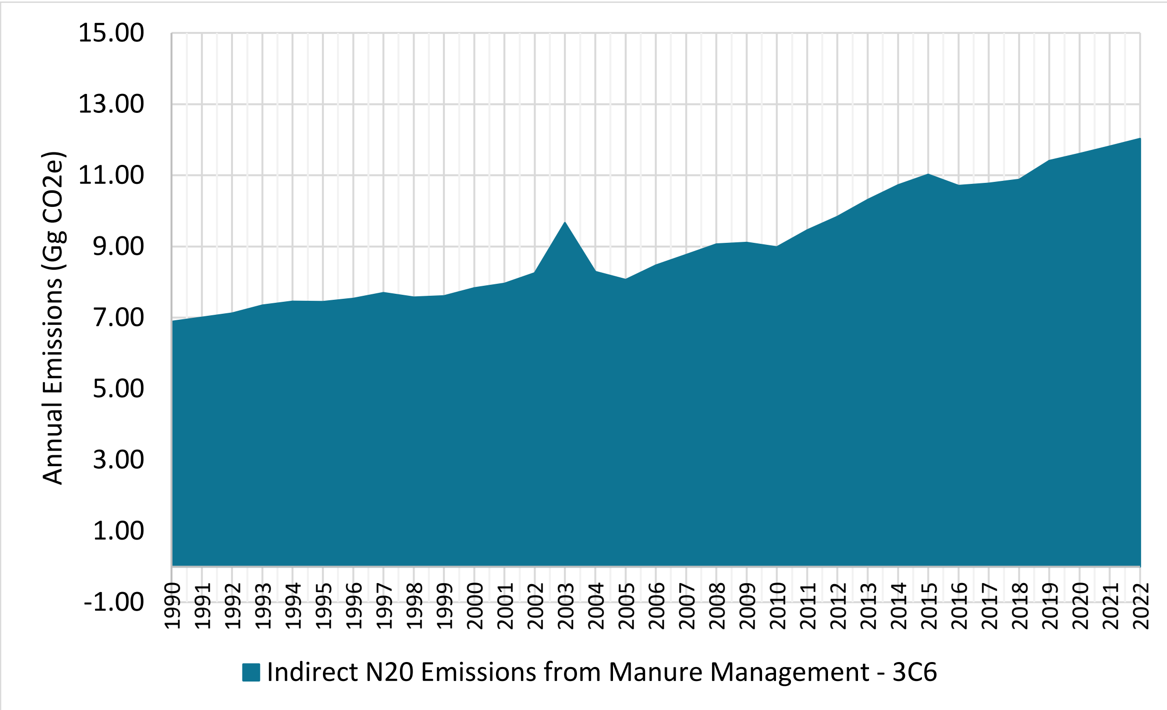

Figure 2.34. Category 3C6 GHG emissions.

Table 2.51. Summary of GHG emissions from Category 3C6 – Indirect N2O Emissions from Manure Management.

	Annual Emissions in Gg CO_2e										
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Indirect N2O Emissions from Manure Management – 3C6	6,89	7,00	7,12	7,35	7,45	7,44	7,54	7,70	7,56	7,60	7,83
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Indirect N2O Emissions from Manure Management – 3C6	7,95	8,25	9,66	8,29	8,07	8,47	8,77	9,06	9,11	8,98	9,46
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Indirect N2O Emissions from Manure Management – 3C6	9,83	10,31	10,73	11,02	10,71	10,77	10,88	11,41	11,61	11,81	12,02

The emissions associated to the Category 3C6 - Indirect N_2O Emissions from Manure Management represent a minimal fraction of Guyana´s GHG inventory. The trends observed from 1990 to 2002 indicate a generally consistent upward trajectory, marked by a significant surge in 2003, followed by a more moderate increase in 2005. Remarkably, the values have doubled from 1990 to 2022, underscoring a substantial overall growth.

Rice cultivations (3C7)

Rice production in different ecosystems can produce CH_4 emissions at varied levels depending on flooded soil environment and agricultural practices. The emissions are caused by anaerobic decomposition of organic material in flooded rice fields which escape to the atmosphere by transport through the rice plants. Those cultivated in lowland have the higher potential to produce CH_4 because of the aerobic condition created by intermittent inundation of the rice field. The determining factors of CH_4 emission in upland rice system or under irrigation are the slope and the dwell time of available water to the rice.

Therefore, the potential of CH_4 emissions from rice cultivation is influenced by the fraction of the total rice cultivation areas under rain fed, irrigation and upland, the prevailing management practices which include the number and duration of crops grown, water regimes before and during cultivation period, and organic and inorganic soil amendments and the environmental conditions such as soil type and temperature.

The Tier 1 methodology was deployed for estimating CH_4 emissions from rice in Guyana, and the default parameters provided in Chapter 5 of the AFOLU sector dedicated to Cropland. The water cultivation of rice was obtained from the Guyana Rice Development Board (GRDB), it follows mainly an irrigated regime with two cultivation seasons of 80-85 days per year.

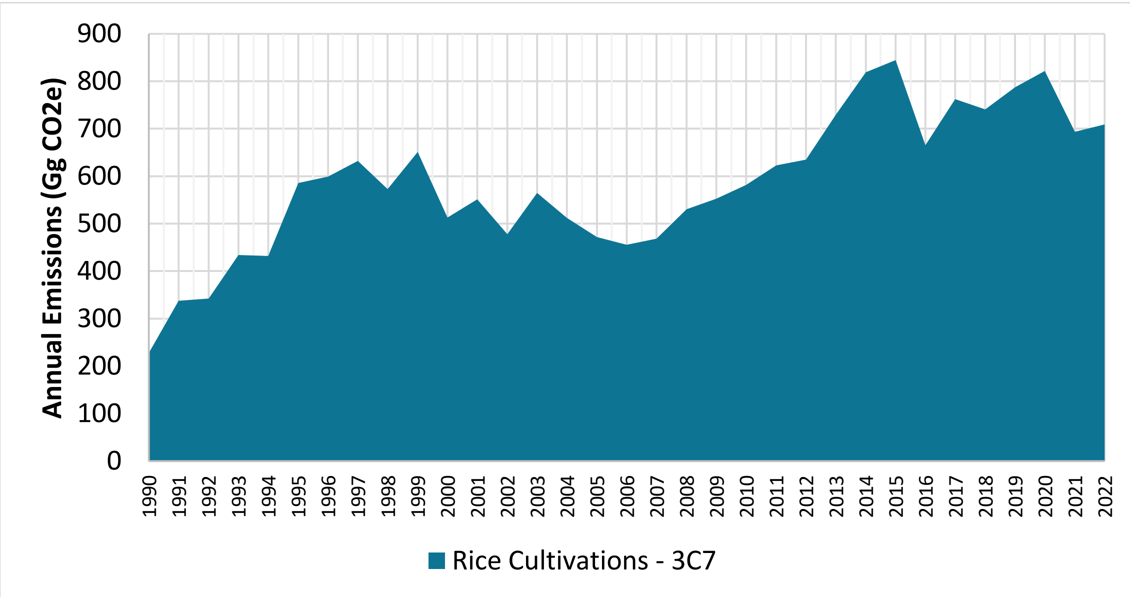

Figure 2.35. Category 3C7 GHG emissions.

Table 2.52. Summary of GHG emissions from Category 3C7 – Rice Cultivations.

	Annual Emissions in Gg CO_2e										
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Rice Cultivations – 3C7	227,31	337,23	342,18	433,93	432,15	585,63	599,32	631,82	572,91	650,80	512,74
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Rice Cultivations – 3C7	551,21	477,48	564,92	512,17	471,91	455,49	468,46	530,09	552,34	581,51	622,49
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Rice Cultivations – 3C7	634,50	729,29	818,73	844,26	664,84	762,24	740,58	786,83	821,75	693,35	708,62

The GHG emissions from Category 3C7 – Rice Cultivations constitute the largest source of CH_2 emissions in the AFOLU sector and emissions have increased by 212% between 1990 and 2022. The increase has been marked by a steady growth of emissions from 227,31 Gg CO_2 eq. in 1990 to 650,80 Gg CO_2 eq. in 1999 after which a significant drop was observed in 2000. The emissions only reached the 1999 levels again in 2013 and have since then fluctuated, growing to its maximum level of 844,26 Gg CO_2 in 2015 and reaching about 708,62 Gg CO_2 eq. in 2022.

Table 2.53. Uncertainty in GHG Emissions from Category 3C – Aggregated sources and non-CO_2 sources from land.

Parameter	Uncertainty
Fuel biomass consumption value for fires (N_2O & CH_4)	141%
Emission factor for dry matter burnt	116%
Global Warming Potential (N_2O & CH_4)	71%
Emission factor for liming	-50%
Emission factor for urea	-50%
EF_1 for N additions from mineral fertilisers, organic amendments and crop residues, and N mineralised from mineral soil as a result of loss of soil carbon	80%
EF_{1FR} for flooded rice fields	363%
$EF_{3PRP, CPP}$ for cattle (dairy, non-dairy and buffalo), poultry and pigs	175%
$EF_{3PRP, SO}$ for sheep and 'other animals'	167%
Default values for N excretion rate (N_{rate})	50%
Default values for live weights for animal categories (TAM)	30%
Emission factor N volatilisation and re-deposition (EF_4)	21%
Emission factor N leaching/runoff (EF_5)	91%
Emission factor for the category 3C7	39%
Default CH4 emission scaling factors for water regimes during the cultivation period relative to continuously flooded fields	28%
Default CH4 emission scaling factors for water regimes before the cultivation period	12%
Default conversion factor for type of organic amendment	16%

6.4. Waste

6.4.1. Description of Sector

The waste sector of Guyana encompasses all GHG emissions arising from the treatment and disposal of both solid wastes and liquid wastes in the country. The waste sector of Guyana has undergone a transformational change over the past five decades and continues evolving towards the attainment of national long-term sustainable and low-carbon development goals as stipulated in the National Solid Waste Management Strategy.

Solid Waste

Solid waste management in Guyana is an important source of CH_4 emissions from the anaerobic decomposition of organic matter at solid waste disposal sites (SWDS). Combustion of all types of waste is also a significant source of CH_4 and N_2O emissions, in addition to CO_2 from the combustion of fossil-based (non-biogenic) waste fractions.

There are three main types of waste generated and treated in Guyana, namely municipal solid waste (MSW), industrial and hazardous waste, and healthcare waste. Due to limited information on industrial, hazardous, and healthcare waste generation, composition, and disposal practices in the country, the present edition of the GHG inventory of Guyana only accounts for MSW.

Municipal solid waste is defined as all waste that is typically collected by local authorities generated from households, commercial institutions, public institutions, as well as green (garden/park) waste, and wastes from construction and demolitions sites. According to the Guyana Solid Waste Management Strategy [20], the MSW generation rates in Guyana varies by region, depending on the share of urban and rural population and the presence of waste from commerce and institutions. For regions 1, 3, 5, 7, 8, and 9, household waste generation rates up to 2010 were estimated at 0.5 kg/person/day and expected to gradually increase to 0.59 kg/person/day by 2024. For regions 2, 4, 6, and 10, the household and commercial waste generation rates up to 2010 were estimated at 0.73 kg/person/day and 0.71 kg/person/day, expected to gradually increase to 0.86 kg/person/day and 0.84 kg/person/day by 2024, respectively.

A comprehensive study was conducted in 2010 by Hydropal-CEMCO Inc. on the MSW composition for Georgetown [21], whereby half of the total waste generated is comprised of food waste, 10% comprised of paper and cardboard, and 25% comprised of plastics and insert wastes, as detailed in Figure 2.36. Such waste distribution was adopted throughout the time series for the entire country, in absence of additional reliable data.

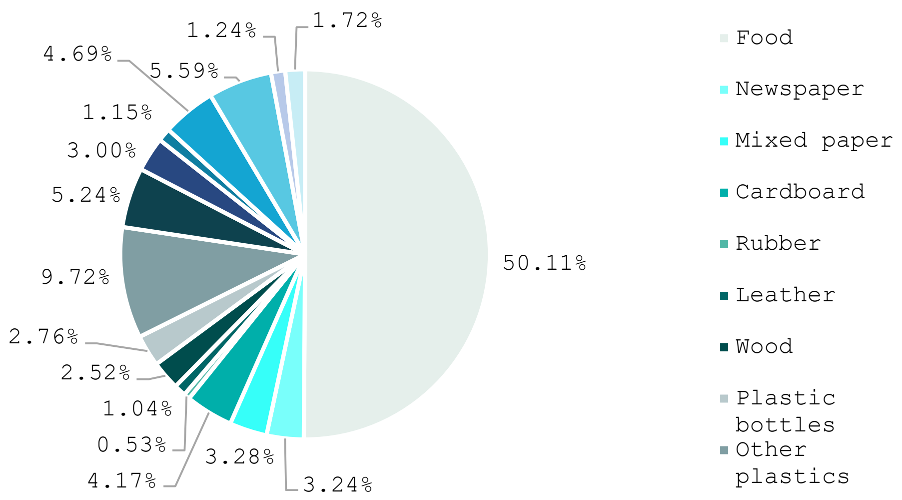

Figure 2.36. Municipal solid waste composition in Georgetown in 2010 [21].

The main MSW disposal methods in Guyana are sanitary landfilling, controlled dumping, open dumping, and open burning.

Approximately 83% of all MSW is deposited at solid waste disposal sites (SWDS). Until 2011, approximately 60% of SWDS were considered controlled dumps with organized waste disposition, compacting and soil coverage at various development conditions. The remaining 40% were considered open dumps, whereby open burning may be observed on particular instances, particularly in rural areas, as per the IPCC default. Efforts are being made to enforce existing legislation marking the illegality of such activities and several ongoing nationwide anti-littler and clean-up campaigns. Due to a lack of information on particular operating conditions at controlled and open dumps, these were classified as "uncategorized SWDS" with a methane correction factor (MCF) of 0.6 as per the IPCC definition. The Haags Bosch Sanitary Landfill was commissioned in 2011 at Eccles in Region 4, covering an area of 50 hectares with a waste fill area of 26 hectares. With an expected lifetime of 25 years, operating conditions at the Haags Bosch landfill are classified at "managed anaerobic SWDS" as per the IPCC definition, featuring waste compaction, application of daily and intermediate soil cover, and leachate treatment, for a methane correction factor (MCF) of 1.0. No CH_4 recovery or flaring takes place at the site. Since commissioning in 2011, the landfill maintains detailed records [37] of waste quantities and composition deposited on a monthly basis, including institutional, industrial, commercial, healthcare, household, and construction and demolition wastes. The amount of waste received at the landfill has significantly increased since commissioning, whereby MSW represents approximately 60% of the total quantity of waste deposited at the site. Upon commissioning in 2011, the site received an approximate 350 tonnes of waste on a daily basis, increasing to over 600 tonnes by 2019 and 750 tonnes by 2023. In all instances, it is assumed no oxidation takes place in soil layers as per the IPCC default. It is worth noting that Guyana is conducting ongoing efforts over the past several years to rehabilitate open dumps and expand access to waste collection services.

An approximate 13% of all MSW is directly opened burned in Guyana, particularly in rural communities according to recent evaluation of waste dynamics at the local level [22].

The remaining 4% of MSW is either recycled, composted, or treated under unspecified methods at pilot or local scales seeking to commercialize or being large-scale deployment across the country, as envisioned by the Guyana Solid Waste Management Strategy [20]. Due to a lack of information on these practices, associated emissions have not been included in the present edition of the Guyana GHG inventory. Some of these ongoing activities include:

- Beverage bottle return programme by Banks DIH.
- Cardboard recycling programme by Caribbean Container Incorporated treating approximately 51% of the total cardboard waste generated in Georgetown.
- Scrap metal recycling coordinated through the Guyana Recycler´s Association.
- Pilot-scale recycling programmes by the Institute of Applied Science and Technology for plastics and sawdust, conversion of vegetable and animal waste into biodiesel and biogas, and processing used tyres for alternate pavement manufacturing.
- Pilot-scale composting programmes for homes, schools, and communities.

Figures 2.37 and 2.38 summarize the MSW management streams for Guyana before and after the commissioning of the Haags Bosch landfill in 2011.

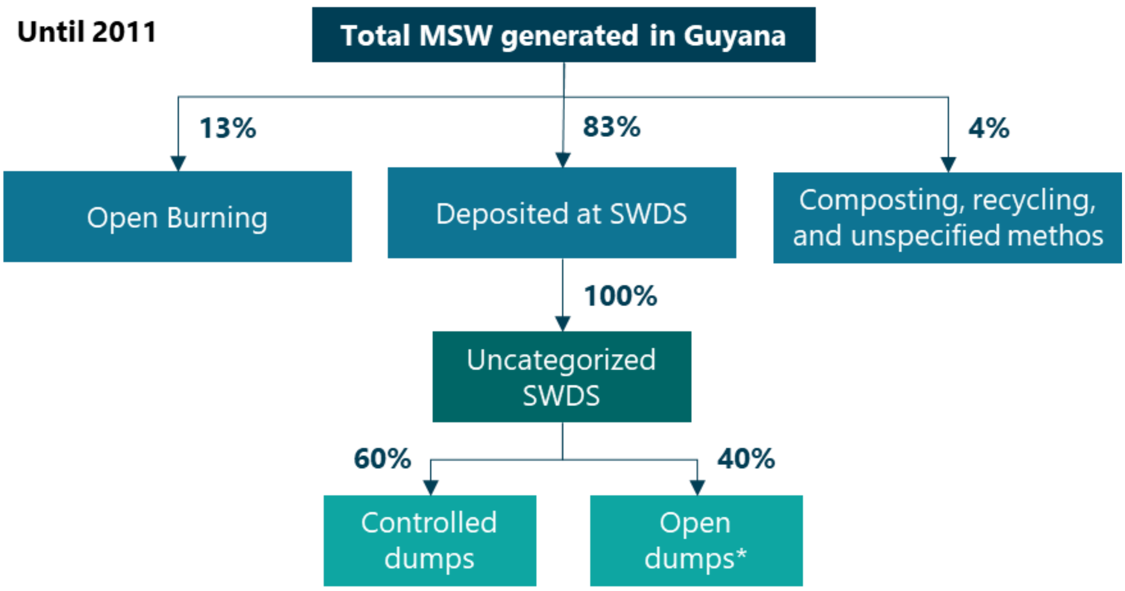

*Figure 2.37. MSW treatment systems in Guyana until commissioning of Haags Bosch Landfill in 2011. *Assuming sporadic occurrences of open burning at open dumps as per IPCC default.*

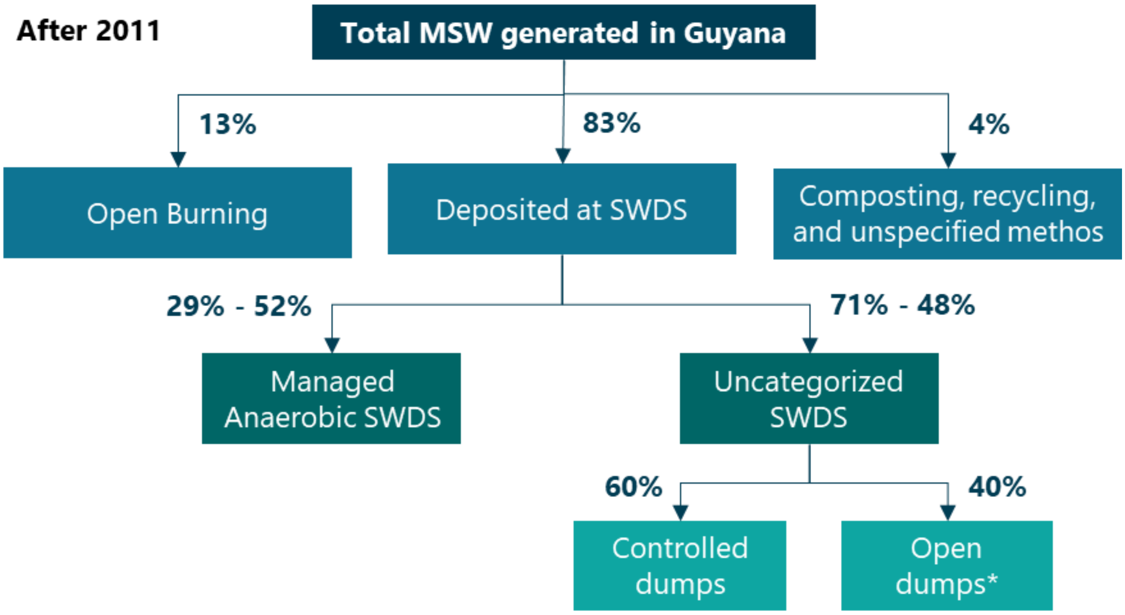

*Figure 2.38. MSW treatment systems in Guyana following commissioning of Haags Bosch Landfill in 2011. *Assuming sporadic occurrences of open burning at open dumps as per IPCC default.*

CH_4 emissions from MSW decomposition at SWDS were estimated using the IPCC First Order Decay (FOD) model implementing the above country-specific activity data for a complete historic time series starting in the year 1950. Default IPCC parameters were adopted in terms of degradable organic carbon (DOC), fraction of DOC dissimilated (DOCf), and CH_4 generation rate constant (k) for each waste component, as summarized in Table 2.54. The default 6-month delay time, 50% fraction of CH_4 in developed biogas, and tropical wat & moist climate zone were also adopted.

Table 2.54. Default IPCC waste characteristics parameters applied in the FOD model.

Waste component	Degradable organic carbon (DOC)	Fraction of DOC dissimilated (DOCf)	Methane generation rate constant (k)
Food	0.15	0.5	0.40
Garden	0.20	0.5	0.17
Paper	0.40	0.5	0.07
Wood	0.43	0.5	0.035
Textiles	0.24	0.5	0.07
Nappies	0.24	0.5	0.17
Plastic & Inerts	NA	NA	NA
Source	2006 IPCC Guidelines	2019 IPCC Refinement	2019 IPCC Refinement

CO_2 emissions from open burning of MSW were estimated using2006 IPCC default values of dry matter content, carbon fraction in dry matter, and fossil carbon fraction in total carbon as summarized Table 2.55, in addition to a default oxidation factor of 0.71 from the 2019 IPCC Refinement. A default CH_4 emission factor of 0.0065 kg CH_4/ kg MSW wet basis and N_2O emission factor of 0.00015 kg N_2O/ kg MSW dry basis were adopted.

Table 2.55. Default IPCC waste characteristics parameters applied for estimating emissions from open burning of waste.

Waste component	Dry matter content (dm)	Carbon fraction in dry matter (CF)	Fossil carbon fraction in total carbon (FCF)
Food	0.40	0.38	0.00
Paper	0.90	0.46	0.01
Wood	0.85	0.50	0.00
Textile	0.80	0.50	0.20
Nappies	0.40	0.70	0.10
Rubber & Leather	0.84	0.67	0.20
Plastics	1.00	0.75	1.00
Metal	1.00	NA	NA
Glass	1.00	NA	NA
Other Inert	0.90	0.03	1.00
Source	2006 IPCC Guidelines	2006 IPCC Guidelines	2006 IPCC Guidelines

Industrial and hazardous waste is defined as all waste that is generated by industrial facilities and disposed of together or separately with MSW at open and controlled dumps throughout the country. There is limited, incomplete, and outdated information available on industrial waste generation and treatment in Guyana, and as such, associated emissions have not been estimated in the present edition of the GHG inventory. A hazardous waste inventory was conducted in 2007 by the Caribbean Environmental Health Institute [38] on selected industrial sectors, excluding mining, revelling annual generation of 317 tonnes of waste oils and hydrocarbon mixtures and emulsions, 180 tonnes of organic solvent by-products, and 0.53 tonnes of acidic solutions or solids. Another study [39] for some sectors was conducted for Region 4 in 2010 revealed an annual 515 tonnes of industrial solid waste and 494 tonnes of semi-solid hazardous waste. However, it is believed actual generation rates may be higher as these surveys did not capture all sectors and economic activity in the country has since significantly expanded.

Healthcare waste is defined as waste generated from healthcare facilities, comprised of approximately 80% non-hazardous components similar to MSW and 20% hazardous components including infectious and pathological waste (15%), sharps (1%), chemicals, and pharmaceuticals (3%), and genotoxic and radioactive fractions (1%) [40].

More information is needed on healthcare waste generation and treatment in Guyana, and as such, associated emissions have not been estimated in the present GHG inventory edition. For planning purposes, the World Health Organization [40] suggests that low-income countries generate between 0.2 and 0.8 kg of hazardous waste per hospital bed per day. According to the Guyana Bureau of Statistics [41], there are a total 1,932 hospital beds in the country, translating to an estimated 141-564 tonnes of healthcare waste generated on an annual basis.

Liquid Waste

Wastewater treatment and discharge in Guyana is an important source of CH_4 emissions from the anaerobic decomposition of organic matter in wastewater (sewage), as well as N_2O emissions from the subsequent nitrification and denitrification of nitrogen in effluent released to rivers and estuaries attributed to dietary protein consumption.

The governance of water resources is guided by the Water and Sewerage Act 2002, and primarily managed by Guyana Water Incorporated (GWI). Currently, investment in water and sanitation is based on the guidance of the Water and Sanitation Sector Strategic Plan 2017 – 2021.

There are three main types of domestic wastewater treatment and discharge pathways in Guyana, namely sewerage systems, septic systems, and latrines, whereby no CH_4 recovery or flaring takes place.

The current sewerage system in Guyana covers only a limited proportion of the population in Georgetown, with the collected wastewater directly released into the ocean environment at sewage outfalls at a default IPCC methane correction factor (MCF) of 0.11. The remainder of the population utilizes on-site decentralized treatment systems such as septic tanks (default MCF of 0.50) and latrines (default MCF of 0.70). Sanitation methods have substantially improved over the past three decades, with a significant proportion of the population upgrading from pit latrines to septic sewage systems as illustrated in Figure 2.39.

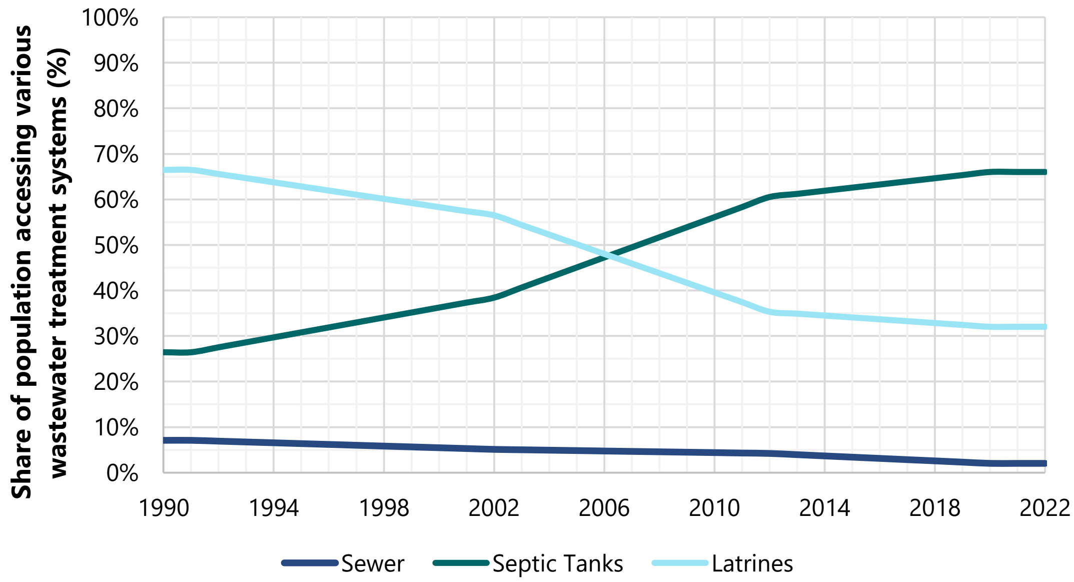

Figure 2.39. Sare of population accessing various wastewater treatment systems in Guyana, extracted from the Guyana Bureau of Statistics 2002 and 2012 census [19, 17], and the Guyana Country Estimate report for SDG6 Monitoring [23].

Both GWI and the Puran Brothers conduct sludge collection services from septic systems throughout the country, to be deposited at SWDS, treated separately, or applied to agricultural fields as soil amendment. However, records of sludge collection rates and application methods are extremely limited and have only become scarcely available since 2017. As such, the present edition of the Guyana GHG emission inventory does not account for sludge removal as per the IPCC default.

Accurate records on wastewater characteristics, in terms of Biochemical Oxygen Demand (BOD), are also limited for which the default IPCC value of 40 g/person/day for the Latin America Region has been adopted. The IPCC default maximum CH_4 producing capacity (Bo) of 0.6 kg CH_4/kg BOD has also been adopted.

Information on industrial wastewater generation and treatment is more notably scarce, for which associated emission have not been estimated in the present edition of the Guyana GHG inventory. However, the potential disposal industrial wastewater into domestic treatment systems has been accounted for through the IPCC default correction factor for additional industrial BOD discharged into domestic systems (I) of 1.25 for sewerage systems and 1.0 for septic systems and latrines.

According to FAO statistics [24, 25], the dietary protein supply in Guyana steadily increased between 1990 and 2022 from 66 to 108 g/person/day. Using the 2019 IPCC default correction factor for protein consumption as a fraction of protein supply for the Latin American Region of 0.92, this is translated to a dietary protein consumption of 22 g/person/day in 1990, increased to 36 g/person/day by 2022. Default parameters from the 2019 IPCC Refinement were adopted to estimate associated N_2O emissions from effluent, including:

- Additional nitrogen from household chemicals, N_{HH} = 1.1
- Factor for non-consumed protein added to the wastewater, $F_{NON\text{-}CON}$ =1.04
- Factor for industrial and commercial co-discharged protein, $F_{IND\text{-}COM}$ = 1.25 for sewerage and 1.0 for septic systems and latrines.
- Fraction of N removed by treatment system (N_{REM}) = 0 for sewerage and direct ocean disposal, 0.15 for septic systems, and 0.12 for latrines
- EF effluent = 0.005 kg N_2O-N/kg N

6.4.2. Coverage of Sector

Figure 2.40 illustrates the coverage of the Guyana waste sector GHG emissions inventory.

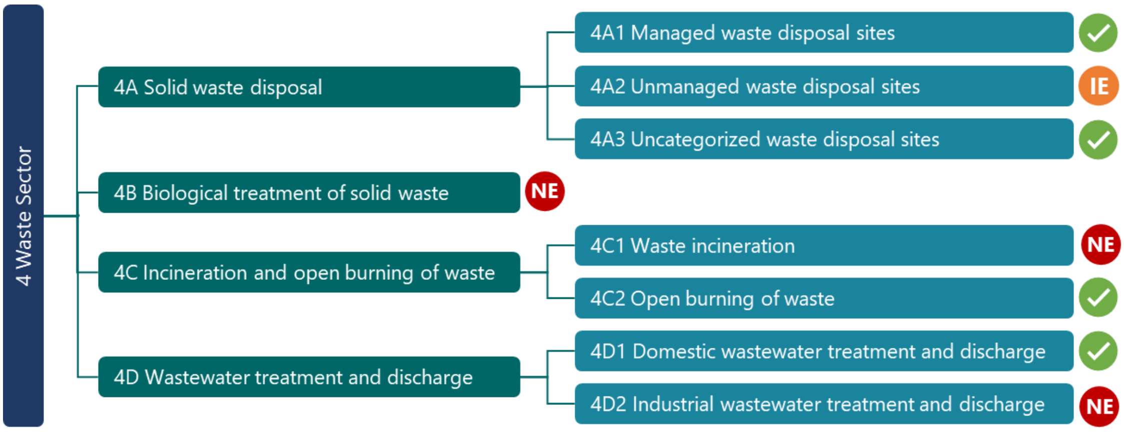

Figure 2.40. Coverage of the Guyana Waste sector GHG emissions inventory. NE – not Estimated; NO – not occurring; IE – included elsewhere; NA – not applicable.

Category 4A - Solid Waste Disposal covers the CH_4 emissions from the anaerobic decomposition of degradable fractions of municipal solid waste (MSW). **Category 4A1 – Managed Solid Waste Disposal Sites** covers includes emissions from the Haags Bosch Landfill operating since 2011. **Category 4A3 – Uncategorized Solid Waste Disposal Sites** covers emissions from Guyana´s controlled and open dumps, which were unable to be classified as per IPCC definitions due to limited information of the site´s operating conditions.

While small-scale composting initiatives exist throughout Guyana, associated emissions under **Category 4B - Biological Treatment of Solid Waste** were not estimated due to a significant lack of reliable data.

Category 4C - Incineration and Open Burning of Waste covers the CH_4, N_2O, and non-biogenic CO_2, emissions from open burning of waste directly taking place throughout the country, as well as the sporadic instances of open burning possibly occurring in Guyana´s open dumps, under **Category 4C2.** While incineration of healthcare waste occurs to a limited degree across Guyana´s healthcare facilities, associated emissions under **Category 4C1** were not estimated due to a lack of data.

Category 4D - Wastewater Treatment and Discharge covers the CH_4 emissions from domestic wastewater and discharge and N_2O emissions from the decomposition of nitrogen compounds in effluent under **Category 4D1.** **Category 4D2** was not estimated as no information is currently available on the existence of in-situ industrial wastewater treatment within industrial sites in Guyana.

6.4.3. Summary of Sector Emissions

In 2022, the waste sector represented 2.97% of total emissions in Guyana, being the third largest source of GHG emissions in the country following the energy and AFOLU sectors, as illustrated in Figure 2.41. The waste sector accounts for 10.51% of the total national CH_4 emissions, 2.13% of the total national N_2O emissions, and only 0.06% of the total national CO_2 emissions.

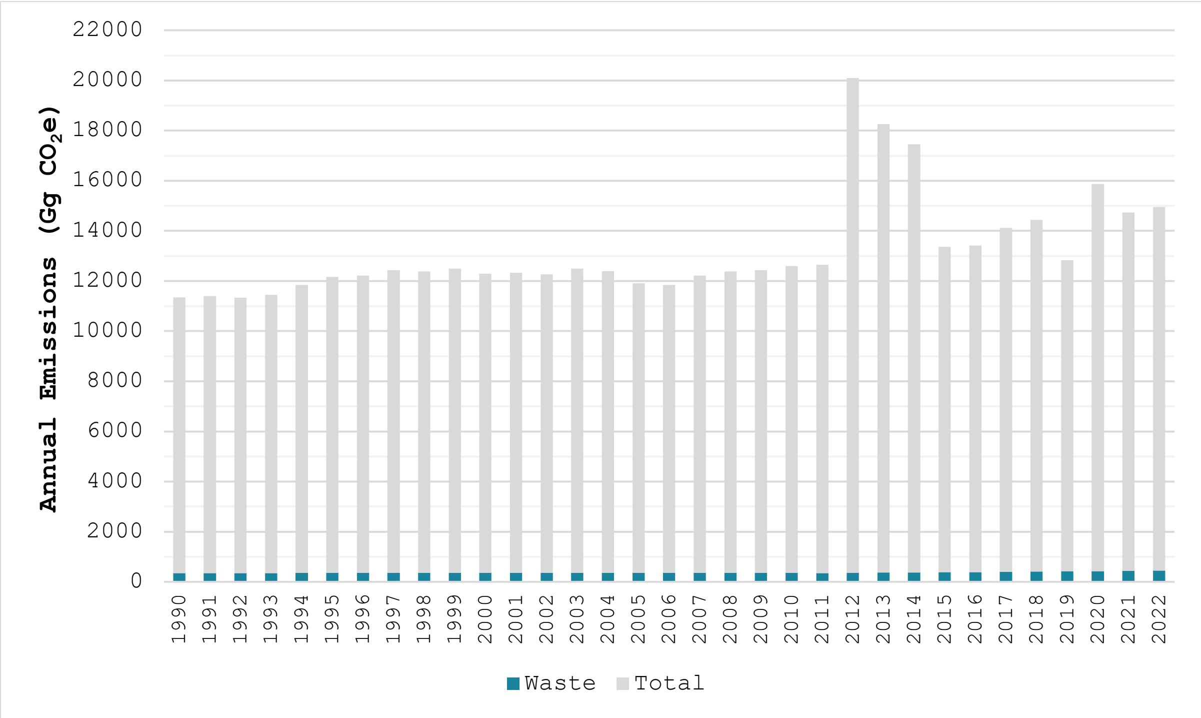

Figure 2.41. Contribution of waste sector emissions to national emission totals.

Figures 2.42 and 2.43 and Table 2.56 summarize sectoral emission trends by category and gas.

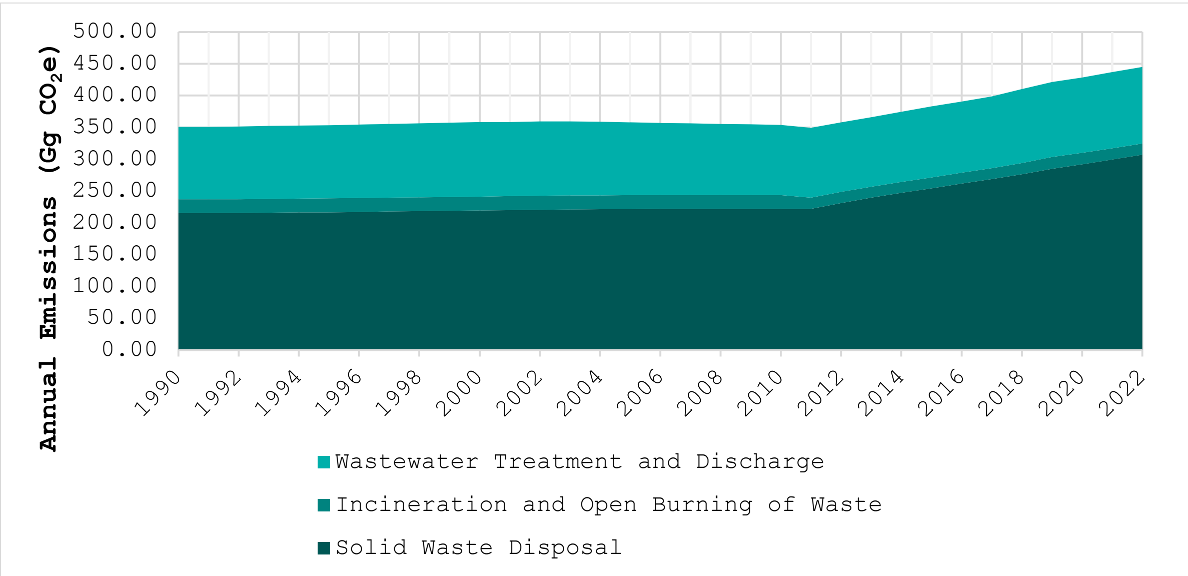

Figure 2.42. Total GHG emissions from the waste sector by category.

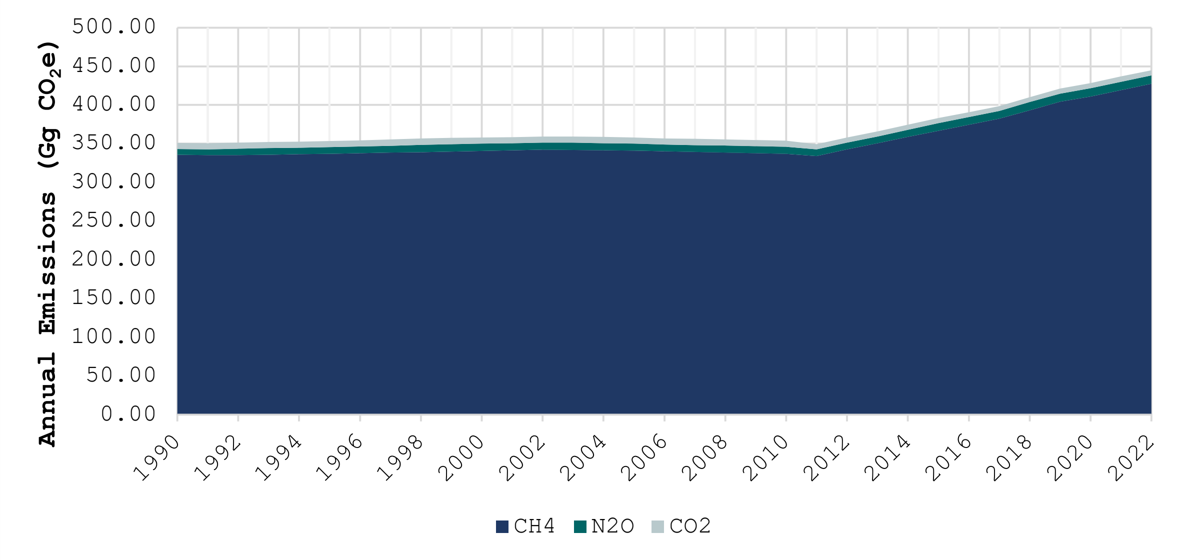

Figure 2.43. Total GHG emissions from the waste sector by gas.

Total emissions from the waste sector have increased by 26.75% from 351.04 Gg CO_2e in 1990 to 444.94 Gg CO_2e in 2022. Such increase is due to a significant increment in emissions from solid waste disposal (Category 4A) attributed to population growth, a continued increase in solid waste generation rates, and the commissioning of the Haags Bosch Landfill in 2011. While the landfill is a significant milestone for improved sanitation contributing to both environmental and human health, its anaerobic operating conditions have increased the CH_4 generation potential of waste deposited therein. In 1990, Category 4A accounted for 215.51 Gg CO_2e (61.39% of total sectoral emissions), increasing by 42.44% to 306.98 Gg CO_2e (68.99% of total sectoral emissions) by 2022.

Emissions from wastewater treatment and discharge (Category 4D) have remained fairly stable with a 5.54% growth from 113.82 Gg CO_2e in 1990 to 120.12 Gg CO_2e in 2022. However, the share of Category 4D emissions on sectoral totals has actually decreased from 32.42% in 1990 to 27.00% in 2022, attributed to improved sanitation facilities.

On the other hand, emissions from open burning of waste (Category 4C) observed a notable 17.85% reduction from 21.72 Gg CO_2e in 1990 to 17.85 Gg CO_2e by 2022, attributed to ongoing rehabilitation of open dumps and anti-litter and illegal dumping campaigns reducing the incidence of open burning in the country. As such, the contribution of Category 4C to sectoral totals have decreased from 6.19% in 1990 to 4.01% in 2022.

CH_4 remains the most important GHG in the Waste Sector. In 2022, a total of 427.28 Gg CO_2e of CH_4, 11.05 Gg CO_2e of N_2O and 6.62 Gg CO_2e of CO_2 were emitted, representing 96.03%, 2.48%, and 1.49% of total sectoral emissions, respectively.

Table 2.56. Total GHG emissions from the waste sector by category and gas.

Category	Gas	Annual emissions in Gg CO_2e															
		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
4 WASTE	CO_2	8.05	8.01	8.03	8.04	8.05	8.07	8.08	8.09	8.11	8.12	8.13	8.15	8.16	8.14	8.13	8.11
	CH_4	335.79	335.32	335.51	335.91	336.45	337.08	337.76	338.48	339.21	339.95	340.69	341.43	342.16	341.90	341.47	340.92
	N_2O	7.21	7.44	7.98	8.36	8.28	8.41	8.51	9.00	9.29	9.48	9.39	9.00	9.14	9.45	9.12	9.09
	Total	351.04	350.78	351.52	352.31	352.79	353.56	354.36	355.57	356.61	357.55	358.21	358.57	359.45	359.49	358.71	358.12
4A Solid Waste Disposal	CO_2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	CH_4	215.51	215.59	215.59	215.80	216.16	216.60	217.11	217.64	218.20	218.76	219.33	219.89	220.45	221.00	221.38	221.63
	N_2O	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
	Total	215.51	215.59	215.59	215.80	216.16	216.60	217.11	217.64	218.20	218.76	219.33	219.89	220.45	221.00	221.38	221.63
4B Biological Treatment of Solid Waste	CO_2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	CH_4	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
	N_2O	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
	Total	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
4C Incineration and Open Burning of Waste	CO_2	8.05	8.01	8.03	8.04	8.05	8.07	8.08	8.09	8.11	8.12	8.13	8.15	8.16	8.14	8.13	8.11
	CH_4	12.00	11.95	11.97	11.99	12.01	12.03	12.05	12.07	12.09	12.10	12.12	12.14	12.16	12.14	12.11	12.09
	N_2O	1.67	1.66	1.66	1.66	1.67	1.67	1.67	1.67	1.68	1.68	1.68	1.69	1.69	1.68	1.68	1.68
	Total	21.72	21.62	21.65	21.69	21.73	21.76	21.80	21.83	21.87	21.90	21.94	21.97	22.01	21.96	21.92	21.88
4D Wastewater Treatment and Discharge	CO_2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	CH_4	108.28	107.79	107.96	108.12	108.29	108.45	108.61	108.77	108.93	109.08	109.24	109.39	109.54	108.76	107.98	107.20
	N_2O	5.54	5.78	6.32	6.70	6.62	6.74	6.84	7.32	7.61	7.80	7.71	7.32	7.45	7.76	7.44	7.41
	Total	113.82	113.57	114.28	114.82	114.90	115.19	115.45	116.09	116.54	116.88	116.94	116.71	116.99	116.52	115.42	114.61

Category	Gas	Annual emissions in Gg CO_2e																
		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
4 WASTE	CO_2	8.09	8.08	8.06	8.04	8.03	6.62	6.53	6.45	6.41	6.37	6.33	6.29	6.47	6.87	6.72	6.71	6.62
	CH_4	340.27	339.55	338.78	337.97	337.11	334.15	342.58	350.81	358.89	366.80	374.65	382.52	393.22	404.26	410.93	419.13	427.28
	N_2O	8.61	8.74	8.77	8.74	8.76	8.67	8.97	8.68	9.19	9.90	9.67	9.74	10.50	10.30	10.73	11.02	11.05
	Total	356.98	356.37	355.62	354.75	353.91	349.44	358.08	365.94	374.48	383.06	390.66	398.56	410.19	421.43	428.38	436.86	444.94
4A Solid Waste Disposal	CO_2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	CH_4	221.79	221.88	221.91	221.90	221.84	221.76	231.10	239.35	246.95	254.36	261.68	269.00	276.37	284.98	292.05	299.26	306.98
	N_2O	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
	Total	221.79	221.88	221.91	221.90	221.84	221.76	231.10	239.35	246.95	254.36	261.68	269.00	276.37	284.98	292.05	299.26	306.98
4B Biological Treatment of Solid Waste	CO_2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	CH_4	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
	N_2O	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
	Total	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
4C Incineration and Open Burning of Waste	CO_2	8.09	8.08	8.06	8.04	8.03	6.62	6.53	6.45	6.41	6.37	6.33	6.29	6.47	6.87	6.72	6.71	6.62
	CH_4	12.06	12.04	12.01	11.99	11.97	9.86	9.73	9.62	9.55	9.49	9.44	9.38	9.65	10.24	10.02	10.01	9.86
	N_2O	1.67	1.67	1.67	1.66	1.66	1.37	1.35	1.33	1.33	1.32	1.31	1.30	1.34	1.42	1.39	1.39	1.37
	Total	21.83	21.79	21.74	21.70	21.65	17.85	17.61	17.40	17.28	17.18	17.08	16.98	17.46	18.52	18.12	18.11	17.85
4D Wastewater Treatment and Discharge	CO_2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	CH_4	106.42	105.64	104.86	104.08	103.30	102.53	101.75	101.85	102.38	102.95	103.53	104.13	107.20	109.04	108.87	109.87	110.44
	N_2O	6.94	7.07	7.11	7.08	7.10	7.30	7.62	7.34	7.86	8.58	8.36	8.44	9.16	8.88	9.34	9.63	9.68
	Total	113.36	112.71	111.97	111.16	110.41	109.83	109.37	109.19	110.24	111.53	111.90	112.57	116.37	117.93	118.21	119.50	120.12

6.4.4. Description of Emissions by Category

Solid Waste Disposal (4A)

This category covers the CH_4 emissions from the anaerobic decomposition of degradable fractions of municipal solid waste (MSW) in Guyana´s managed anaerobic solid waste disposal site (SWDS), namely the Haags Bosch Landfill under Category 4A1, as well as all uncategorized SWDS encompassing controlled and open dumps under Category 4A3. Category results are summarized in Figure 2.44 and Table 2.57.

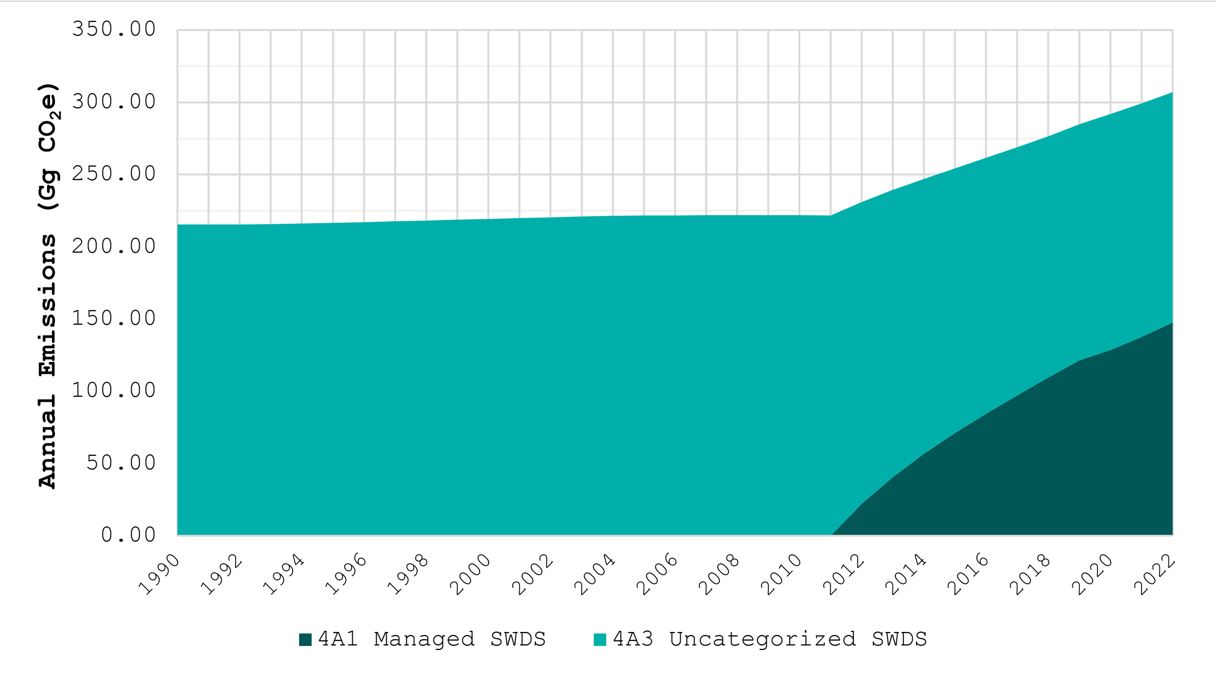

Figure 2.44. Category 4A GHG emissions by SWDS type.

Table 2.57. Summary of GHG emissions from Category 4A – Solid Waste Disposal.

Annual Emissions in Gg CO_2e								
Category	**GHG**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
4A1 Managed SWDS	CH_4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4A2 Unmanaged SWDS	CH_4	IE	IE	IE	IE	IE	IE	IE
4A3 Uncategorized SWDS	CH_4	215.51	215.59	215.59	215.80	216.16	216.60	217.11
4A SOLID WASTE DISPOSAL	CH_4	215.51	215.59	215.59	215.80	216.16	216.60	217.11
Category	**GHG**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
4A1 Managed SWDS	CH_4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4A2 Unmanaged SWDS	CH_4	IE	IE	IE	IE	IE	IE	IE
4A3 Uncategorized SWDS	CH_4	217.64	218.20	218.76	219.33	219.89	220.45	221.00
4A SOLID WASTE DISPOSAL	CH_4	217.64	218.20	218.76	219.33	219.89	220.45	221.00
Category	**GHG**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
4A1 Managed SWDS	CH_4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4A2 Unmanaged SWDS	CH_4	IE	IE	IE	IE	IE	IE	IE
4A3 Uncategorized SWDS	CH_4	221.38	221.63	221.79	221.88	221.91	221.90	221.84
4A SOLID WASTE DISPOSAL	CH_4	221.38	221.63	221.79	221.88	221.91	221.90	221.84

Category	GHG	2011	2012	2013	2014	2015	2016	2017
4A1 Managed SWDS	CH_4	0.00	22.17	40.65	56.69	71.13	84.51	97.22
4A2 Unmanaged SWDS	CH_4	IE	IE	IE	IE	IE	IE	IE
4A3 Uncategorized SWDS	CH_4	221.76	208.93	198.69	190.26	183.23	177.17	171.79
4A SOLID WASTE DISPOSAL	CH_4	221.76	231.10	239.35	246.95	254.36	261.68	269.00
Category	**GHG**	**2018**	**2019**	**2020**	**2021**	**2022**		
4A1 Managed SWDS	CH_4	109.50	121.52	128.63	137.73	147.73		
4A2 Unmanaged SWDS	CH_4	IE	IE	IE	IE	IE		
4A3 Uncategorized SWDS	CH_4	166.87	163.47	163.42	161.52	159.25		
4A SOLID WASTE DISPOSAL	CH_4	276.37	284.98	292.05	299.26	306.98		

Solid waste disposal is the main contributor of emissions within the waste sector. In 2022, Category 4A accounted for 71.85% of CH_4 emissions and 68.99% of the total emissions from the waste sector. A 42.44% growth in solid waste disposal emissions is observed from 215.51 Gg CO_2e in 1990 to 306.98 Gg CO_2e in 2022. There are three main drivers for this increasing trend:

- Population growth: As the population of Guyana continues to grow, the total quantity of waste generated in the country is increasing accordingly.
- Increased solid waste generation rates: Urbanization and economic development is leading to more elevated per capita MSW generation rates throughout all parts of the country.
- Commissioning of the Haags Bosch landfill: While the landfill is a significant milestone for improved sanitation contributing to both environmental and human health, its anaerobic operating conditions have significantly increased the CH_4 generation potential of waste deposited therein, compared to open and controlled dumps.

Prior to 2011, all emissions from the sector were attributed to Category 4A3, observing a steady 2.9% growth from 215.51 Gg CO_2e in 1990 to 221.76 Gg CO_2e in 2011. Upon commissioning of the Haags Bosch Landfill in 2011, emissions from Category 4A1 began to rise logarithmically as expected under the FOD model to 147.73 Gg CO_2e in 2022. Meanwhile, emissions from Category 4A3 reduced by 28.19% during this period to 159.25 Gg CO_2e in 2022, as newly generated MSW is increasingly diverted away from controlled and open dumps for disposal at the Haags Bosch Landfill. By 2022, the Haags Bosch Landfill (Category 4A1) accounted for 48.12% of emissions from solid waste disposal and 33.20% of emissions from the waste sector overall.

The combined uncertainty of emissions from Category 4A has been estimated at 79% for the year 2022. Inherent modelling uncertainties are introduced by the FOD model, as well as the default parameters/emission factors embedded within the IPCC FOD model spreadsheet used to represent the logarithmic decay of degradable waste material and subsequent CH_4 emissions released from solid waste disposal sites. Additional uncertainty is introduced through the waste generation rates, waste composition, and percentage of waste deposited ant each type of SWDS, given that these values were obtained from a single study performed in 2010. Table 2.58 presents the uncertainties for the key parameters used to estimate emissions from Category 4A, consistent with the 2019 IPCC Refinement.

Table 2.58. Uncertainty in GHG Emissions from Category 4A - Solid Waste Disposal.

Parameter	Uncertainty
Total quantity of MSW generated	-30%,+30%
Fraction of MSW sent to SWDS	-30%,+30%
Waste composition	-30%,+30%
Degradable organic carbon	-20%,+20%
Fraction of DOC dissimilated	-20%,+20%
CH_4 generation rate constant – (average for combined waste)	-27%,+27%
Delay time	-33%, +33%
Fraction of CH_4 in developed gas	-5%,+5%
Oxidation factor	0%
Methane correction factor – managed anaerobic SWDS	.10%-0%
Methane correction factor - uncategorized SWDS	-50%,+60%

Biological Treatment of Solid Waste (4B)

While small-scale composting initiatives exist throughout Guyana, associated emissions under this Category 4B were not estimated due to a significant lack of reliable data.

Incineration and Open Burning of Waste (4C)

Category 4C has been included for the first time in the present edition of the Guyana GHG emissions inventory, marking an important milestone in improving the completeness of the inventory. This category covers the CH_4 and N_2O emissions, in addition to non-biogenic CO_2 emissions from the open burning of waste under Category 4C2. While incineration of healthcare waste occurs to a limited degree across Guyana´s healthcare facilities, associated emissions under Category 4C1 were not estimated due to a significant lack of data. Category results are summarized in Figure 2.45 and Table 2.59.

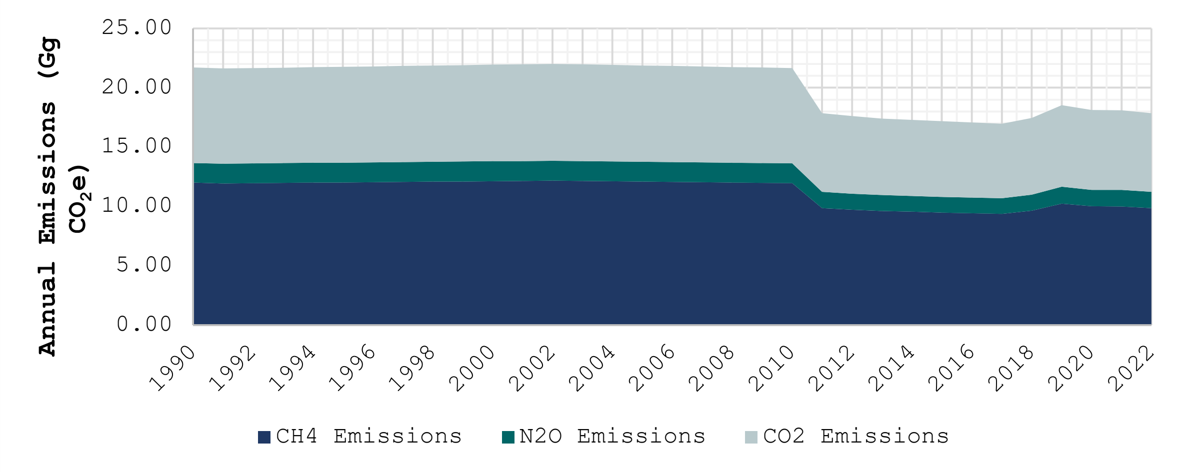

Figure 2.45. Category 4C GHG emissions by gas.

Table 2.59. Summary of GHG emissions of Category 4C – Incineration & Open Burning of Waste.

Annual Emissions in Gg CO_2e								
Category	**GHG**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
4C1 Waste Incineration	CO_2	NE	NE	NE	NE	NE	NE	NE
	CH_4	NE	NE	NE	NE	NE	NE	NE
	N_2O	NE	NE	NE	NE	NE	NE	NE
4C2 Open Burning of Waste	CO_2	8.05	8.01	8.03	8.04	8.05	8.07	8.08
	CH_4	12.00	11.95	11.97	11.99	12.01	12.03	12.05
	N_2O	1.67	1.66	1.66	1.66	1.67	1.67	1.67
4C INCINERATIN & OPEN BURNING OF WASTE	Total	21.72	21.62	21.65	21.69	21.73	21.76	21.80
Category	**GHG**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
4C1 Waste Incineration	CO_2	NE	NE	NE	NE	NE	NE	NE
	CH_4	NE	NE	NE	NE	NE	NE	NE
	N_2O	NE	NE	NE	NE	NE	NE	NE
4C2 Open Burning of Waste	CO_2	8.09	8.11	8.12	8.13	8.15	8.16	8.14
	CH_4	12.07	12.09	12.10	12.12	12.14	12.16	12.14
	N_2O	1.67	1.68	1.68	1.68	1.69	1.69	1.68
4C INCINERATIN & OPEN BURNING OF WASTE	Total	21.83	21.87	21.90	21.94	21.97	22.01	21.96
Category	**GHG**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
4C1 Waste Incineration	CO_2	NE	NE	NE	NE	NE	NE	NE
	CH_4	NE	NE	NE	NE	NE	NE	NE
	N_2O	NE	NE	NE	NE	NE	NE	NE
4C2 Open Burning of Waste	CO_2	8.13	8.11	8.09	8.08	8.06	8.04	8.03
	CH_4	12.11	12.09	12.06	12.04	12.01	11.99	11.97
	N_2O	1.68	1.68	1.67	1.67	1.67	1.66	1.66
4C INCINERATIN & OPEN BURNING OF WASTE	Total	21.92	21.88	21.83	21.79	21.74	21.70	21.65
Category	**GHG**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
4C1 Waste Incineration	CO_2	NE	NE	NE	NE	NE	NE	NE
	CH_4	NE	NE	NE	NE	NE	NE	NE
	N_2O	NE	NE	NE	NE	NE	NE	NE
4C2 Open Burning of Waste	CO_2	6.62	6.53	6.45	6.41	6.37	6.33	6.29
	CH_4	9.86	9.73	9.62	9.55	9.49	9.44	9.38
	N_2O	1.37	1.35	1.33	1.33	1.32	1.31	1.30
4C INCINERATIN & OPEN BURNING OF WASTE	Total	17.85	17.61	17.40	17.28	17.18	17.08	16.98
Category	**GHG**	**2018**	**2019**	**2020**	**2021**	**2022**		
4C1 Waste Incineration	CO_2	NE	NE	NE	NE	NE		
	CH_4	NE	NE	NE	NE	NE		
	N_2O	NE	NE	NE	NE	NE		
4C2 Open Burning of Waste	CO_2	6.47	6.87	6.72	6.71	6.62		
	CH_4	9.65	10.24	10.02	10.01	9.86		
	N_2O	1.34	1.42	1.39	1.39	1.37		
4C INCINERATIN & OPEN BURNING OF WASTE	Total	17.46	18.52	18.12	18.11	17.85		

Open burning of waste is the main contributor of non-biogenic CO_2 emissions from the waste sector. In 2022, Category 4C2 accounted for 100% of sectoral CO_2 emissions in 2022 at a value of 6.62 Gg CO_2e, 2.3% of sectoral CH_4 emissions at a value of 9.86 Gg CO_2e, and 12.40% of N_2O emissions at a value of 1.37 Gg CO_2e.

Until 2010, Category 4C2 emissions remained relatively constant, oscillating at an average 21.81 Gg CO_2e, equivalent to 6.13% of sectoral total emissions. A notable 17.55% reduction in total emissions from open burning is observed from 21.65 in 2010 (6.12% of sectoral total) to 17.85 Gg CO_2e in 2022 (4.01% of sectoral total) attributed to:

- Primarily the commissioning of the Haags Bosch landfill in 2011 leading to enhanced waste management practices across the country complying with environmental, health, and safety standards; and
- At a lesser extent, then ongoing rehabilitation of open dumps and anti-litter and illegal dumping campaigns reducing the incidence of open burning in the country.

The combined uncertainty of CO_2, CH_4, and N_2O emissions from Category 4C has been respectively estimated at 66%, 113%, and 113% for the year 2022. Default emission factors for N_2O and CH_4 emissions from open burning of waste have a relatively high level of uncertainty, accounting for the greater combined uncertainty of these to gases in comparison with CO_2 emissions.

The major uncertainty associated with the CO_2 emissions estimate is related to the estimation of the fossil carbon fraction in the waste. Table 2.60 presents the uncertainties for the key parameters used to estimate emissions from Category 4C, consistent with the 2019 IPCC Refinement.

Table 2.60. Uncertainty in GHG Emissions from Category 4C – Incineration and Open Burning of Waste.

Parameter	Uncertainty
Total quantity of MSW generated	-30%,+30%
Fraction of MSW open-burnt	-30%,+30%
Waste composition	-30%,+30%
Combined CO_2 emission factors for open burning of waste	-40%,+40%
CH_4 emission factor for open burning of waste	-100%,+100%
N_2O emission factor for open burning of waste	-100%,+100%

Wastewater Treatment and Discharge (4D)

This category covers the CH_4 emissions from the treatment and discharge of domestic wastewater in Guyana´s sewerage, septic, and latrine systems, as well as the N_2O emissions from the decomposition of nitrogen compounds in effluent under category 4D1. Category 4D2 was not estimated as no information is currently available on the existence of in-situ industrial wastewater treatment within industrial sites in Guyana. Category results are summarized in Figure 2.46 and Table 2.61.

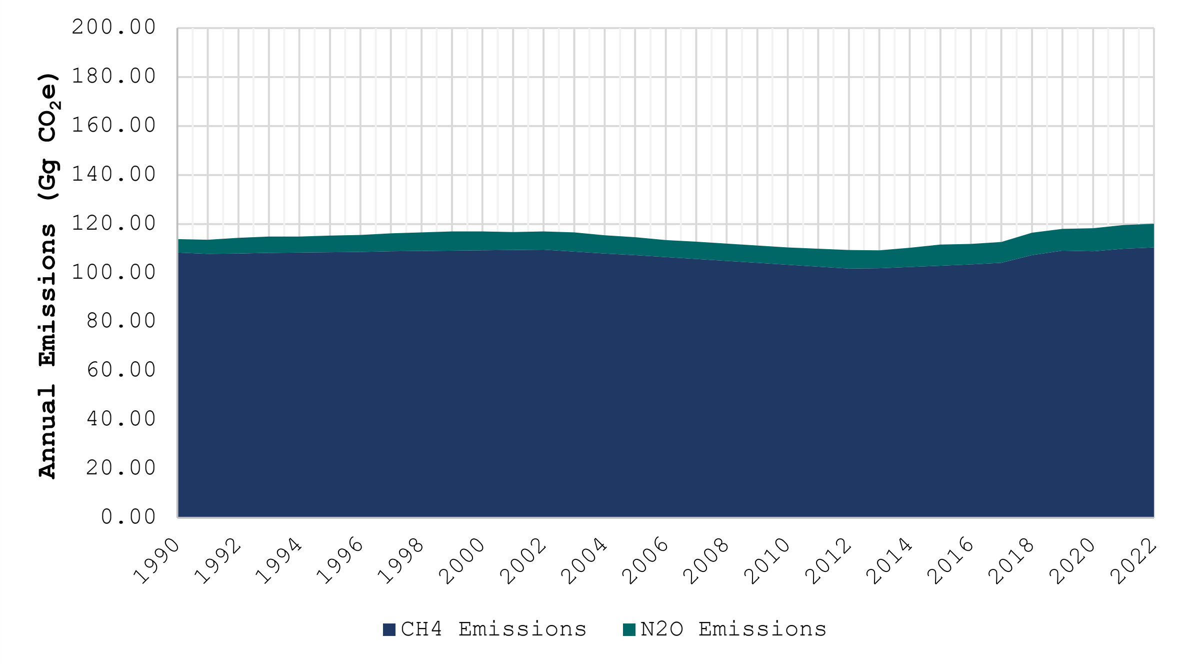

Figure 2.46. Category 4D GHG emissions by gas.

Table 2.61. Summary of GHG emissions from Category 4D – Wastewater Treatment and Discharge.

Annual Emissions in Gg CO_2e								
Category	**GHG**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
4D1 Domestic Wastewater	CH_4	108.28	107.79	107.96	108.12	108.29	108.45	108.61
	N_2O	5.54	5.78	6.32	6.70	6.62	6.74	6.84
4D2 Industrial Wastewater	CH_4	NE	NE	NE	NE	NE	NE	NE
	N_2O	NE	NE	NE	NE	NE	NE	NE
4D WASTEWATER TREATMENT AND DISCHARGE	Total	113.82	113.57	114.28	114.82	114.90	115.19	115.45
Category	**GHG**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
4D1 Domestic Wastewater	CH_4	108.77	108.93	109.08	109.24	109.39	109.54	108.76
	N_2O	7.32	7.61	7.80	7.71	7.32	7.45	7.76
4D2 Industrial Wastewater	CH_4	NE	NE	NE	NE	NE	NE	NE
	N_2O	NE	NE	NE	NE	NE	NE	NE
4D WASTEWATER TREATMENT AND DISCHARGE	Total	116.09	116.54	116.88	116.94	116.71	116.99	116.52
Category	**GHG**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
4D1 Domestic Wastewater	CH_4	107.98	107.20	106.42	105.64	104.86	104.08	103.30
	N_2O	7.44	7.41	6.94	7.07	7.11	7.08	7.10
4D2 Industrial Wastewater	CH_4	NE	NE	NE	NE	NE	NE	NE
	N_2O	NE	NE	NE	NE	NE	NE	NE
4D WASTEWATER TREATMENT AND DISCHARGE	Total	115.42	114.61	113.36	112.71	111.97	111.16	110.41
Category	**GHG**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
4D1 Domestic Wastewater	CH_4	102.53	101.75	101.85	102.38	102.95	103.53	104.13
	N_2O	7.30	7.62	7.34	7.86	8.58	8.36	8.44

4D2 Industrial Wastewater	CH_4	NE	NE	NE	NE	NE	NE	NE
	N_2O	NE	NE	NE	NE	NE	NE	NE
4D WASTEWATER TREATMENT AND DISCHARGE	Total	109.83	109.37	109.19	110.24	111.53	111.90	112.57

Category	GHG	2018	2019	2020	2021	2022
4D1 Domestic Wastewater	CH_4	107.20	109.04	108.87	109.87	110.44
	N_2O	9.16	8.88	9.34	9.63	9.68
4D2 Industrial Wastewater	CH_4	NE	NE	NE	NE	NE
	N_2O	NE	NE	NE	NE	NE
4D WASTEWATER TREATMENT AND DISCHARGE	Total	116.37	117.93	118.21	119.50	120.12

Solid waste disposal is the second largest contributor of CH_4 emissions and the largest contributor or N_2O emissions under the waste sector. In 2022, Category 4D accounted for 25.85% (110.44 Gg CO_2e) of CH_4 emissions, 87.60% (9.68 Gg CO_2e) of N_2O emissions, and 27.00% (120.12 Gg CO_2e) of the total emissions from the waste sector.

Total emissions from Category 4D have remained fairly stable and their contribution share of sectoral totals has actually decreased from 32.42% in 1990 to 27.00% in 2022. CH_4 emissions have observed a mere 1.99% increase in emissions between 1990 and 2022, despite an 11.25% population growth within the same time period. Such trend is attributed to improved sanitation facilities by the replacement of latrines (MCF=0.7) with septic systems (MCF=0.5). N_2O emissions, on the other hand, have observed a 74.73% increase between 1990 and 2022 attributed to population growth and economic development leading to higher protein consumption rates, and thus higher presence of nitrogen in effluent.

The combined uncertainty of CH_4 and N_2O emissions from Category 4D has been respectively estimated at 83% and 500% for the year 2022. As asserted by the 2006 IPCC Guidelines, large uncertainties are associated with the IPCC default emission factors for N_2O from effluent. The main source of uncertainty in CH_4 emissions are both the BOD values and the degree of utilization of each type of wastewater treatment/discharge stream. Table 2.62 presents the uncertainties for the key parameters used to estimate emissions from Category 4D, consistent with the 2006 IPCC Guidelines.

Table 2.62. Uncertainty in GHG Emissions from Category 4D – Wastewater Treatment and Discharge.

Parameter	Uncertainty
Population	-5%,+5%
Per capita protein consumption	-10%, +10%
Nitrogen removed with sludge	0%
Fraction of nitrogen in protein	-6%, +6%
Factor for non-consumed protein added to the wastewater	-9%, +27%
Factor for industrial and commercial co-discharged protein	-20%, +20%
Factor to account for losses of nitrogen prior to discharge	-50%, +50%

Parameter	Uncertainty
N_2O emission factor for effluent	-90%, +1400%
Per capita BOD	-30%, +30%
Correction factor for additional industrial BOD discharged into sewers	-20%, +20%
Degree of utilization of treatment method	-50%, +50%
Organic component removed as sludge	0%
Annual mass of CH_4 recovered and flared	0%
Maximum CH_4 producing capacity	-30%, +30%
Methane correction factors from sewerage and direct disposal	-50%, +50%

7. Data Gaps and Improvement Plans

During the GHG inventory compilation process, specific areas were identified that should be the focus of improvement efforts by Guyana to reduce uncertainties to the extent possible and enable continuous improvement of inventory estimates. Tables 2.63, 2.64, 2.65, and 2.66 presents the findings and recommendations for improvement under each sector, including the relevant timeframes and responsible institutions.

7.1. Energy

Table 2.63. Improvement plan for the energy sector.

Energy Sector – Energy Industries (1A1)				
Identified gaps	**Improvement actions**		**Proposed timeframe**	**Responsible institution**
Sectoral consumption is estimated based on the growth rate of the supply data.	1	Collect data on fuel consumption from the main activity producers of electricity generation, combined heat and power generation, and heat plants for the entire time series.	2024-2026	GPL
Energy Sector – Manufacturing Industries and Construction (1A2)				
Identified gaps	**Improvement actions**		**Proposed timeframe**	**Responsible institution**
Sectoral consumption is estimated based on the growth rate of the supply data.	1	Collect data on fuel consumption from the manufacturing industries by sub-categories that correspond to the ISIC for the entire time series.	2024-2026	GRA
Energy Sector – Transport (1A3)				
Identified gaps	**Improvement actions**		**Proposed timeframe**	**Responsible institution**
No information is available on domestic navigation and the sectoral consumption is estimated based on the	1	Collect data on fuel consumption for all transport activities specified by sub-categories for the entire time series.	2024-2026	GRA

growth rate of the supply data.				
Energy Sector – Other Sectors (1A4)				
Identified gaps		**Improvement actions**	**Proposed timeframe**	**Responsible institution**
Sectoral consumption is estimated based on the growth rate of the supply data.	1	Collect data on fuel consumption for activities in commercial and institutional buildings, households, and in agriculture, forestry, fishing and fishing industries for the entire time series.	2024-2026	GRA
Energy Sector – Other (1A5)				
Identified gaps		**Improvement actions**	**Proposed timeframe**	**Responsible institution**
Sectoral consumption is estimated based on the growth rate of the supply data.	1	Collect data on any remaining fuel combustion for the entire time series.	2024-2026	GRA
Energy Sector – Oil and Natural Gas (1B2)				
Identified gaps		**Improvement actions**	**Proposed timeframe**	**Responsible institution**
Data on oil and natural gas production is available, however, activity data is not clearly split by oil and gas segment.	1	Implement an MRV system to continuously collect data from producers on activity data.	2024-2026	EPA

7.2. Industrial Processes and Product Use

Table 2.64. Improvement plan for the IPPU sector.

IPPU Sector – Non-Energy Products from Fuels and Solvent Use (2D)				
Identified gaps		**Improvement actions**	**Proposed timeframe**	**Responsible institution**
Emissions from lubricant use for their lubricant properties are not estimated.	1	Collect data on total lubricant consumption for lubrication purposes for the entire timeseries.	2024-2026	GRA
	2	Collect data on lubricant consumption for lubrication purposes split by the quantities of different types of lubricants for the entire timeseries.	2026-2028	GRA
Emissions from the use of paraffin waxes are not estimated.	1	Collect data on total paraffin wax consumption for the entire timeseries.	2024-2026	GRA
	2	Collect data on paraffin wax consumption split by quantities and type of paraffin waxes and their respective use for the entire timeseries.	2026-2028	GRA
IPPU Sector – Product Uses as Substitutes for Ozone Depleting Substances (2F)				
Identified gaps		**Improvement actions**	**Proposed timeframe**	**Responsible institution**
Emissions from the use of HFC and PFC gases are not estimated.	1	Collect data on total HFC and PFC imports and split between application area such as refrigeration and air conditioning, foam blowing and fire protection for the entire timeseries.	2024-2026	GRA/NOAU

	2	Collaborate with the Ozone Secretariat in the framework of the Kigali Amendment to assess whether the data they collect can be used for the estimates of the GHG inventory.	2024-2026	GRA/NOAU
IPPU Sector – Other Product Manufacture and Use (2G)				
Identified gaps	**Improvement actions**		**Proposed timeframe**	**Responsible institution**
Emissions from the use of electrical equipment in the transmission and distribution of electricity are not estimated.	1	Collect data on SF_6 consumption for electrical insulation and interruption in equipment utilised in electricity transmission and distribution for the entire timeseries.	2024-2026	GPL
Emissions from the medical use of N_2O as anaesthesia are not estimated.	1	Collect the data on supply from companies that commercialize N_2O for medical applications (anaesthetic use, analgesic use and veterinary use) or data on N_2O consumption from the hospitals for the entire timeseries.	2024-2026	GRA/ Hospitals
	2	Collect data on N_2O consumption for other type of product use such as use as a propellant in aerosol products, primarily in food industry for the entire timeseries.	2026-2028	GRA
IPPU Sector – Other (2H)				
Identified gaps	**Improvement actions**		**Proposed timeframe**	**Responsible institution**
Emissions for the pulp and paper industry are not estimated.	1	Collect data on pulp and paper production split by sub-processes in the pulp and paper industry for the entire timeseries.	2024-2026	GRA
Emissions for the food and beverages industry are not estimated.	1	Collect data on food and beverages production split by production sub-processes in the food and beverages industry for the entire timeseries.	2024-2026	GRA

7.3. Agriculture, Forestry, and Other Land Use

Table 2.65. Improvement plan for the AFOLU sector.

AFOLU Sector – Livestock (3A)				
Identified gaps	**Improvement actions**		**Proposed timeframe**	**Responsible institution**
Livestock data for total cattle is not disaggregated by dairy and other cattle for the periods: 1990-1992 and 2019-2022.	1	Disaggregate total cattle by dairy and other cattle for those years.	2024-2026	GLDA
	2	Collect data for those both categories in the future.	2024-2026	GLDA
AFOLU Sector – Land (3B)				
Identified gaps	**Improvement actions**		**Proposed timeframe**	**Responsible institution**
Forest land cover data is not disaggregated by specific vegetation types or ecological zones	1	Analyse forest cover data by specific vegetation types and ecological zones	2024-2026	GFC

No data was identified for afforestation or reforestation activities	1	Collect data on hectares of land reforested or afforested if they occur.	2026-2028	GFC
Emission factors reported in the previous GHG inventory report were not referenced effectively, thus tracking the source and methodology followed for certain values was not easily done.	1	Ensure all data and information used for calculations are referenced correctly to enhance transparency in reporting.	2024-2026	GFC
AFOLU Sector – Aggregate Sources and Non-CO2 Emission Sources on Land (3C)				
Identified gaps	**Improvement actions**		**Proposed timeframe**	**Responsible institution**
Inconsistencies between the area burnt of sugarcane and the harvested area for this crop.	1	Maintain accurate records because all areas harvested are eventually burnt, before or after harvesting	2024-2026	GUYSUCO
No national data for limestone and synthetic fertilizer applied or burnt area for sugarcane crops after 2016.	1	Collect data for limestone and synthetic fertilizer applied on sugarcane crops, and for area of sugarcane burnt.	2024-2026	GUYSUCO
No national data for limestone application for other crops except sugarcane	1	Collect data on lime application on crops	2024-2026	NAREI
No national data on annual harvested area before 2014 and no data on crop production before 2016 (except for rice and sugar)	1	Keep collecting data regularly on harvested area and crop production	2024-2026	NAREI
Inconsistencies exist between two national sources for harvested area and synthetic fertilizers data on sugarcane crops	1	Maintain accurate records of the synthetic fertilizer use and on harvested area	2024-2026	GUYSUCO
No national data on synthetic fertilizer imports before 2020. Data from 2020 to 2023 has no detail of the nitrogen content per product	1	The national data is there but only in a paper-based system so not accessible. The rec could probably be to have the data provided. Maintain accurate records of the synthetic fertilizer and classify the imports by content of nitrogen	2024-2026	GRA
No national data on urea imports before 2020 and some products only appear one of the years for the period 2020-2023. Inconsistencies exist between national and FAO data for the years 2020 and 2021.	1	The classification of the fertilisers based on N content would be a legal matter currently not required by law. Maybe change rec to stat collecting N content & fertiliser Maintain accurate records of the urea imports	2024-2026	GRA

7.4. Waste

Table 2.66. Improvement plan for the waste sector.

Waste Sector – Solid Waste Disposal (4A)				
Identified gaps and barriers	**Improvement actions**		**Proposed timeframe**	**Responsible institution**
Elevated uncertainty in emission estimated from MSW disposal.	1	Establish and operate a system for conducting recurring waste characterization studies using standardized nomenclature throughout the different regions of Guyana.	2024-2026	MLGRD
	2	Maintain accurate records of the quantity of waste deposited at all of Guyana´s landfills and controlled dumps either through weighbridges or accounting for number of truckloads received at each site.	2024-2030	MLGRD
Controlled and open dumps could not be classified under IPCC definitions.	1	Launch studies and maintain updated records of operating conditions throughout all of Guyana´s controlled and open dumpsites to enable classification as “managed aerobic”, “managed anaerobic”, “unmanaged deep” or “unmanaged shallow” as per IPCC definitions.	2024-2026	MLGRD
Emissions from industrial solid waste were not estimated.	1	Launch detailed studies and begin data collection on industrial waste generation rates, composition, and management practices.	2026-2028	MLGRD
Waste Sector – Biological Treatment of Solid Waste (4B)				
Identified gaps and barriers	**Improvement actions**		**Proposed timeframe**	**Responsible institution**
Emissions from composting are not estimated.	1	Begin collecting data on composting rates using standardized templates.	2028-2030	MLGRD
Waste Sector – Incineration and Open Burning of Waste (4C)				
Identified gaps and barriers	**Improvement actions**		**Proposed timeframe**	**Responsible institution**
Emissions for healthcare waste incineration are not estimated.	1	Establish regular, standardized, and mandatory record-keeping and reporting of healthcare waste generation and treatment practices, including incineration.	2024-2026	Ministry of Health´s Food and Drug Department, Materials Management Unit, and Hospitals
Waste Sector – Wastewater Treatment and Discharge (4D)				
Identified gaps and barriers	**Improvement actions**		**Proposed timeframe**	**Responsible institution**
Elevated uncertainty in emission estimated from domestic wastewater treatment and discharge systems.	1	Establish a system for frequent and standardized BOD measurements specific to each wastewater treatment and discharge stream, including sewerage, septic systems, and latrines.	2024-2026	GWI

Sludge removal and treatment is not accounted for.	1	Regularly collect data on sludge removal and treatment methods.	2026-2028	GWI and Puran Brothers
Emissions from industrial wastewater treatment and discharge are not estimated.	1	Develop an inventory of industrial facilities with on-site wastewater treatment systems in Guyana.	2026-2028	GWI
	2	Regularly collect data on the quantity and characteristics of industrial wastewater generated and treated on-site, including treatment systems implemented.	2028-2030	GWI

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3 Mitigation Actions and their Effects

1. National Climate Change Overarching Policy Framework

Guyana´s nationally determined contribution (NDC) [1] and Low Carbon Development Strategy (LCDS) [2] constitute the country´s core climate change mitigation policy documents establishing the vision and plan towards attaining the overarching goal of achieving a low-emission economic development pathway.

Guyana´s **Low Carbon Development Strategy** was originally developed in 2009, with Guyana being the first developing country to publish a strategy of its kind. It set out a three-phase approach to creating a mechanism for forest climate services with those revenues from ecosystem conservation being invested in Guyana's emerging low carbon economy. Later updated in 2013, and subsequently updated in 2022 following an extensive national stakeholder consultation process, Guyana´s updated LCDS 2030 outlines the country's plans to continue advancing Guyana's payment for forest climate services model and expanding the country's vision to include Guyana's other globally significant ecosystem services taking into consideration the new national circumstances.

The LCDS 2030 therefore establishes a unique world-class self-financing model that seeks to avoid deforestation and maintain its forest cover, while at the same time growing the economy five-fold over 10 years and keeping energy emissions flat or decreasing; investing in urban, rural and Amerindian development; protecting the coast and hinterland through adaptation to climate change; creating jobs in a suite of low carbon sectors; aligning the education and health sectors with low carbon development, and integrating Guyana's economy with its neighbours.

The LCDS 2030's vision is articulated into four inter-linked objectives for Guyana, the first three of which were the basic objectives of the LCDS since 2009 and the fourth of which was added to reflect new local and global realities as shown in Figure 3.1, including Guyana´s support for the achievement of net zero by 2050.

Figure 3.1. Strategic objectives of Guyana´s LCDS 2030. [2]

As a developing country, a coastal low-lying small island developing state (SIDS), and one of few net carbon sink countries, Guyana submitted to the United Nations Framework for Climate Change Convention (UNFCCC) in 2016 its **nationally determined contribution** with the overarching goal to transition the national economy to realise improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. This includes the pursuit of a resilient, low-carbon, socially-inclusive economy that provides a better quality of life for all within the ecological limits of the planet.

Guyana´s NDC establishes the country´s international conditional and unconditional commitments to 2025 under the forestry and energy sectors, where the majority of the nation´s current and historic emissions are produced. Under the forestry sector, Guyana seeks to utilise a combination of conservation and sustainable forest management practices and enhanced governance to combat climate change, including efforts from the timber and mining industries as well as its national protected area system. Under the energy sector, Guyana seeks to eliminate the country´s near complete dependence on fossil fuels and fortify energy efficiency.

Table 3.1 outlines more specific NDC objectives per sector. Guyana has been actively working towards achieving these commitments.

For the energy sector, the country has implemented various solar photovoltaic (PV) and hydroelectric actions to increase the coverage and penetration of renewable energy sources across the country. Furthermore, the country has developed several actions to increase energy efficiency and create a sustainable energy system for Guyana. For the forestry sector, Guyana has established a state-of-the art monitoring, reporting, and verification system (MRVS) enabling the access to international carbon markets pay-for-results mechanisms, helping to propel Reducing Emissions from Deforestation and Degradation (REDD+) activities set out under the LCDS 2030, including the empowerment of indigenous communities to participate in and benefit from such actions, in addition to fortified frameworks ensuring the legality of the timber industry. Further details on the mitigation actions undertaken by Guyana in the energy and forestry sector are respectively provided in Section 2.2 and 2.3 to this Chapter.

Table 3.1. Overview of first NDC commitments.

Type	Forestry Sector	Energy Sector
Unconditional	• Enhance sustainable forest management encompassing: – Compliance and monitoring the legality of the timber industry. – Improved added- value activities locally to assist in creating a higher potential for carbon storage in long-use wood products. – Strengthened support for indigenous communities as they continue the stewardship of their lands and accrue benefits from REDD+ activities.	• Rapidly expand the coverage and penetration of the renewable energy power supply through a mix of wind, solar, biomass and hydropower. • Reduce energy consumption and increase energy efficiency through standards, incentives, and education programmes.
Conditional	• Empower the Emission Reduction Programme for Forests by: – Fortifying the ongoing improvement and implementation of Guyana's MRVS. – Building institutional and private sector capacity to comply with international timber trade and supply conditions and implement reduced impact logging. – Implementing policy reforms, education, technologies, and incentives for integrated sustainable planning and management of the mining industry. – Expanding the National Protected Area System to conserve an additional 2 million hectares.	• Develop a 100% renewable power supply.

In accordance with commitments under the UNFCCC and the Paris Agreement, the Government of Guyana begun revising and updating its NDC in 2021 for an envisioned 2021-2027 implementation period. As the final stage in the NDC revision process, the Government released a revised draft NDC for public review and comments by September 29^{th} 2023 [3]. The revised version of the NDC, which will take into consideration comments received, will be submitted to the UNFCCC in due course.

2. Mitigation Actions by Sector and their Effects

Over the past decade, Guyana has been actively engaging in a variety of strategies, actions and plans to address climate change, both on a nationwide scale and in particular regions of the country. As previously stated, these actions are primarily aligned with the goals and objectives outlined in the country's two main national climate change policies, Guyana's NDC and Guyana's LCDS.

The mitigation actions encompass activities within the energy sector, as well as the forestry sector, including some cross-cutting initiatives. This is in line with the sectoral coverage of Guyana's NDC, which solely focuses on the forest and energy sectors as this is where the majority of Guyana's current and historical emissions are produced, and the objective of the LCDS, which aims to enhance clean energy and create incentives for a low-carbon economy through primarily the forestry sector. Furthermore, Guyana has actively participated in REDD+ and the latest developments in market-based mechanisms supported by the Paris Agreement. Further details regarding these activities are presented in Chapter 4 of this Biennial Update Report (BUR).

, Guyana's domestic agriculture sector is critical to the country´s food security and rural livelihoods and is under threat from the adverse effects of climate change, including floods and droughts. For these reasons, Guyana's focus on agriculture is currently centred on adaptation measures.

Guyana is using Hydrofluorocarbons (HFCs) and Perfluorocarbons (PFCs) as substitutes for phasing out Chlorofluorocarbons (CFCs), halons, carbon tetrachloride, methyl chloroform, and, ultimately, hydrochlorofluorocarbons (HCFCs) under the Montreal Protocol. Guyana acceded to the Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer on August 12, 1993 and subsequently ratified the London Amendment, Copenhagen Amendment and Montreal Amendment on July 23, 1999. This commitment contributes to emission reductions in the Industrial Processes and Product Use (IPPU) sector by utilising HFCs and PFCs as substitutes for ozone-depleting substances.

Concerning the waste sector, Guyana is partaking in significant investments to enhance solid waste management collection and disposal technologies, including the inauguration of the Haags Bosch Sanitary Landfill, the rehabilitation of open dumpsites, and the control of illegal and informal waste management techniques, coupled with community-scale composting and recycling initiatives. Substantial achievement has also been observed in improved sanitation infrastructure, upgrading from pit latrines to septic systems. In this sense, priority for the waste sector has been on improved sanitation concentrating on human and environmental health.

The following sections provide a comprehensive overview of the various mitigation actions that have been implemented, are currently ongoing, or are planned for implementation within the energy, forestry sector, and cross-cutting sectors. The GHG emission reductions are provided in metric tons.

Annex II to the BUR outlines the mitigation actions categorised by sector, offering comprehensive information on their status, duration, implementing entity, GHG coverage, as well as their geographic and sectoral scope. Additionally, it includes detailed descriptions and objectives, quantitative goals, steps taken or envisaged to achieve the action, estimated outcomes and GHG emission reductions, methodologies, and assumptions, along with progress indicators.

2.1. Energy Sector

The energy sector is the largest emitter and is at the forefront of national priorities to reduce overall GHG emissions. Guyana recognises this fact and thus, has planned substantial mitigation actions related to the energy sector. A total of 29 mitigation actions are included in this sector, comprising 18 completed, 9 ongoing, and 2 planned initiatives. Among these, 23 are categorised as projects, while 6 are considered enabling activities.

The transition towards a clean energy matrix from the current fossil-dependent matrix is one of the key priorities in Guyana's national policies. As a result, mitigation actions in the energy sector are predominantly focused on how energy is generated. Of the 29 mitigation actions, 15 focus on power generation, 4 on energy efficiency, 5 on rural electrification, 1 on transport, and 4 on training and development.

For 3 of the mitigation actions in the energy sector, GHG emission reductions could not be estimated due to insufficient information, and 9 actions do not directly reduce GHG emissions.

Table 3.2 offers a concise summary of the various mitigation actions within the energy sector, along with their associated mitigation potential. A more detailed description of each action is provided in Annex II to the BUR.

Table 3.2. Overview of mitigation actions in the energy sector.

Number of mitigation actions	29
Total estimated GHG emission reductions	782,947.75 tons CO_2e/yr

Description	**Status (planned, ongoing, completed)**	**Estimated GHG emission reductions**
Guyana Utility Scale Solar Photovoltaic Program (GUYSOL)	Ongoing	37,500 tons CO_2e/yr
Sustainable Energy Program for Guyana	Ongoing	842 tons CO_2e/yr
Electric Vehicle Supporting Infrastructure	Completed	Not Applicable
Pilot Rice Husk Biogas Power Plant	Completed	101 tons CO_2e/yr
Leguan 0.6MWp Solar PV Farm	Planned	841 tons CO_2e/yr
EcoMicro Guyana	Completed	Not Estimated
Energy Matrix Diversification and Institutional Strengthening of the Department of Energy (EMISDE)	Ongoing	3.67 tons CO_2e/yr
Expanding Bioenergy Opportunities in Guyana	Completed	Not Applicable
Enhancing Guyana's Access to green Climate Fund (GCF) to Transition to Renewable Energy	Completed	Not Applicable
Amaila Falls Hydroelectric Project Preparation Studies	Completed	Not Applicable
Wakenaam 0.75MWp Solar Farm	Ongoing	940 tons CO_2e/yr
Small Hydropower Project for the Cooperative Republic of Guyana	Ongoing	12,344 tons CO_2e/yr
Hinterland Solar PV Farms	Planned	3,046 tons CO_2e/yr
Solar PV Public Buildings Program	Completed	15,518 tons CO_2e/yr
Promotion of Private Solar PV Rooftop Systems	Completed	1,431 tons CO_2e/yr
Transitioning to National Energy Security: Bartica as a Model Green Town	Ongoing	Not Applicable
Promotion of Energy Efficiency Measures in the Manufacturing and Service Sectors	Completed	291 tons CO_2e/yr
Project for the Introduction of Renewable Energy and Improvement of Power System in Guyana	Completed	429.65 tons CO_2e / yr
Sustainable Business Models for Rural Electrification and Energy Access in Guyana	Completed	Not Applicable

Solar Home Systems	Ongoing	5,003.71 tons CO_2e / yr
Solar PV Mini-grids	Ongoing	958.52 tons CO_2e / yr
Power Utility Upgrade Program	Completed	Not Estimated
Sustainable Operation of the Electricity Sector and Improved Quality of Service	Completed	Not Estimated
Power Sector Support Program	Completed	Not Applicable
Strengthening Capacity in Energy Planning and Supervision	Completed	Not Applicable
Mabaruma 0.4MWp Solar PV Farm	Completed	478 tons CO_2e/yr
Gas to Energy Project	Ongoing	703,150 tons CO_2e/yr
Caribbean Renewable Energy Development Programme	Completed	Not Applicable
Moraikobai Micro-grid PV System	Completed	70.20 tons CO_2e/yr

2.2. Forestry Sector

In addressing climate change within the forestry sector, Guyana is employing a combination of conservation and sustainable forest management strategies.

Within this sector, a total of 5 mitigation actions are included, comprising 2 completed and 3 ongoing initiatives. Among these, 1 is categorised as a project, while 4 are considered enabling activities.

For one mitigation action, precise GHG emission reductions could not be estimated due to insufficient information, and 2 activities do not directly lead to GHG emission reductions as they are more governance and institutional related actions. However, two specific mitigation actions within the forestry sector provide detailed insights into the associated GHG emission reductions. These initiatives underscore Guyana's commitment to mitigation GHG emissions and combatting climate change through effective and measurable actions in the forestry sector.

Table 3.3 provides a brief summary of the diverse mitigation actions undertaken in the forestry sector, while a more comprehensive outline of each mitigation action is presented in Annex II to the BUR.

Table 3.3. Overview of mitigation actions in the forestry sector.

Number of mitigation actions	5
Total estimated GHG emission reductions	109,317,406 tons CO_2e

Description	Status (planned, ongoing, completed)	Estimated GHG emission reductions
Institutional Strengthening for the Implementation of the LCDS 2030 under REDD+ Partnerships	Completed	Not Applicable
Guyana-EU Forest Law Enforcement, Governance and Trade Voluntary Partnership Agreement	Ongoing	Not Estimated
Guyana REDD+ Monitoring Reporting & Verification System (MRVS) and Forest Climate Services Payment Mechanism	Ongoing	108.47 million tons CO_2e[6]
Forest Carbon Partnership Facility Project in Guyana	Completed	Not Applicable

2.3. Cross-cutting Sector

In total, there are 6 cross-cutting mitigation actions, with 3 successfully completed and 3 currently in progress. Among these initiatives, 5 are classified as projects, and 1 is identified as enabling activity. The primary focus of these cross-cutting actions is on hinterland development and economic advancement, with 3 mitigation actions categorised by focus area.

Importantly, none of these cross-cutting mitigation actions have undergone estimation of their GHG emission reduction potential. This is either due to a current lack of information or because the nature of the action does not directly lead to GHG emission reductions.

Table 3.4 provides a brief overview of the diverse mitigation actions in the cross-cutting sector. Annex II to the BUR presents more comprehensive information for each of the actions.

Table 3.4. Overview of mitigation actions in the cross-cutting sector.

Number of mitigation actions	6	
Total estimated GHG emission reductions	Not Estimated	
Description	**Status (planned, ongoing, completed)**	**Estimated GHG emission reductions**
Amerindian Development Fund	Completed	Not Estimated

[6] The implementation of the Guyana REDD+ Monitoring Reporting & Verification System (MRVS) is anticipated to result in a substantial avoidance of 108.47 million tons CO2e over the period from 2016 to 2030 [4]. Guyana has been issued 33.47 million ART-TREES credits for the period 2016-2020, with an estimated additional 75 million credits to be issued for the period 2021-2030. Each credit being equivalent to 1 ton CO_2e, the total reduction over the 2016-2030 period is estimated at 108.47 million tons CO_2e.

Support for Micro and Small Enterprise and Vulnerable Groups' Low-Carbon Livelihoods	Completed	Not Estimated
Amerindian Land Titling	Ongoing	Not Estimated
ICT Access and E-services for Hinterland, Remote, and Poor Communities	Ongoing	Not Estimated
Village Sustainability Plans	Ongoing	Not Estimated
Strengthened Monitoring, Enforcement and Uptake of Environmental Regulations in Guyana's Gold Mining Sector	Completed	Not Estimated

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4 REDD+ in Guyana

Guyana is committed to safeguarding its forests, recognising their vital role in mitigating climate change by absorbing substantial amounts of CO_2. It acknowledges that when forests are destroyed or damaged, they can become a source of GHG emissions.

In Guyana, historical deforestation has been one of the lowest rates in the world (0.02% to 0.079% per year between 2009 and 2020) [1]. Guyana is therefore considered to be a high forest cover low deforestation rate (HFLD) country, with forests covering approximately 85% of the country (18.39 million hectares) and containing an estimated 5.96 Gt of carbon in aboveground biomass which is equivalent to 21.8 Gt of CO_2 with the inclusion of soil carbon.

However, in addition to being one of Guyana's most valuable natural assets, these forests are suitable for logging and agriculture, and have significant mineral deposits. Mining is the primary driver of deforestation in Guyana[7], accounting for 85% of all deforestation between 2001 and 2012, and 74% of deforestation between 2013 and 2020. Agriculture, roads and mining infrastructure, forestry infrastructure, and forest fire are the remaining drivers of deforestation and forest degradation in Guyana.

To achieve a balance between preserving Guyana's forests as a global asset in the fight against climate change and at the same time meeting addressing poverty and other developmental challenges, Guyana has pursued a Low Carbon development Strategy (LCDS).

The latest revision of the LCDS sets out plans up to 2030 to maintain Guyana's low deforestation and high HFLD score [2] including through the use of economic incentives. These economic incentives are grounded in united Nations Framework for Climate Change (UNFCCC) modalities, including Reducing Emissions from Deforestation and Degradation (REDD+) and the latest evolution of market-based mechanisms underpinned by the Paris Agreement, in particular its Articles 6.2 and 6,4. Consequently, the country is actively engaged in the REDD+ framework and in the Architecture for REDD+ Transactions Environmental Excellence Standard (ART-TREES) to preserve its forests, aligning with the goals of the Paris Agreement.

[7] Decision 4, CP.15 paragraph 1(a) requests developing country Parties to identify drivers of deforestation and forest degradation resulting in emissions.

1. REDD+

'REDD' stands for 'Reducing emissions from deforestation and forest degradation in developing countries. The '+' stands for additional forest-related activities that protect the climate, namely sustainable management of forests and the conservation and enhancement of forest carbon stocks [3].

The primary objective of REDD+ is to encourage developing countries like Guyana to actively contribute to climate change mitigation. This is achieved by curbing, stopping, and reversing forest loss and degradation, while simultaneously enhancing the removal of greenhouse gases (GHGs) from the atmosphere through the conservation, management, and expansion of forests. There are five globally agreed-upon REDD+ activities that play a crucial role in mitigating climate change in the forest sector:

1. Reducing emissions from deforestation.
2. Reducing emissions from forest degradation.
3. Conservation of forest-carbon stocks.
4. Enhancement of forest-carbon stocks.
5. Sustainable management of forests.

Within the framework of these REDD+ activities, Guyana has been receiving results-based payments for REDD+ activities. The outcomes of REDD+ efforts are quantified in metric tonnes of CO_2e or GHG emissions reductions, leading to the creation of REDD+ Results Units (RRUs).

Guyana set out to start building a mechanism for REDD+, through a three-phase process:

- Phase I – a bilateral agreement with a partner which shared Guyana's vision.
- Phase II – available market-based mechanisms.
- Phase III – a fully-fledged UNFCCC REDD+ mechanism.

In Phase I, a forest reference emission level (FREL) was established by utilising historical data and applying internationally accepted methods for projecting future developments. Within the REDD+ framework and utilising the FREL, the Governments of Guyana and Norway established a REDD+ agreement in 2009, known as the Guyana – Norway Partnership. In the agreement, Norway committed to providing Guyana up to $250 million USD by 2015 for REDD+ results.

In Phase II, the FREL serves as a benchmark for voluntary carbon market engagement, and in Phase III, the mechanism will be seamlessly integrated once a UNFCCC REDD+ mechanism is fully operational [4].

In this context, Guyana is submitting its first REDD+ Technical Annex alongside its first Biennial Update Report (BUR). This Annex outlines the country's endeavours in preserving environmental integrity and promoting the sustainable use of its forest resources. These efforts align with the promotion of sustainable development along a low-carbon pathway, in accordance with national priorities and international obligations [5]. The Technical Annex includes an overview of the FREL, GHG emission reduction results, consistency in methodology between REDD+ results calculation and FREL construction, details about the national forest monitoring system and the responsibilities of relevant authorities, as well as the necessary information for the reconstruction of the results.

The initial REDD+ Technical Annex accompanying the first BUR details Guyana's achievements from 2013 to 2022. It relies on the FREL submitted in 2015, encompassing historical data until 2012. The FREL is pivotal within REDD+, serving as the benchmark against which emission reductions are gauged.

2. ART-TREES

For Phase II of Guyana’s approach to forest climate services, Guyana has adopted the Architecture for REDD+ Transactions (ART) as the accreditation standard for integration with voluntary and carbon markets. The overall approach was set out in Guyana’s LCDS 2030 – Appendices 1 and 2.

ART’s “The REDD+ Environmental Excellence Standard”, known as TREES, is ART’s market-based approach to crediting REDD+ performance. TREES outlines the criteria for crediting emission reductions from REDD+ on both national and subnational scales. It encompasses rigorous standards for accounting and crediting, monitoring, reporting, and independent third-party verification, as well as measures for mitigating leakage and reversal risks, preventing double counting, ensuring robust environmental and social safeguards, and ensuring the transparent issuance of serialised TREES Credits on a public registry [6].

As part of its transition towards ART-Issued TREES Credits, Guyana is in the process of revising the FREL and establishing a new baseline for comparing actual emissions [7]. This updated FREL will be effective from 2023 and was part of a nation-wide national consultation on the LCDS 2030. It will serve as a refinement of the 2015 FREL, incorporating stepwise improvements and additional data. Noteworthy revisions include:

- Inclusion of additional data collected, ensuring nationwide coverage and eliminating stratification based on the convergence of biomass values and updated emission factors.
- Adjustment of the reference period.
- Incorporation of all national drivers contributing to both deforestation and forest degradation.

3. Background to Guyana's FREL

As set out in Guyana's REDD+ Technical Annex, the establishment of Guyana's updated FREL [7] is guided by the objectives of aligning with methodologies which are: (i) scientifically valid and conservative, (ii) recognise all elements of REDD+ as defined by the UNFCCC and summarised in the LCDS 2030, (iii) consistent with Guyana's original FREL, and also being (iv) capable of integrating with market-based mechanisms that are compatible with advances within the UNFCCC since the original FREL was approved.

As set out in Guyana's REDD+ Technical Annex. Guyana's original reference level, dated September 2015, utilised the Combined FREL. The Combined FREL is developed by averaging the rate of pan-tropical forest loss with the annual rate of Guyana's forest loss. This average rate is then applied to the total current carbon stocks to develop the combined FREL in CO_2. While there are multiple options for an estimate of pan-tropical forest loss, Hansen et al. is the most up-to-date source and is based on high resolution data from 151 countries located between 30 degrees north and 30 degrees south. This model was applied under the Guyana Norway Bilateral Cooperation on Climate and Forests.

Since then, Guyana continued work on its monitoring, reporting, and verification system (MRVS) and continued to expand the time series of spatial and field data, including emissions tracking. Guyana's average emissions from 2016 to 2020 were 14.4 million tons of CO_2, 0.08% of total carbon stocks, with a high of 17.2 million tons CO_2 in 2019 and a low of 13.0 million tons CO_2 in 2016.

Building on this improved data and aligning with the Paris Agreement and other UNFCCC decisions, Guyana's FREL has been upgraded and will commence from year 2023.

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5 Constraints, Gaps and Support Received

To effectively implement climate change actions, significant financial, technical, and capacity-building support is required. While there has been a notable increase in such support in recent years, the global demand far surpasses the assistance provided. Beyond the need for increased financial resources, substantial barriers to executing effective climate actions persist due to deficiencies in skills and technical resources. Consequently, targeted assistance for capacity-building and technology transfer is globally required.

Similar to most developing countries, Guyana plans to strengthen reporting capabilities to the United Nations Framework for Climate Change Convention (UNFCCC) both in regard to climate change objectives and with respect to reporting. These gaps include the availability of financial resources, technological gaps as well as capacities. Nonetheless, in recent years, innovative solutions for mobilising resources for climate action were brought underway, including first of a kind carbon credits and results-based payments for forest protection in Guyana.

This chapter highlights the prevailing constraints and gaps faced by Guyana and offers an in-depth analysis of the financial, technical, and capacity-building support required and received by the country.

1. Constraints and Gaps and Related Needs

Identified areas for further strengthening include communication, networking, encompassing both financial and technical aspects. In 2016, a Technology Needs Assessment (TNA) [1] was conducted in Guyana, analysing the potential of implementing and scaling mitigation actions and identifying the associated technological barriers. In the TNA, substantial potential was identified for the energy sector, in particular for the scale up of renewable technologies such as hydro and solar power.

Summarising the prevalent technological, resource and capacity gaps, Table 5.1 outlines the primary constraints Guyana faces, covering different dimensions of climate change action and reporting. This furthermore includes the preparation and development of the greenhouse gas (GHG) inventory, and the formulation and implementation of mitigation actions.

Table 5.1. Constraints and gaps faced by Guyana and related needs.

Dimension	Constraints and Gaps	Associated needs	Measures to address constraints and gaps	Priority
GHG Inventory	Institutional and technical capacity to develop GHG inventories on a continuous basis and fulfil the reporting obligations under the UNFCCC.	Capacity	Enhance the stakeholder capacity in the key institutions such as the Department of Environment and Climate Change (DECC) and other ministries for which funding is required to hire and employ adequately skilled persons, to provide training and to acquire material.	High
	The data collected for the inventory should be enhanced.	Technical / Capacity	Implement an effective and centralised monitoring, reporting, and verification (MRV) system to guide thorough data collection procedures in line with the reporting cycles under the UNFCCC. To do so, harness existing sectoral MRV approaches to streamline the procedures.	High
	Awareness on the required collaboration among data providers for GHG inventory compilation and lack of protocols in place to ensure data protection and confidentiality.	Capacity	Accelerate sectoral outreach as well as inter-institutional data-sharing agreements and memoranda of understanding. Foster awareness and trust through high confidentiality standards and clear agreements.	High
	Integrated databases and national statistics to facilitate the inventory development process.	Technical	Enhance key national statistics such as the Energy Balance, customs data, as well as forestry and agricultural information and develop effective databases to draw from for the inventory development.	High
	Incentives for improving national research on sectoral GHG emissions.	Financial / Capacity	Establish cooperation with national research universities and institutes to develop a strong knowledge basis in the country.	Medium
Mitigation	Technical capacity to thoroughly estimate the mitigation impact of the key actions.	Capacity	Enhance the stakeholder capacity in the key institutions responsible for reporting and for implementation of sectoral mitigation actions through training and adequate material.	High
	National resources to achieve more ambitious forestry sector actions.	Financial	Mobilise additional funding for forestry sector projects.	Medium

Dimension	Constraints and Gaps	Associated needs	Measures to address constraints and gaps	Priority
	Resources and incentives to support research and guide the development and implementation of mitigation actions.	Financial / Capacity	Establish cooperation with national research universities and institutes to develop a strong knowledge basis in the country and to inform adequate policy decisions.	Medium
	Additional sectors such as agriculture, transport, industrial processes and product use (IPPU), and waste need to be prioritised for mitigation actions.	Technical / Capacity	Conduct sectoral analyses to assess the potential for emissions reduction in these sectors in view of the respective GHG emissions profiles and available funding opportunities.	Medium
Policy and Cooperation Framework				
	Streamlining climate change effectively into specific strategies and plans across institutions.	Capacity	Enhance the policy response to climate change by leveraging key national strategies such as the Low Carbon Development Strategy (LCDS) and the nationally determined contribution (NDC) and streamlining the key objectives into sectoral development plans.	High
	Coordination and collaboration among agencies.	Technical / Capacity	Improve inter-institutional coordination through an effective MRV framework and increased awareness activities.	High
	Some reliance on donor finance for implementation of climate action.	Financial	Enhance private sector contribution to climate action through (1) incentive mechanisms and public-private partnerships, (nd (3) improving the Guyana REDD+ MRV framework (MRVS) to enable the sale of the highly innovative Architecture for REDD+ Transactions Environmental Excellence Standard (ART-TREES) carbon credits.	Medium

2. Total Support Received and Anticipated

In Guyana, substantial resources are mobilised to finance activities in the priority sectors, namely energy and forestry and, to a lesser extent, transport, as outlined in Guyana's Nationally Determined Contribution (NDC) [3] and Low Carbon Development Strategy (LCDS) [4].

Additionally, operational support for fulfilling reporting obligations under the UNFCCC is provided. The funding is obtained from various sources, including the country's budgetary investments, investment loans and grants from bilateral and multilateral entities, as well as through private sector investment.

A concise summary of the funding received and anticipated, categorised by source and financial instrument, is presented in Table 5.2.

Overall, the funding received by Guyana underscores a significant dependence in the past on bilateral support often disbursed as grants and on concessional loans from multilateral development institutions in the past. Moreover, the Global Environment Facility (GEF) [5] and the Green Climate Fund (GCF) [6] provided support in the form of project grants to fund projects aimed at enhancing the country´s operational capacity for climate action.

However, since 2022, this situation has changed with the vast amount of the funding yet to be received being formed of increasing mobilisation of market instruments and private sector investments as major sources of climate finance.

Table 5.2. Summary of total support received and anticipated.

Funding Source and Financial Instrument	Support received (USD)	Support anticipated (USD)
Bilateral	**322,748,817.00**	**886,143,847**
Concessional loan	**7,290,000.00**	**2,710,000.00**
Government of India	7,290,000.00	2,710,000.00
Grant	**95,458,817.00**	**17,433,847.00**
Government of Canada	350,000.00	
Government of India	62,126.00	
Government of Italy	1,275,000.00	3,045,000.00
Guyana REDD+ Investment Fund (GRIF) - Norwegian Agency for Development Cooperation (NORAD)	67,485,292.00	13,804,349.00
Government of Japan	675,000.00	
United Arab Emirates Caribbean Energy Development Fund (UAE-CREC)	2,300,000.00	
European Union Caribbean Investment Facility (CIF)	21,965,250.00	
German Development Bank (KfW)	146,149.00	584,498.00
Japan International Cooperation Agency (JICA)	1,200,000.00	
Loan		**646,000,000.00**
Export and Import Bank US (EXIM)		646,000,000.00
Results-based payment	**220,000,000.00**	**220,000,000.00**
GRIF - NORAD	220,000,000.00	220,000,000.00
Multilateral Climate Funds	**8,168,744.00**	**4,698,911.00**
Grant	**8,168,744.00**	**4,698,911.00**
Global Environment Facility (GEF)	6,731,617.00	4,122,202.00
Green Climate Fund (GCF)	1,292,950.00	
World Wildlife Fund (WWF)	144,177.00	576,709.00

Funding Source and Financial Instrument	Support received (USD)	Support anticipated (USD)
Multilateral Development Banks	**86,821,990.00**	**10,595,452.00**
Concessional loan	**80,548,750.00**	**10,595,452.00**
Inter-American Development Bank (IDB)	65,918,750.00	10,595,452.00
Islamic Development Bank (IsDB)	14,630,000.00	
Grant	**6,273,240.00**	
IDB	2,473,240.00	
World Bank	3,800,000.00	
Private Sector	**152,100,000.00**	**1,555,500,000.00**
Equity	**2,100,000.00**	**955,500,000.00**
ExxonMobil		955,500,000.00
Private Sector Guyana	2,100,000.00	
Market-based Climate Finance	**150,000,000.00**	**600,000,000.00**
Hess Corporation	150,000,000.00	600,000,000.00
Grand Total	**569,839,551.00**	**2,456,938,210.00**

3. Support Received by Sector

Aligned with the priority sectors, the implemented climate change actions are closely tied to the reduction of GHG emissions in the energy sector and the increase of removals in the forestry sector. This involves the protection and reforestation of the vast Amazon Forest, alongside the expansion of renewable energy sources. Similarly, initiatives are underway to leverage cleaner fossil energy sources, particularly natural gas. Additionally, there are cross-cutting activities that offer climate change mitigation co-benefits, such as promoting sustainable practices in remote communities or providing operational support for climate change.

The subsequent sections detail climate change projects in Guyana, organised by sector. They provide key information on the received and anticipated funding, the status of implementation, and the involved donors and national entities.

3.1. Energy Sector

Given its status as the sector with the highest emissions, Guyana prioritises the energy sector in its climate change efforts, thus aiming to secure substantial funding to implement targeted actions. This includes renewable energy projects, supporting technology transfer particularly in the solar photovoltaic (PV) and hydropower domains, along with significant initiatives leveraging gas exploration to replace heavy fuel oil in electricity production. The development of an advanced gas-to-power infrastructure is currently in progress to facilitate this transition.

Furthermore, numerous actions within the energy sector specifically target remote and hinterland communities, aiming to provide secure and clean energy across the entire country. To support the development and adoption of cleaner energy sources and ensure effective integration, Guyana implements projects that enhance institutional and technical capacities within communities. As such, a substantial portion of the actions implemented in the energy sector involve targeted capacity-building to enable the utilisation of new technologies in the renewable energy sector and to enhance the effectiveness of energy efficiency actions in communities.

The funding sources for the energy sector actions and projects are diverse. While large energy infrastructure projects tend to receive support in the form of private sector investment, beneficial loans mobilised through the large multilateral banks or bilateral support, preparatory activities, small to mid-scale projects, and capacity-building initiatives are often backed by project grants from major multilateral climate funds.

Table 5.3 provides an overview of the total number of supported actions, the total received amount, and the outstanding amount yet to be disbursed for these initiatives.

Table 5.3. Overview of funding status of energy sector actions.

Number of actions supported	**23**
Actions involving capacity-building	**15**
Actions involving technology transfer	**20**
Power Generation	12
Energy Efficiency	4
Rural Electrification	3
Training and Development	4
Total amount of support received	**$ 127,253,732 USD**
Power Generation	$ 34,401,492 USD
Energy Efficiency	$ 2,975,000 USD
Rural Electrification	$ 13,603,240 USD
Training and Development	$ 76,274,000 USD
Total amount of support anticipated	**$ 1,702,650,452 USD**
Power Generation	$ 1,696,895,452 USD
Energy Efficiency	$ 3,045,000 USD
Rural Electrification	$ 2,710,000 USD
Training and Development	$ 0 USD

The significant share of funding that is anticipated stems from one major project, namely the installation of a 300MW Gas-to-Power Plant, with a total cost of $ 1,601,000,000 USD, representing nearly all of the funding anticipated in this sector.

In Table 5.4, all completed, ongoing, or planned actions within the energy sector are listed. Additional information on the financial source, instrument, and the scope of each activity is provided. It is important to note that 'funding anticipated' denotes the ongoing requirement for disbursing financial resources to facilitate the implementation of the respective project or action.

Table 5.4. Detailed overview of support received and anticipated for energy sector actions.

Title	Energy Matrix Diversification and Institutional Strengthening of the Department of Energy (EMISDE) – Components 1&2										
Duration	**Status**	**Implementing Entity**	**Funding**				**Type of Funding**			**Geographic scope**	**Sectoral Scope**
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
Component 1											
2019-2024	Ongoing	Guyana Energy Agency (GEA)	Inter-American Development Bank (IDB)	Concessional loan	8,449,578	547,262	✓	✓	✓	National	Power Generation
Component 2											
2019-2026	Ongoing	Guyana Power and Light Inc. (GPL)	Inter-American Development Bank (IDB)	Concessional loan	2,700,422	9,462,738	✓	✓	✓	Regions 2 and 3	Power Generation
Title	**Expanding Bioenergy Opportunities in Guyana**										
Duration	**Status**	**Implementing Entity**	**Funding**				**Type of Funding**			**Geographic scope**	**Sectoral Scope**
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2008-2010	Completed	Inter-American Development Bank (IDB)	Government of Japan	Grant	675,000		✓	✓	✓	National	Power Generation
			Inter-American Development Bank (IDB)	Grant	250,000		✓	✓	✓		
Title	**Enhancing Guyana's Access to GCF to Transition to Renewable Energy**										
Duration	**Status**	**Implementing Entity**	**Funding**				**Type of Funding**			**Geographic scope**	**Sectoral Scope**
			Source	Mechanism	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2019-2020	Completed	Global Green Growth Institute (GGGI)	Green Climate Fund (GCF)	Grant	300,000		✓	✓		National	Power Generation

Title	Guyana Utility Scale Solar Photovoltaic Program (GUYSOL)										
Duration	**Status**	**Implementing Entity**	**Funding**				**Type of Funding**			**Geographic scope**	**Sectoral Scope**
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2022-2027	Ongoing	Guyana Power and Light Inc. (GPL)	GRIF - NORAD	Results-based payment (Grant)		83,300,000	✓	✓	✓	Regions 2, 5, 6, 10	Power Generation
			GRIF - NORAD	Results-based payment (Grant)		1,500,000	✓				

Title	Pilot Rice Husk Biogas Power Plant										
Duration	**Status**	**Implementing Entity**	**Funding**				**Type of Funding**			**Geographic scope**	**Sectoral Scope**
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2018-2021	Completed	Guyana Energy Agency (GEA)	Government of India	Grant	62,126		✓		✓	Regions 5 and 6	Power Generation

Title	Leguan 0.6MWp Solar PV Farm										
Duration	**Status**	**Implementing Entity**	**Funding**				**Type of Funding**			**Geographic scope**	**Sectoral Scope**
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2023-2025	Planned	Guyana Energy Agency (GEA)	Inter-American Development Bank (IDB)	Concessional loan	1,200,000	585,452	✓		✓	Region 3	Power Generation

Title	Amaila Falls Hydroelectric Project Preparation Studies										
Duration	**Status**	**Implementing Entity**	**Funding**				**Type of Funding**			**Geographic scope**	**Sectoral Scope**
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2010-2011	Completed	Inter-American Development Bank (IDB)	GRIF - NORAD	Grant	1,210,000		✓		✓	Regions 3, 4, 5, 6, 10	Power Generation

Title	Wakenaam 0.75MWp Solar Farm										
Duration	**Status**	**Implementing Entity**	**Funding**				**Type of Funding**			**Geographic scope**	**Sectoral Scope**
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2019-ongoing	Ongoing	Guyana Power and Light Inc. (GPL)	UAE-CREC	Grant	2,300,000		✓		✓	Region 3	Power Generation

Title	Small Hydropower Project for the Cooperative Republic of Guyana											
Duration	Status	Implementing Entity	Funding				Type of Funding			Geographic scope	Sectoral Scope
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2022-ongoing	Ongoing	Guyana Energy Agency (GEA)	Islamic Development Bank (IsDB)	Concessional loan	14,630,000		✓		✓	Region 9	Power Generation

Title	Promotion of Private Solar PV Rooftop Systems										
Duration	Status	Implementing Entity	Funding				Type of Funding			Geographic scope	Sectoral Scope
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2020-2022	Completed	Guyana Power and Light Inc. (GPL) and private actors	Private Sector	Equity	2,100,000		✓			National	Power Generation

Title	Gas to Energy Project										
Duration	Status	Implementing Entity	Funding				Type of Funding			Geographic scope	Sectoral Scope
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2023-ongoing	Ongoing	Ministry of Public Works	Export and Import Bank US (EXIM)	Loan		646,000,000	✓		✓	National	Power Generation
			Private Sector (ExxonMobil)	Equity		955,500,000	✓		✓		

Title	Caribbean Renewable Energy Development Programme										
Duration	Status	Implementing Entity	Funding				Type of Funding			Geographic scope	Sectoral Scope
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2004-2015	Completed	Caribbean Community (CARICOM)	GEF	Grant	524,366		✓	✓	✓	Regional	Power Generation

Title	EcoMicro Guyana										
Duration	Status	Implementing Entity	Funding				Type of Funding			Geographic scope	Sectoral Scope
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2018-2022	Completed	Institute for Private Enterprise Development (IPED)	Government of Canada	Grant	350,000		✓	✓	✓	National	Energy Efficiency

Title	Transitioning to National Energy Security: Bartica as a Model Green Town										
Duration	Status	Implementing Entity	Funding				Type of Funding			Geographic scope	Sectoral Scope
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2017-ongoing	Ongoing	Office of Climate Change (OCC)	Government of Italy	Grant	1,275,000	3,045,000	✓	✓	✓	Region 7	Energy Efficiency

Title	Promotion of Energy Efficiency Measures in the Manufacturing and Service Sectors										
Duration	Status	Implementing Entity	Funding				Type of Funding			Geographic scope	Sectoral Scope
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2011-2013	Completed	Guyana Manufacturing & Services Association (GMSA)	Inter-American Development Bank (IDB)	Grant	150,000		✓	✓	✓	National	Energy Efficiency

Title	Project for the Introduction of Renewable Energy and Improvement of Power System in Guyana										
Duration	Status	Implementing Entity	Funding				Type of Funding			Geographic scope	Sectoral Scope
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2018-2022	Completed	Guyana Energy Agency (GEA)	Japan International Cooperation Agency (JICA)	Grant	1,200,000		✓		✓	Region 4	Energy Efficiency

Title	Sustainable Business Models for Rural Electrification and Energy Access in Guyana										
Duration	Status	Implementing Entity	Funding				Type of Funding			Geographic scope	Sectoral Scope
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2015-2019	Completed	Hinterland Electrification Company Inc. (HECI)	Inter-American Development Bank (IDB)	Grant	1,333,240		✓	✓	✓	Regions 1, 2, 7, 8, 9	Rural Electrification

Title	Sustainable Energy Program for Guyana										
Duration	Status	Implementing Entity	Funding				Type of Funding			Geographic scope	Sectoral Scope
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2013-2023	Ongoing	Guyana Energy Agency (GEA)	Global Environment Facility (GEF)	Grant	2,200,000		✓	✓	✓	Region 8	Rural Electrification
		The Hinterland Electrification Company Inc. (HECI)	Global Environment Facility (GEF)	Grant	2,780,000		✓	✓	✓	National	

Title	Solar Home Systems										
Duration	Status	Implementing Entity	Funding				Type of Funding			Geographic scope	Sectoral Scope
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2021-ongoing	Ongoing	Guyana Energy Agency (GEA)	Government of India	Concessional loan	7,290,000	2,710,000	✓	✓	✓	National	Rural Electrification

Title	Power Utility Upgrade Program										
Duration	Status	Implementing Entity	Funding				Type of Funding			Geographic scope	Sectoral Scope
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2014-2021	Completed	Guyana Power and Light Inc. (GPL)	Inter-American Development Bank (IDB)	Concessional loan	36,568,750		✓	✓	✓	Regions 2, 3, 4, 5, 6, 9, 10	Training and Development
			European Union Caribbean Investment Facility (CIF)	Investment grant	21,965,250		✓	✓	✓		

Title	Sustainable Operation of the Electricity Sector and Improved Quality of Service										
Duration	Status	Implementing Entity	Funding				Type of Funding			Geographic scope	Sectoral Scope
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2011-2017	Completed	Guyana Power and Light Inc. (GPL)	Inter-American Development Bank (IDB)	Concessional loan	5,000,000		✓	✓	✓	National	Training and Development

Title	Power Sector Support Program

Duration	Status	Implementing Entity	Funding				Type of Funding			Geographic scope	Sectoral Scope
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2007-2012	Completed	Guyana Power and Light Inc. (GPL)	Inter-American Development Bank (IDB)	Concessional loan	12,000,000		✓	✓	✓	National	Training and Development
Title	**Strengthening Capacity in Energy Planning and Supervision**										
Duration	**Status**	**Implementing Entity**	**Funding**				**Type of Funding**			**Geographic scope**	**Sectoral Scope**
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2012-2016	Completed	Inter-American Development Bank (IDB)	Inter-American Development Bank (IDB)	Grant	740,000		✓	✓		National	Training and Development

3.2. Forestry Sector

The primary source of funding for climate change mitigation in the forestry sector is mobilised through the sale of forest climate services, which seek to put a fair value on the services provided by Guyana's forests as a national and global asset.

As set out earlier in this document, in 2009, Guyana's original LCDS set out a three-phase approach to the sale of these services, with Phase I being Results Based Payments from the Government of Norway, Phase II being integration with voluntary and compliance markets and Phase III being full integration with a UNFCCC-compliant system once operational.

Phase I saw the establishment of the Guyana REDD+ Investment Fund (GRIF) as the payment mechanism for the intermediation of funds received from Guyana's success in avoiding GHG emissions by minimising deforestation and forest degradation through maintaining forest cover. The GRIF was established in 2010 under the Guyana-Norway Partnership, signed by the two countries as a bilateral agreement in 2009. This partnership fostered the provision of results-based payments, released upon the successful completion of specified forestry sector mitigation actions as outlined in the joint concept note [7].

Initially conceptualised as a multi-donor fund, the GRIF currently relies solely on the Norwegian Agency for Development Corporation (NORAD) as the participating jurisdiction.

Guyana has now entered into the second phase of its three-phase approach building on Phase I, where GRIF created the capacities that were required by Guyana as it entered into Phase II, with participation in the Architecture for REDD+ Transactions Environmental Excellence Standard (ART-TREES), tailored for both voluntary and compliance carbon markets with the specific goal of preventing forest loss and degradation. Notably, Guyana stands as the first country globally with the opportunity to sell these credits to international enterprises, generating extensive additional financial resources. To accelerate climate change action in Guyana, proceeds from the sale of the credits issued by ART-TREES are being used to finance additional climate change mitigation projects across various sectors.

As a result, the GRIF and receipts from the sale of ART credits, constitute key components of the LCDS and serves as a major long-term funding source in Guyana. Moreover, activities supported through the GRIF, and other forestry sector actions strongly consider the need for continued capacity building of national stakeholders and rural communities in order to create widespread awareness and empowerment on forest protection actions, thereby strengthening the effectiveness of the implemented forest conservation and reforestation projects. Following a similar objective, substantial transfer of technology is fostered in the implementation of Guyana´s MRVS for REDD+ which utilises innovative imaging and processing technology allowing for detailed monitoring of the country´s forested areas.

Table 5.5 provides an overview of the total number of supported actions, the total amount received, and the amount yet to be disbursed for these initiatives. Notably, the large share of anticipated funding in the forestry sector is largely driven by outstanding ART-TREES carbon credits awaiting disbursement.

Table 5.5. Overview of funding status of forestry sector actions.

Number of actions supported	**5**
Actions involving capacity-building	**5**
Actions involving technology transfer	**0**
Total amount of support received	**$ 351,175,362 USD**
Total amount of support anticipated	**$ 575,283,409 USD**

Table 5.6 presents all the forestry sector actions that are completed, ongoing or planned and provides additional information on the financial source, instrument, and the scope of each activity. It is important to note that 'funding anticipated' refers to the ongoing disbursement of the financial resources to implement the relevant project or action.

Table 5.6. Detailed overview of support received and anticipated for forestry sector actions.

Title	Institutional Strengthening for the Implementation of the LCDS 2030 under REDD+ Partnerships										
Duration	**Status**	**Implementing Entity**	**Funding**				**Type of Funding**			**Geographic scope**	**Sectoral Scope**
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2011-2017	Completed	Guyana Forestry Commission (GFC)	GRIF - NORAD	Grant	7,467,412		✓	✓		National	Forestry
Title	**Guyana-EU Forest Law Enforcement, Governance and Trade Voluntary Partnership Agreement**										
Duration	**Status**	**Implementing Entity**	**Funding**				**Type of Funding**			**Geographic scope**	**Sectoral Scope**
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2012-2025	Ongoing	Guyana Forestry Commission (GFC)	GRIF - NORAD	Grant	1,700,000		✓	✓		National	Forestry
Title	**Guyana REDD+ Monitoring Reporting & Verification System (MRVS)**										
Duration	**Status**	**Implementing Entity**	**Funding**				**Type of Funding**			**Geographic scope**	**Sectoral Scope**
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2010-2025	Ongoing	Guyana Forestry Commission (GFC)	GRIF - NORAD	Grant	19,387,073		✓	✓	✓	National	Forestry
			GRIF - NORAD	Results-based Payments (Grant)	190,000,000	60,000,000	✓				
			Hess Corporation	ART-TREES/Carbon Credits	127,500,000	510,000,000	✓				
Title	**Forest Carbon Partnership Facility Project in Guyana**										
Duration	**Status**	**Implementing Entity**	**Funding**				**Type of Funding**			**Geographic scope**	**Sectoral Scope**
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2014-2020	Completed	Guyana Forestry Commission (GFC)	World Bank	Grant	3,800,000		✓	✓		National	Forestry

Title	Securing a Living Amazon through Landscape Connectivity in Southern Guyana									
Duration	**Status**	**Implementing Entity**	**Funding**				**Type of Funding**			**Geographic scope**	**Sectoral Scope**
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2022-2027	Ongoing	Environmental Protection Agency (EPA) / Protected Areas Commission (PAC)	Global Environment Facility (GEF)	Grant	1,030,551	4,122,202	✓	✓		Region 9	Forestry
			WWF	Grant	144,177	576,709	✓	✓			
			German Development Bank (KfW)	Grant	146,149	584,598	✓	✓			

3.3. Cross-cutting Sectors

In addition to activities in the energy and forestry sectors, a variety of cross-cutting projects are being implemented. Cross-cutting projects are those that impact two or more different sectors, encompassing activities addressing both mitigation and adaptation, as well as those providing mitigation co-benefits. Furthermore, projects focused on providing operational support and enhancing the capacity and readiness of national institutions for climate action fall under the umbrella of cross-cutting initiatives.

In Guyana, many of these projects are funded through the GRIF, generating co-benefits related to rural development and/or adaptation. Additionally, there are numerous projects aimed at providing operational support which tend to receive support in the form of grants provided by multilateral development funds such as the GEF or the GCF.

Table 5.7 provides a brief overview of the total number of supported actions, the total amount received, and the amount yet to be disbursed for these initiatives.

Table 5.7. Overview of funding status of cross-cutting sector actions.

Number of actions supported	**11**
Actions involving capacity-building	**10**
Actions involving technology transfer	**0**
Total amount of support received	**$ 61,410,457 USD**
Total amount of support anticipated	**$ 103,804,349 USD**

Much like the observed funding still anticipated in the forestry sector, the outstanding amount of support yet to be received is primarily linked to non-disbursed funds from carbon credits and from results-based payments of the GRIF. Notably, through the GRIF, extensive cross-cutting activities are supported which foster the access to and the training on information technologies in rural communities to enhance connectivity and accelerate the uptake of sustainable practices.

Table 5.8 outlines all cross-cutting sector actions, indicating whether they are completed, ongoing, or planned. Additional information is provided on the financial source, instrument, and the scope of each activity. It is important to note that 'funding anticipated' denotes the ongoing need for the disbursement of financial resources to facilitate the implementation of the respective projects or actions.

Table 5.8. Detailed overview of support received and anticipated for cross-cutting sector actions.

Title	Amerindian Development Fund									
Duration	Status	Implementing Entity	Funding				Type of Funding			Geographic scope	Sectoral Scope
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2012-2016	Completed	Ministry of Amerindian Affairs (MoAA)	GRIF - NORAD	Grant	8,143,042		✓	✓		National	Hinterland Development

Title	Support for Micro and Small Enterprise and Vulnerable Groups' Low-Carbon Livelihoods										
Duration	Status	Implementing Entity	Funding				Type of Funding			Geographic scope	Sectoral Scope
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2012-2018	Completed	Ministry of Business (MoB)	GRIF - NORAD	Grant	5,127,476		✓	✓		National	Economic Development

Title	Amerindian Land Titling										
Duration	Status	Implementing Entity	Funding				Type of Funding			Geographic scope	Sectoral Scope
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2013-ongoing	Ongoing	Ministry of Amerindian Affairs (MoAA)	GRIF - NORAD	Grant	4,340,746	6,415,244	✓	✓		National	Hinterland Development

Title	Information and Communications Technology (ICT) Access and E-services for Hinterland, Remote, and Poor Communities										
Duration	Status	Implementing Entity	Funding				Type of Funding			Geographic scope	Sectoral Scope
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2017-ongoing	Ongoing	Office of the Prime Minister (OPM)	GRIF - NORAD	Grant	17,030,752	3,755,320	✓	✓	✓	National	Hinterland Development

Title	Village Sustainability Plans										
Duration	Status	Implementing Entity	Funding				Type of Funding			Geographic scope	Sectoral Scope
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2021-2025	Planned	Ministry of Amerindian Affairs (MoAA) / National Toshaos Council (NTC)	GRIF - NORAD	Grant		3,400,000	✓	✓		National	Hinterland Development

	Ongoing	Ministry of Amerindian Affairs (MoAA)	Hess Corporation	ART-TREE/Carbon Credits	22,500,000	90,000,000	✓				
Title	**Strengthened Monitoring, Enforcement and Uptake of Environmental Regulations in Guyana's Gold Mining Sector**										
Duration	**Status**	**Implementing Entity**	**Funding**				**Type of Funding**			**Geographic scope**	**Sectoral Scope**
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2014-2017	Completed	Environmental Protection Agency (EPA)	GRIF - NORAD	Grant	803,653		✓	✓		National	Economic Development
Title	**Guyana-Norway Partnership Operational Support – GGGI**										
Duration	**Status**	**Implementing Entity**	**Funding**				**Type of Funding**			**Geographic scope**	**Sectoral Scope**
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2021-2024	Ongoing	Green Global Growth Institute (GGGI)	GRIF - NORAD	Grant	935,138	233,785	✓	✓		National	Operational Support
Title	**GRIF operational Support – Trustee**										
Duration	**Status**	**Implementing Entity**	**Funding**				**Type of Funding**			**Geographic scope**	**Sectoral Scope**
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2011-ongoing	Ongoing	World Bank	GRIF - NORAD	Grant	1,340,000		✓			National	Operational support
Title	**Enabling Guyana to Prepare its First National Communication in Response to its Commitments to UNFCCC**										
Duration	**Status**	**Implementing Entity**	**Funding**				**Type of Funding**			**Geographic scope**	**Sectoral Scope**
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
1997	Completed	Government and Guyana with support of the United Nations Development Programme (UNDP)	Global Environment Facility (GEF)	Grant	196,700		✓	✓		National	Operational support

Title	Development of Guyana's National Climate Finance Strategy, MRV Framework and Project Pipeline to Support NDC Implementation									
Duration	**Status**	**Implementing Entity**	**Funding**				**Type of Funding**			**Geographic scope**	**Sectoral Scope**
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2020-2023	Completed	Department of Environment and Climate Change / Green Global Growth Institute (GGGI)	Green Climate Fund (GCF)	Grant	692,950		✓	✓		National	Operational support

Title	National Designated Authority (NDA) Strengthening and Country Programming support for Guyana through CCCCC										
Duration	**Status**	**Implementing Entity**	**Funding**				**Type of Funding**			**Geographic scope**	**Sectoral Scope**
			Source	Financial Instrument	Disbursed (USD)	Anticipated (USD)	Financial Support	Capacity-building	Technology Transfer		
2015-2016	Completed	Caribbean Community Climate Change Centre (CCCCC)	Green Climate Fund (GCF)	Grant	300,000		✓	✓		National	Operational Support

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6 National MRV

1. The Concept of MRV

1.1. International Context

The United Nations Framework Convention on Climate Change (UNFCCC) is the foundation for the current system of reporting of information related to the global intergovernmental action to combat climate change. As per its Article 12, it requires all Parties to communicate to the Conference of the Parties (COP) information relevant to the implementation of the Convention. This is a key element that supports the provision of reliable, transparent, and comprehensive information that allows for assessing the progress in the implementation of the Convention [1].

Throughout the years, the arrangements for national reporting have evolved into a more comprehensive measurement, reporting, and verification (MRV) framework. This concept of MRV was first adopted in 2007 through the Bali Action Plan at the 13th Conference of the Parties (COP 13) of the UNFCCC [2] and provides the foundation for the subsequent elaboration of the existing comprehensive MRV framework for developing country Parties. The concept of MRV was further elaborated in decisions adopted at subsequent COPs and several decisions were adopted detailing guidance on the establishment of the provisions for national frameworks for MRV. More recently it has been extended and reinforced under the Enhanced Transparency Framework (ETF) of the Paris Agreement in 2015, which aims to provide a clear understanding of Parties' climate change action including good practices, priorities, needs and gaps [3].

The ETF includes new reporting requirements which are further defined in the Modalities, Procedures, and Guidelines (MPGs). The MPGs define the set of rules for reporting and review of information submitted by Parties under the ETF of the Paris Agreement and outline in detail the reporting requirements for all country Parties, developed and developing country Parties alike, to the Paris Agreement [4].

As such, the ETF dilutes the difference between the reporting requirements of developed and developing countries, and the enhanced reporting provisions under the Paris Agreement will therefore provide substantial obstacles to developing countries and imply a strengthening of the reporting requirements for developing country Parties, regarding frequency and scope of reporting. It is thus important for all countries to make decisions regarding the institutionalisation of its MRV frameworks to ensure their capacity to provide high-quality data in the right formats and at the right time.

However, it is important to note that the MPGs provide flexibility to those countries that require it in light of their capacities and to least-developed-country (LDC) Parties and small island developing states (SIDS). Although Guyana is recognised as a SIDS, preparations for the ETF have already been initiated.

1.2. Components of MRV Frameworks

Developing and setting up comprehensive national MRV frameworks is thus an essential element for developing country Parties to comply with the enhanced international reporting requirements. Developing a national and integrated MRV framework can be seen as a way of systematising the activities needed for reporting by:

- **Formalising institutional arrangements** defining clear roles and responsibilities of all stakeholders involved.
- **Developing step by step manuals** (named as MRV procedures and protocols) defining all the activities to be done under the MRV (data collection, estimation, verification, reporting).
- **Setting up data management systems** for data sharing, archiving and dissemination.

There are several elements under the UNFCCC and the Paris Agreement that require the provision of reliable, transparent, and comprehensive information. Each of these elements possesses unique characteristics, involves distinct scopes, and diverse data implications. It is therefore essential to comprehend the nature of each element, as they contribute to the comprehensive reporting requirements, ensuring a thorough understanding of the multifaceted aspects involved in compliance with the UNFCCC and the Paris Agreement. The different subsystems within a national and integrated MRV framework are depicted in Figure 6.1.

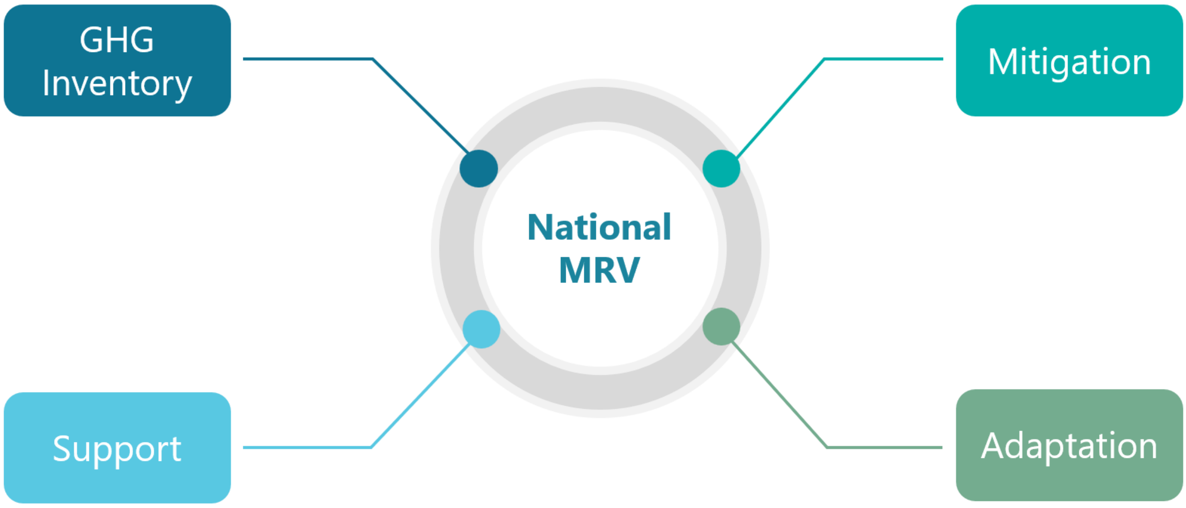

Figure 6.1. MRV subsystems of a national MRV framework.

2. The National MRV Framework of Guyana

The Government of Guyana has proactively worked towards strengthening its national MRV framework for climate change reporting. In establishing a national MRV framework, Guyana has a unique opportunity to efficiently conform to the requirements of the approaching ETF and initiate the incorporation of institutional arrangements that encompass all MRV subsystems essential for implementing the Paris Agreement.

Over the years, Guyana has diligently built capacities and implemented various policies that serve as a solid foundation for the enhanced reporting structure. Once these efforts are formalised and officially adopted, they will play a crucial role in systematically monitoring Guyana's endeavours and ensuring compliance with the existing framework for international progress reporting on a continuous basis.

As such, Guyana is now in the crucial stage of defining the systems required to estimate the national greenhouse gas (GHG) inventory, determine and track mitigation actions, and define the support needed and received in compliance with the reporting requirements under the UNFCCC and the Paris Agreement. The country has already established a national Reducing Emissions from Deforestation and Degradation (REDD+) monitoring, reporting, and verification system (MRVS) and has advanced work on developing sectoral MRV frameworks for the agriculture and energy sectors of the national GHG inventory.

2.1. Overall Coordination of National MRV Framework

2.1.1. Legal Framework

The Constitution of the Co-operative Republic of Guyana, enacted in 1980 and amended in 2001, is the supreme law of Guyana, rendering any conflicting legislation void to the extent of inconsistency.

The Constitution recognises the right of every person to an environment that is not harmful to his or her health or well-being and the duty of every citizen to participate in activities designed to improve the environment and protect the health of the nation. Furthermore, it expresses Guyana's commitment to protect its natural environment and resources while taking advantage of global finances, industry, communication, education, business, and technology.

The Environmental Protection Act of 1996, along with its 2005 Amendment, serves as the legislative framework for implementing environmental provisions outlined in the Constitution. The Act and its amendment cover aspects such as management, conservation, protection, and improvement of the environment; prevention or control of pollution; assessment of the impact of economic development on the environment; and the sustainable use of natural resources.

While not explicitly addressing climate change, the Constitution empowers the Environmental Protection Agency (EPA), which was established under the Environmental Protection Act in 1996, to implement measures for the effective management of the natural environment and its various components and to ensure the right to healthy environmental conditions, laying the groundwork for potential climate-related legislation.

2.1.2. Institutional Arrangements

The core components of a national MRV framework hinge on well-structured institutional arrangements that ensure the seamless flow of information from various stakeholders, including government agencies, the private sector, non-governmental organisations (NGOs), and international institutions. These arrangements set a clear framework for the flow of data and information.

In Guyana, the Office of Climate Change (OCC) within the Office of the President was established in 2009 and was the National Focal Point (NFP) to the UNFCCC. In this role, it had the responsibility to coordinate Guyana's international reporting requirements.

In 2020, the OCC merged with the DoE forming the Department of Environment and Climate Change (DECC) under the Office of the President, which is currently the NFP to the UNFCCC and is tasked with coordinating Guyana's international engagements with the UNFCCC and other climate change processes both nationally and internationally. As such, DECC is the governmental agency responsible for developing and implementing national policies and actions for 'climate change mainstreaming' and coordinating efforts to mitigate and adapt to climate change.

DECC has been taking on aspects of a coordinating role, working with key agencies in this process. DECC has several data sharing agreements (DSA) or memorandums of understanding (MoUs) with other public and private entities to facilitate the process and plans to initiate other such agreements to mainstream data provision. DECC works with local and international consultants. This process is depicted in Figure 6.2.

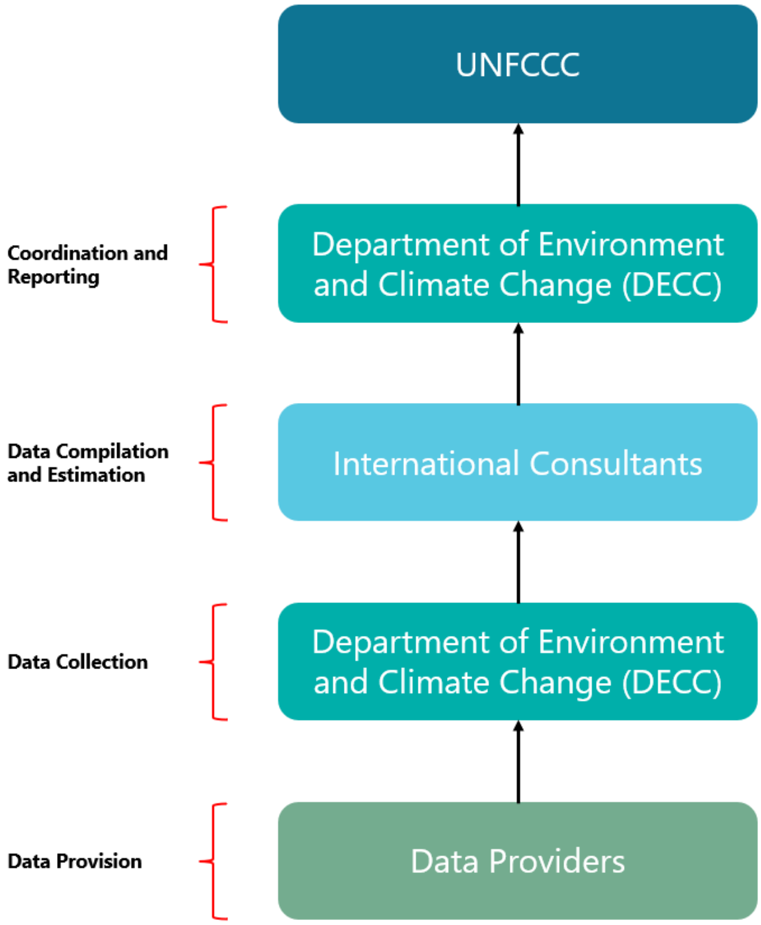

Figure 6.2. Guyana's current institutional arrangements.

Guyana has been actively developing and setting up a national MRV framework aimed at putting in place a sustainable institutionalised framework with clear processes and procedures. As the country progresses towards the establishment of a national MRV framework, the following key activities will be prioritised in its development within each sector:

- Building on existing foundations placing emphasis on leveraging existing processes and procedures to form the basis of the national MRV framework.
- Creating easy to follow systems that exploit synergies between various reporting components, ensuring efficiency and coherence.
- Defining distinct roles and responsibilities to streamline the functioning of the national MRV framework.
- Securing data flows through diverse legal instruments that are tailored to the specific circumstances and nature of the entities involved.
- Ensuring stakeholder engagement from conceptualisation of the national MRV framework to establish trust among stakeholders to encourage the seamless provision of data and to build technical capacities to enable stakeholders to continuously update and enhance their data.
- Incorporating gradual implementation and continuous improvement of the national MRV framework to ensure the long-term sustainability in order to comply with all requirements of the ETF.

2.2. MRV of GHG Inventory

To ensure the sustainable preparation and reporting of the national GHG inventory without relying on international support, the country is actively working on establishing a GHG inventory MRV framework that encompasses all relevant sectors.

The recently designed energy sector MRV framework [5] and MRV framework for the agriculture sector in Guyana [6] exemplify these ongoing initiatives, while the industrial processes and product use (IPPU) and waste sectors will be designed in 2024. This will enable Guyana to sustainably compile complete and accurate information to estimate GHG emissions in all the relevant Intergovernmental Panel on Climate Change (IPCC) sector categories, sub-categories and sources of the national GHG inventory of Guyana. Such endeavours will allow Guyana to ensure national capacity to communicate reliable, transparent, and comprehensive information allowing to meet the enhanced reporting requirements under the Paris Agreement of the GHG inventory to the UNFCCC and take informed policy decisions at national level.

As part of the GHG inventory MRV framework, the establishment of well-considered, relevant institutional arrangements are a key enabling factor for the continued estimation, compilation and timely preparation and submission of Guyana’s national GHG inventory. The general institutional arrangements within the GHG inventory MRV framework of Guyana have designated a responsible entity or entities in the country, as follows.

Political oversight and verification

The Office of the President is the designated political oversight and verification body of the information to be submitted to the UNFCCC. The Office of the President has the high-level political decision-making power that would be required of this role, and the designation of the Office of the President for providing the final approval of all reports before they are sent to the UNFCCC will help to ensure that the feedback of a variety of ministerial representatives is considered, helping to leverage synergies and implement climate action as well as encourage buy-in in terms of international climate reporting across the public sector.

National coordination and reporting

The Department of Environment and Climate Change (DECC) is assigned the role of coordination and reporting. The DECC is the designated national focal point (NFP) in Guyana, and GHG Inventory compilation and UNFCCC reporting fall under this agency. As the DECC has already taken on aspects of coordination and reporting in prior inventory cycles and additionally has coordination responsibilities with respect to climate change activities as a core aspect of its institutional mandate, it will be well-equipped to take on this role within the GHG inventory MRV framework. Building on the coordination role already assigned to DECC, ideally, this agency should house the National Inventory Coordinator, whose main responsibility will be the coordinating and overseeing of the national MRV framework implementation and administration.

Technical Quality Assurance

The national MRV framework proposes to establish an inter-agency technical committee. The composition of this inter-agency technical committee will require further attention, which Guyana aims to conduct in 2024. As such, the establishment of an inter-agency technical committee will require additional input to identify relevant and willing institutions with the capacities and interest to contribute to the inter-agency technical committee.

Sectoral data collection and estimation

Sectoral data collection and estimation involves taking charge of gathering data for a specific sector. The objective is to streamline communication with pertinent stakeholders, ease reporting, and assume the responsibility of estimating emissions and removals for the corresponding subsector.

Data provision

There is a substantial list of data providers which play a crucial role in providing essential data for the estimation of the GHG emissions. These data providers engage in the collection of crucial information from a multitude of sources, encompassing public records, surveys, sensors, research findings, databases, social media, and other diverse formats.

Figure 6.3 presents the institutional arrangements for the national GHG inventory MRV framework of Guyana.

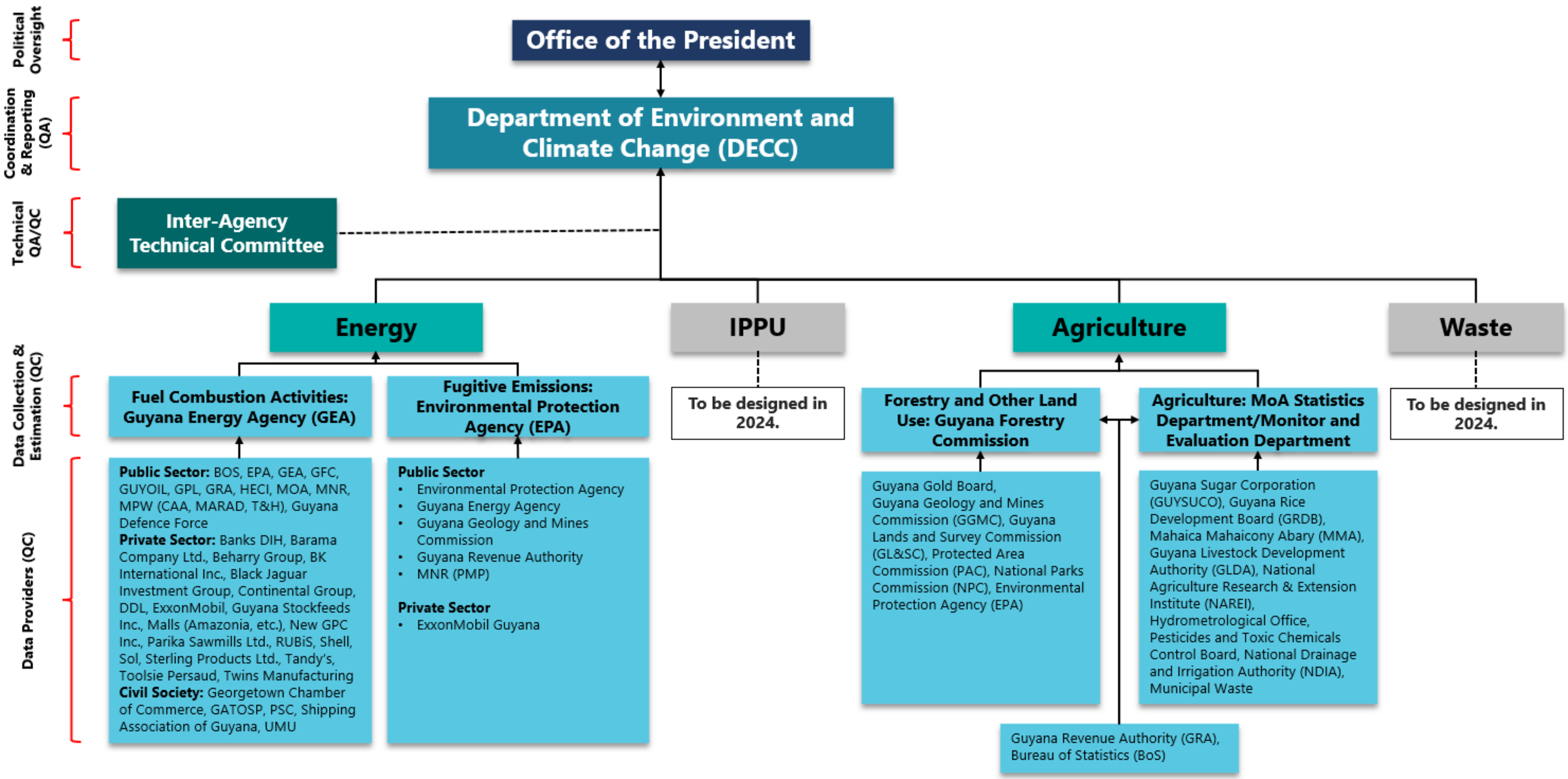

Figure 6.3. Institutional arrangements for the GHG inventory MRV framework.

These core functions, as part of the designed national GHG inventory MRV framework, each require conducting specific activities, hold certain responsibilities, and be in the possession of several expected capacities. Figure 6.4 provides an overview of the process between each of the roles and responsibilities. It shows the flow of the steps that are conducted by each function and the activity that is being conducted in each step.

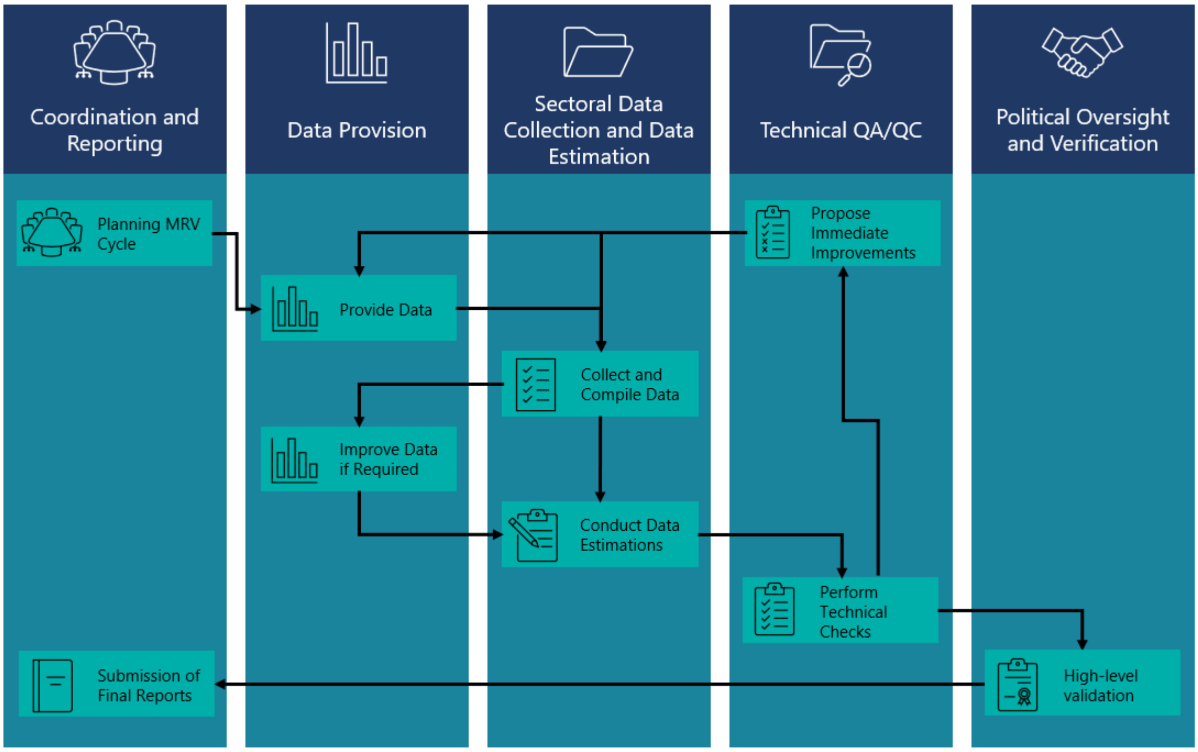

Figure 6.42. Overview of the processes between the different roles and responsibilities within the GHG inventory MRV framework.

2.3. REDD+ MRVS

Guyana has established and implemented a REDD+ monitoring, reporting, and verification system (MRVS), which is fully operational. REDD+ refers to a process moderated by the UNFCCC which supports countries' efforts to reduce emissions from deforestation and forest degradation, and foster conservation, sustainable management of forests, and enhancement of forest carbon stocks.

In 2009 the Governments of Guyana and Norway agreed to cooperate on broader emission reduction goals under the umbrella of UNFCCC-REDD+. The activity resulted in the development of a MRVS for a comprehensive, consistent, transparent, and verifiable assessment of forest area change [7]. Through this, the Government of Guyana aims to protect and maintain its forests in an effort to reduce global carbon emissions and at the same time attract resources to foster growth and development along a low carbon emissions path.

As an initial step to the implementation of a REDD+ MRVS for Guyana, a road map for the development of a MRVS for REDD+ participation for Guyana was designed. Furthermore, a capacity gap assessment was done to evaluate Guyana's capacities and REDD specific characteristics to provide the basis to specify the recommendations and next steps for developing capacities for the implementation of an MRVS for Guyana.

As such, the overall goal was a capacity development process to establish a sustained MRVS for implementing REDD policies and results-based compensation in Guyana and the development of a national REDD+ MRVS which uses a phased approach along a roadmap that specifies near-term priorities & long-term targets.

The execution of the work is centralised at the Guyana Forestry Commission (GFC) agency within the Ministry of Natural Resources. The GFC is the focal agency for coordinating all aspects of data collection, analysis, research execution and assessments and for routine continuous monitoring of the system.

Roadmap Phase 1

The MRVS roadmap for phase 1 (2010 to 2014) was designed to guide the development of a MRVS for REDD+ in Guyana [8]. Seven key areas as immediate activities for starting the capacity development process for Guyana were identified for the first phase:

1. Develop and implement a national mechanism and institutional framework.
2. Conduct a comprehensive forest area change assessment for a historical period.
3. Build carbon stock measurement capacities.
4. Develop MRVS for a set of REDD demonstration activities.
5. Engagement with international community.
6. Sustained internal communication mechanism on MRVS.
7. Conduct/support research on key issues.

As such, phase 1 included a detailed capacity assessment based on the state of the existing national forest monitoring technical capabilities and the requirements for implementation of the MRVS in order to define a detailed plan to establish sustained MRVS capacities within the country and to bridge the gap in capacities. Through the realisation of phase 1 of the roadmap, Guyana made significant achievements in implementing a national forest monitoring and MRVS. The key achievements under phase 1 are summarised in Table 6.1 [8].

Table 6.1. REDD+ MRVS roadmap phase 1 achievements (2010 to 2014).

Priority	Key areas of achievement
Objectives	Gather and integrate information & fill data gaps for national REDD opportunities, scoping, and REDD+ implementation.
Key results and national capacities developed	• MRVS roadmap completed, MRVS Steering Committee formed and meets quarterly. Partnerships established with bodies such as CI, World Wildlife Fund (WWF), Iwokrama, etc. • Dedicated national focal points for Low Carbon Development Strategy (LCDS), REDD+, and IPCC and capacity built within each. • Data collection, analysis and reporting capabilities built in forest area change assessment and forest carbon measurement and monitoring, and interim reporting with standard operating procedures and protocols developed. • Data available on forest carbon, forest area, land use and allocation, historical drivers of change and current drivers, location specific details on forest change. Methods, and training materials. Satellite imagery. • Assessment of historical emissions, two/three annual periods of emission estimates, Proposal for forest reference emission level (FREL) for REDD+ for submission to UNFCCC in last quarter of 2014 [9] Exploring co-benefits and synergies.
Objectives	Develop capacities, conduct historical monitoring, and implement a (minimum) IPCC Tier 2 national forest carbon monitoring, establish the FREL and report on interim performance.
Key results and national capacities developed	• Capacities in place for consistent and continuous acquisition and analysis of key data for Tier 2 nationally and Tier 3 for demonstration/activity sites including international reporting using IPCC - Land Use, Land Use Change and Forestry (LULUCF); uncertainty assessment; MRVS improvement plan developed. • FREL established based on historical data, and future developments using internationally accepted methods. • Regular reporting on REDD demonstrations and interim performance • Continued engagement with key national stakeholders for REDD+ implementation and assuring long-term sustainability of MRVS capacities (i.e. universities).
Objectives	Establish consistent and continuous MRVS supporting national REDD+ actions and international IPCC good practice reporting and verification.
Key results and national capacities developed	• IPCC key category analysis completed, key elements operating at Tier 3, Independent international review of MRVS reporting. • Institutional capacity to deliver verified and compliance assessment. Facilitate verification and process involved. • National data infrastructure of management data and land cover data established. Central database continually updated. • Integration of key aspects of new and improved technologies in areas of accuracy assessment, monitoring of forest degradation, high resolution data coverage, exploration of radar-based data usage in Recover Project, etc.

Roadmap Phase 2

The overall aim of phase 2 of the roadmap (2015 to 2019) was to consolidate and expand capacities for national REDD+ monitoring and MRVS [8]. This supports Guyana in meeting the evolving international reporting requirements from the UNFCCC as well as continuing to fulfil additional reporting requirements e.g., meeting obligations under the bilateral cooperation agreement with the Government of Norway. It also supported Guyana in further developing forest monitoring as a tool for REDD+ implementation. Consolidating and expanding capacities following phase 2 of the roadmap allowed Guyana to fulfil its REDD+ objectives to:

- Underpin and stimulate strategies and priorities for REDD+ implementation.
- Track performance of REDD+ activities and their impacts (carbon & non-carbon).
- Continue to support the building of capacity for MRVS implementation at the government and non-government levels and with other parties that have a role in MRVS related activities.

Three specific areas were identified where key activities are recommended in order to consolidate and expand capacities:

1. Consolidate capacities and routine REDD+ monitoring and MRVS.
2. Develop national forest monitoring as a tool for REDD+ implementation.
3. Knowledge sharing and capacity building.

As such, the focus of phase 2 of the roadmap was to retain the reporting standards and capacities already achieved while also streamlining processes, improving functionality, and reducing operational costs (i.e. the reliance on commercial image data) post-2019. The key achievements under phase 2 are summarised in Table 6.2 [8].

Table 6.2. REDD+ MRVS roadmap phase 2 achievements (2015 to 2019).

Priority	Key areas of achievement
1. Consolidate capacities and routine REDD+ monitoring and MRVS.	
Continue routine monitoring of activity data and emission factors	• Capacities developed at the GFC, to continue monitoring activity data and emission factors on a routine basis in Guyana, which provided annual estimates of forest-related emissions. • Developed methods for accounting for additional activities, including shifting cultivation and degradation from mining, infrastructure, and illegal logging. • Developed an improved long-term monitoring plan for Guyana's forest monitoring.
Refining the measurement and reporting of forest degradation	• Developed and adopted a definition of degradation. • Consolidated analysis of relevant drivers of forest degradation. • Definition for monitoring forest degradation and modalities for monitoring each driver of forest degradation finalised.

Priority	Key areas of achievement
Improve emission factors for some specific processes (towards Tier 3)	• Eliminated stratification based on additional field plots and developed country-wide emission factors by activity, with low uncertainty. • Continued field-based measurements on forest carbon stocks and stock changes, allometry, and increasing total plots and ensuring the entirety of the country was well represented. • Emission factors from shifting cultivation finalised and monitoring protocols finalised.
Advance uncertainty assessments	• Uncertainty assessment completed on other types of errors in addition to sampling errors in the emission factors (e.g. Monte Carlo approaches).
Develop foundations and data sources for a REDD+ SIS	• Guyana's First Summary of Information (SoI) completed on REDD+ Safeguards and submitted to the UNFCCC.
2. Develop national forest monitoring as tool for REDD+ implementation.	
Institutional arrangements and multi-sector engagement	• Multi Sector Engagement launched and active with data sharing operationalized. • Agreement developed in the form of a MoU for use of data across agencies and partners.
Expand national monitoring to include local communities and stakeholders	• Standard Operating Procedures developed including user friendly documentation for non-technical users. • Technical capacities of local forest-based communities built in monitoring of community forest resources (Community MRV).
Options for near-real time monitoring for high priority sites	• Data agnostic system developed benefitting from the testing completed on different data streams and their usefulness and integration for near-real time monitoring. • A framework developed to use near-real time monitoring to ensure compliance.
3. Knowledge sharing and capacity building.	
Exchange of information and capacities with national stakeholders	• A system of communication and explanation of the national forest monitoring system to different governmental actors initiated. • Agreement with the University of Guyana on data sharing, use and feedback.
Engage in South-South collaboration	• Project partnerships created in the Guiana Shield Region and Amazon Basin through Amazon Cooperation Treaty Organization (ACTO) and Ecosystemic Services Observatory of the Guiana (ECOSEO) Projects. • Training and Capacity Building programme continuous.
Scientific work, publication and synthesis	• Partnership established with the University of Guyana. • Publications in scientific Journals and Technical Conferences. • Guyana experiences in research collaborations and international processes shared with international partners including Global Forest Observations Initiative (GFOI), National Aeronautics and Space Administration (NASA), Google Earth Engine, and Forest Carbon Partnership Facility (FCPF).

Roadmap Phase 3

The overall objective for phase 3 of the roadmap (2020 to 2025 and beyond) is to maintain an efficiently functioning MRVS that meets international and national requirements and that supports natural resources management in Guyana [10]. This will support Guyana in meeting the evolving international reporting requirements from the UNFCCC as well as continuing to fulfil additional reporting requirements. The MRVS will address the needs of the Paris Agreement and the guidance of the accompanying Katowice Rulebook on the enhancing the transparency framework, the reporting needs related to Biennial Update Reports (BUR) and tracking of Guyana's progress in implementing its NDC commitments. It will also support Guyana in further developing forest monitoring as a tool for REDD+ implementation. Consolidating and expanding capacities following phase 3 of the roadmap will allow Guyana to fulfil its REDD+ objectives to:

- Underpin and stimulate strategies and priorities for REDD+ implementation.
- Track performance of REDD+ activities and their impacts (carbon & non-carbon).
- Continue to support the building of capacity for MRVS implementation at the government and non-government level and other parties that have a role in MRVS related activities.

Three specific areas were identified where key activities are recommended in order to consolidate and expand capacities:

- Maintain fully operational MRVS and mainstream results at policy, decision making and stakeholder levels locally and internationally.
- Consolidate existing REDD+ monitoring and MRVS processes.
- Mainstreaming reporting and verification systems for MRVS applications and agreements.

Within the third phase emphasis will be placed on consolidating existing methodologies to meet annual forest change reporting requirements, while also improving the system to provide regular forest change updates and to make the data layers generated more readily available. This shift is seen as an important step in making the current system more sustainable by integrating the MRVS monitoring function into sustainable management of Guyana's natural resources, and the development and implementation of appropriate land use policies.

After twelve years of annual monitoring (2010-2022), of equal importance is the dissemination of MRVS results, engagement in dedicated research, and the communication and sharing of knowledge within and outside of Guyana.

2.4. MRV of Mitigation Actions

Guyana is actively engaged in implementing various mitigation actions and the country is exploring the establishment of an MRV framework dedicated to tracking the progress of mitigation efforts. In these instances, the existing approach is project-based, relying solely on data obtained from sources associated with mitigation action funding.

Recognising the importance of a more comprehensive and systematic approach to MRV of mitigation activities, Guyana is currently in the process of establishing a robust mitigation MRV framework, commencing in 2024.

2.5. MRV of Support

Guyana plans to develop an MRV framework and methodology for tracking climate support needed and received as part of the national MRV framework. This will enable the assessment of needed technological, financial, and capacity-building support, as well as tracking the support received.

Guyana is currently in the process of developing a robust support MRV framework for which work will start in 2024.

2.6. National MRV Data Management System

Although not yet in place, Guyana is intending to develop a sector led data management system as part of its national integrated MRV framework. The country will work to create a structure to feed information from the sector level into a reporting system for the UNFCCC. The envisioned data management system will collate data at the sector level and support the organisation, storage, and archiving of Guyana's information utilised within its national MRV framework. This, in turn, will play a crucial role in shaping national policies and plans while ensuring the fulfilment of the country's reporting obligations to international agreements.

By creating this networking structure, the national MRV, with implementation at the sector level generating inputs for a dedicated data management system, Guyana aims to integrate all MRV subsystems. This approach is designed to facilitate the fulfilment of commitments under both the UNFCCC and the Paris Agreement, providing an effective solution for comprehensive and streamlined reporting processes.

The data management system for Guyana’s national MRV framework will be developed based on several key considerations:

1. **Agreement on consistent and comparable definitions:** Adopting consistent and comparable definitions, abbreviations, and acronyms will support alignment of datasets, which allows for more detailed comparisons and, ultimately, better informs policy discussions.
2. **Stakeholder engagement and consultation during design and development:** Identifying and engaging stakeholders is crucial for the design of the data management system. This process offers various benefits, such as aligning the system with national priorities, securing early buy-in from key user groups, and building capacity to reduce data entry errors. Stakeholder engagement also aids in maintaining public support and refining the system by gathering feedback on specific needs and functional components during requirements gathering and testing.
3. **Gradual implementation and continuous improvement framework for long-term sustainability:** Regular enhancements to the data management system will be anticipated to align with evolving policy landscapes and enhance overall system functionality. This will ensure the adaptability to policy changes and the ability to harmonise data from various reporting elements.
4. **Build sense checking into systems to ensure robust data systems:** Input errors are likely to occur when large volumes of data are submitted to the system, undermining users' confidence in the data quality. To mitigate these errors, checks will be incorporated into the data submission process including safeguards to ensure data integrity. This will ensure user confidence in the robustness of the data, which will ensure that the data is used for decision-making.
5. **Create data security and integrity controls:** Security measures will be incorporated for authenticating access to ensure that the data on the system is protected.
6. **Training and support to ensure that the system is used effectively and reduces user error:** Enhanced user understanding of the data management system improves the accuracy of data submissions. Post-system development, supporting and building the capacity of climate data management users will be ensured for smooth operations. In addition, the diverse capacities among reporters are recognised and an ongoing system for user training will significantly improves data submission quality.

As such, the data management system of Guyana is planned to digitise the various aspects of climate change actions and tracking. This encompasses the storage and archiving of data related to GHG inventories, mitigation actions for NDC tracking, and support. The system will be designed to monitor the country's adherence to international commitments under the UNFCCC and the Paris Agreement and generate information to inform national and regional policies related to climate change action and support.

The National Data Management Authority (NDMA) is the legislative authority for data management, storage, and archiving. Established by the National Data Management Authority Act in 1983, the NDMA is tasked with developing automated solutions to enhance efficiency in the public sector in Guyana. By supporting government agencies and ministries, the NDMA ensures the delivery of government services on an interconnected mediation platform. This positions the NDMA as the ideal entity to oversee the data management system, safeguarding its confidentiality, integrity, and availability through its cyber security department.

Capacities at the sector level will be enhanced to consistently generate required data for UNFCCC reporting.

2.6.1. GHG Inventory Module

It is planned for the GHG inventory module within the data management system to utilise the IPCC Inventory Software for the management, storage, and generation of national GHG estimates. This software allows multi-user access from a centralised location, producing reporting tables in the required format for submission to the UNFCCC. This minimises the risk of errors during data transfer into the mandated table format. As such, the IPCC Inventory Software serves as an ideal database for storing and managing GHG data of Guyana as part of the national MRV framework.

All agencies contributing information for the national GHG inventory must input their data into the data management system. Once entered into the IPCC Inventory Software, all information informing the estimates is archived when the inventory version is archived. The dedicated server housing this data is managed and hosted by the NDMA, the agency overseeing the overall management of the data management system.

2.6.2. Mitigation Module

The mitigation module will oversee the management, storage, and archiving of national-level mitigation actions utilising the mitigation tracking tool that Guyana is currently developing. The DECC will hold the responsibility for managing this data, while the NDMA will administer access to the data collection tool based on DECC guidance. Consequently, all documents related to mitigation projects for UNFCCC reports will be stored by the NDMA, accessible upon request.

2.6.3. Support Module

The support module will handle the management and storage of information related to financial, technological, and capacity-building transfers. The data management system will be linked to the support tracking tool that Guyana currently is developing.

2.6.4. Overview

The data management system will enable multi-access and multi-use for the various users. Its implementation will occur in phases, consolidating all components of various MRV subsystems into a unified data system (Figure 6.5).

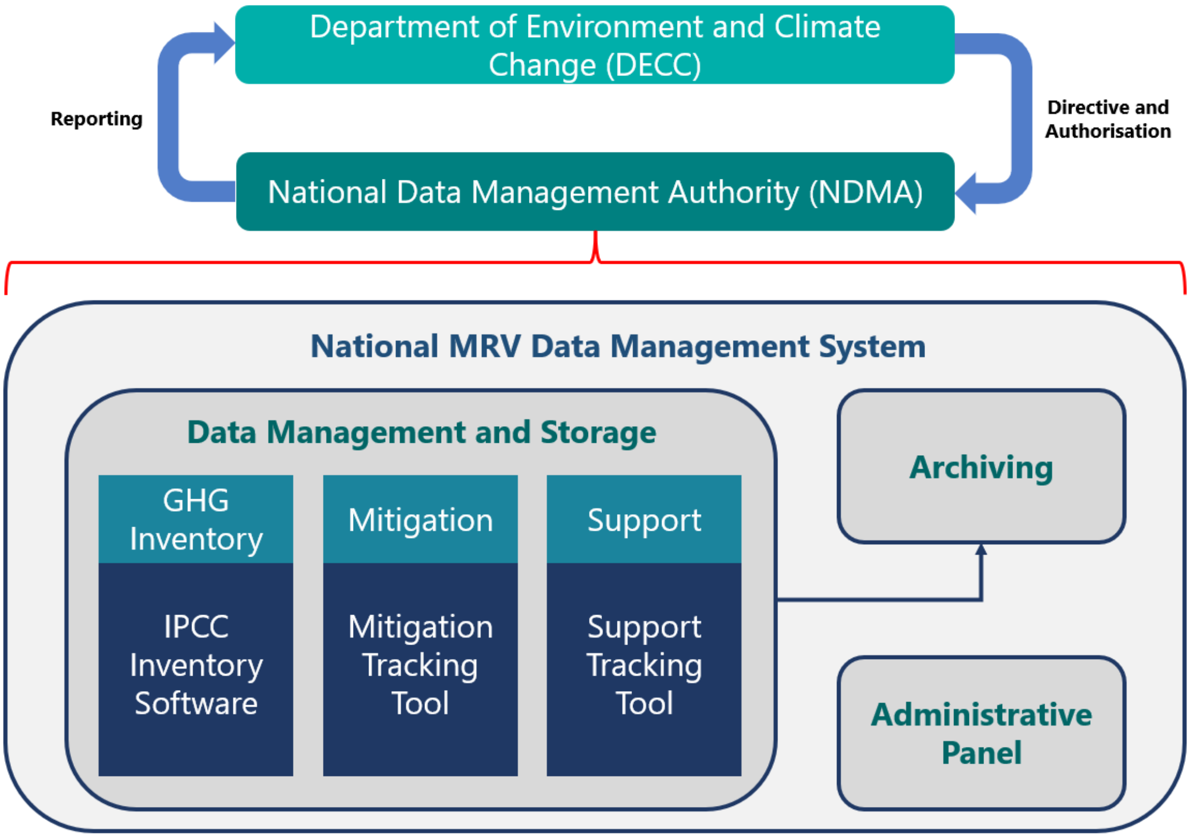

Figure 6.5. Overview of proposed national MRV data management system of Guyana.

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Annex I | Key Category Analysis

Table AI.1. Key category analysis with FOLU – level assessment for 2022.

IPCC Category	Gas	Emissions year 2022 (Gg CO_{2e}) *	Absolute value of emissions year 2022 (Gg CO_{2e})	Contribution for year 2022 (%)	Cumulative contribution total for year 2022 (%)	KCA order 2022
3B1a – Forest Land Remaining Forest Land	CO_2	-148,875.77	148,875.77	90.9	90.9	**1**
3B6B – Land Converted to Other Land	CO_2	5,534.47	5,534.47	3.4	94.2	**2**
1B2a – Oil	CH_4	1,540.15	1,540.15	0.9	95.2	**3**
*Positive values correspond to emissions, while negative values correspond to removals.						

Table AI.2. Key category analysis with FOLU – level assessment for 1990.

IPCC Category	Gas	Emissions year 1990 (Gg CO_{2e}) *	Absolute value of emissions year 1990 (Gg CO_{2e})	Contribution for year 1990 (%)	Cumulative contribution total for year 1990 (%)	KCA order 1990
3B1a – Forest Land Remaining Forest Land	CO_2	-152,319.30	152,319.30	93.1	93.1	**1**
3B6B – Land Converted to Other Land	CO_2	7,716.75	7,716.75	4.7	97.8	**2**
*Positive values correspond to emissions, while negative values correspond to removals.						

Table AI.3. Key category analysis with FOLU – trend assessment for 1990-2022.

IPCC Category	Gas	Trend assessment	Contribution to the trend (%)	Total cumulative trend contribution (%)	KCA order trend
3B1a – Forest Land Remaining Forest Land	CO_2	0.068	87.7	87.7	**1**
3B6B – Land Converted to Other Land	CO_2	0.011	14.2	101.9	**2**

Table AI.4. Key category analysis without FOLU – level assessment for 2022.

IPCC Category	Gas	Emissions year 2022 (Gg CO_{2e})	Absolute value of emissions year 2022 (Gg CO_{2e})	Contribution for year 2022 (%)	Cumulative contribution total for year 2022 (%)	KCA order 2022
1B2a – Oil	CH_4	1,540.15	1,540.15	18.1	18.1	**1**
1A3b – Road Transport	CO_2	1,094.72	1,094.72	12.9	31.0	**2**
1A4 – Other Sectors	CO_2	878.97	878.97	10.4	41.4	**3**
1B2a – Oil	CO_2	873.44	873.44	10.3	51.7	**4**
1A1 – Energy Industries	CO_2	838.97	838.97	9.9	61.6	**5**
3C7 – Rice Cultivations	CH_4	708.62	708.62	8.3	69.9	**6**
1B2b – Natural Gas	CH_4	648.52	648.52	7.6	77.6	**7**
3A1 – Enteric Fermentation	CH_4	535.68	535.68	6.3	83.9	**8**
3C4 – Direct N2O Emissions from Managed soils	N_2O	299.92	299.92	3.5	87.4	**9**
4A3 – Uncategorized Waste Disposal Sites	CH_4	159.25	159.25	1.9	89.3	**10**
4A1 – Managed Waste Disposal Sites	CH_4	147.73	147.73	1.7	91.0	**11**
3C5 – Indirect N2O Emissions from Managed soils	N_2O	139.06	139.06	1.6	92.7	**12**
3C1 – Biomass Burning	CH_4	111.48	111.48	1.3	94.0	**13**
4D1 – Domestic Wastewater Treatment and Discharge	CH_4	110.44	110.44	1.3	95.3	**14**

Table AI.5. Key category analysis without FOLU – level assessment for 1990.

IPCC Category	Gas	Emissions year 1990 (Gg CO_{2e})	Absolute value of emissions year 1990 (Gg CO_{2e})	Contribution for year 1990 (%)	Cumulative contribution total for year 1990 (%)	KCA order 1990
3A1 – Enteric Fermentation	CH_4	381.22	381.22	13.9	13.9	**1**
1A1 – Energy Industries	CO_2	332.98	332.98	12.2	26.1	**2**
1A2 – Manufacturing Industries and Construction	CO_2	301.18	301.18	11.0	37.1	**3**
3C4 – Direct N_2O Emissions from Managed soils	N_2O	269.75	269.75	9.8	46.9	**4**
1A4 – Other Sectors	CO_2	242.31	242.31	8.8	55.7	**5**
1A3b – Road Transport	CO_2	231.33	231.33	8.4	64.2	**6**
3C7 – Rice Cultivations	CH_4	227.31	227.31	8.3	72.5	**7**
4A3 – Uncategorized Waste Disposal Sites	CH_4	215.51	215.51	7.9	80.3	**8**
4D1 – Domestic Wastewater Treatment and Discharge	CH_4	108.28	108.28	4.0	84.3	**9**
3C5 – Indirect N2O Emissions from Managed soils	N_2O	103.71	103.71	3.8	88.1	**10**
1A4 – Other Sectors	CH_4	76.20	76.20	2.8	90.9	**11**
3C1 – Biomass Burning	CH_4	63.16	63.16	2.3	93.2	**12**
3A2 – Manure Management	CH_4	36.75	36.75	1.3	94.5	**13**
1A3a – Domestic Aviation	CO_2	34.56	34.56	1.3	95.8	**14**

Table AI.6. Key category analysis without FOLU – trend assessment for 1990-2022.

IPCC Category	Gas	Trend assessment	Contribution to the trend (%)	Total cumulative trend contribution (%)	KCA order trend
1B2a – Oil	CH_4	0.562	20.3	20.3	**1**
1B2a – Oil	CO_2	0.319	11.5	31.8	**2**
1A2 – Manufacturing Industries and Construction	CO_2	0.313	11.3	43.0	**3**
1B2b – Natural Gas	CH_4	0.237	8.5	51.6	**4**
3A1 – Enteric Fermentation	CH_4	0.235	8.5	60.1	**5**
3C4 – Direct N2O Emissions from Managed soils	N_2O	0.195	7.0	67.1	**6**
4A3 – Uncategorized Waste Disposal Sites	CH_4	0.185	6.7	73.8	**7**
1A3b – Road Transport	CO_2	0.138	5.0	78.8	**8**
4D1 – Domestic Wastewater Treatment and Discharge	CH_4	0.082	3.0	81.7	**9**
1A4 – Other Sectors	CH_4	0.082	3.0	84.7	**10**
1A1 – Energy Industries	CO_2	0.070	2.5	87.2	**11**
3C5 – Indirect N2O Emissions from Managed soils	N_2O	0.066	2.4	89.6	**12**
4A1 – Managed Waste Disposal Sites	CH_4	0.054	1.9	91.6	**13**
1A4 – Other Sectors	CO_2	0.047	1.7	93.3	**14**
3C1 – Biomass Burning	CH_4	0.031	1.1	94.4	**15**
1A3a – Domestic Aviation	CO_2	0.025	0.9	95.3	**16**

Annex II | Mitigation Actions by Sector and their Effects

Energy Sector

Power Generation

Name of Action	Energy Matrix Diversification and Institutional Strengthening of the Department of Energy (EMISDE)					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Project	Ongoing	2019-2024 (Component I) 2019-2026 (Component II)	Guyana Energy Agency (GEA) Components I and III and Guyana Power & Light Inc (GPL) Component II	CO_2	National	Power Generation
Description and Objective						
The main objective of the program is to support Guyana's evolving energy sector by: (i) investing in sustainable/cleaner energy solutions to diversify the energy matrix in the Hinterland while contributing to climate change mitigation; (ii) investing in the reinforcement of transmission infrastructure to improve reliability and stability of the Demerara-Berbice Interconnected System (DBIS); and (iii) strengthening the Department of Energy (DE) to develop a regulatory framework and improve institutional capacity and governance of the Oil and Gas (O&G) sector. The project is structured around three main components. Under component 1 'Renewable Energy Solutions for the Hinterland' of the project, the Government of Guyana, Ministry of Public Works facilitates the development of grid connected Solar Photovoltaic (PV) systems with a total installed capacity of 3.15 MW to supply the regional grids of the communities of Mahdia (0.65MW), Lethem (1MW), and Bartica (1.5MW). The diversification of the energy matrix and energy security in these three communities aims to promote socioeconomic development through the supply of reliable and affordable electricity to the three communities as well as						

reduce CO_2 emissions from the power generation sector by utilising a renewable energy source and will support Guyana's evolving energy sector with investment in sustainable and reliable energy solutions along the path to a cleaner and diversified energy matrix, beginning with innovative solutions for energy security and reliability for hinterland townships. The project incorporates a pilot smart metering initiative that is considered an important step forward as it will provide a technological advancement in the operation of the distribution grid. Furthermore, the introduction of solar energy presents a great opportunity to implement a women's economic empowerment program at the community level, contributing mainly to the development of productive uses of electricity and community engagement. Under component 2 'Reinforcement of Transmission Infrastructure' of the project, Guyana reinforced the transmission infrastructure to improve the reliability and stability of the Demerara-Berbice Interconnected System (DBIS) in the Kingston-Sophia transmission section with: (i) reinforcements of the new Sophia substation; and (ii) investments in transmission system redundancy. This includes the installation of a reactive compensation system, a Volt-Ampere-Reactive (VAR) at the New Sophia substation, installation of a 69-kV bay or equivalent, construction of an additional transmission line between Kingston and Sophia, and upgrading of the existing transmission line. The conductor under the current configuration is operating almost to its maximum capacity so the new one will provide the grid the possibility to operate at higher amps consequently reducing the risk of trips and outages. This will reduce outages by reducing the level of emergency maintenance and allowing the system to operate under a regular maintenance schedule. The component incorporates the development of standards for the storage and disposal of unused electric equipment in the company, providing a guideline for GPL improvement in management and operation of the substations. Under component 3 'Institutional Strengthening and Governance of the Department of Energy' of the project, it includes consultancies for capacity building initiatives and a best-practice organizational structure; and technical support for the design of a new oil and gas legislative and regulatory framework.		
Quantitative Goals		
• The project is expected to generate approximately 4,299 MWh of electricity annually (Mahdia – 892 MWh/yr, Lethem – 1,457 MWh/yr, and Bartica – 1,950 MWh/yr) at an average cost (weighted average levelized cost of electricity - LCOE) of US$0.15 per kWh. • It will contribute to an estimated 69% reduction in electricity generation cost and an estimated annual cost savings of US$1,932,992 for the hinterland utilities. • The addition of renewables to the energy mix will reduce approximately 1,815,015 litres of diesel consumption and 3.67 tCO_2e per year. • The project is expected to lead to an improvement of unserved electricity demand. • It will contribute to a reduced number of outages in the DBIS. • It will improve the reliability and stability of the DBIS.		
Steps Taken or Envisaged to Achieve Action		
The GEA under the purview of the Ministry of Public Works is responsible for the execution of the project components I and III and overseeing the provision of the policy support, technical planning, and the development of operating codes and regulations while the Hinterland Electrification Company Inc. (HECI) is in charge of the implementation and operation of projects via local utilities of small grids and solar systems installed in rural areas. Throughout the project implementation, GEA and HECI work in close collaboration due to some overlap in responsibilities. Lethem's solar PV system was completed and fully commissioned on August 5, 2022 while Bartica is was completed by the end of March 2023. The Mahdia solar PV system was scheduled for completion in September 2023. Furthermore, the project involved the installation of 800 AMI compatible smart meters at Bartica, which were completed on 15 December 2022. GPL as the state electricity utility company is responsible for executing component II of the project. Throughout the project implementation, the transmission system of the DBIS has been reinforced and upgraded to attend to the increasing electricity demand estimated over the next years, reach international operating standards by replacing aged and unreliable equipment, integrate new generation sources (such as solar and wind), improve quality of service, and ensure a constant electricity supply that can adapt to variation due to seasonal or daily flows.		
Estimated Outcomes	**Estimated GHG Emission Reductions**	**Methodologies and Assumptions**
• Decrease in electricity generation costs. • Avoidance of CO_2 emissions. • Electricity generation in the three townships is diversified. • Renewable energy solutions are introduced.	3.67 tons CO_2e / yr	The combined annual power generation of 4,299 MWh/yr in the three communities Mahdia, Lethem, and Bartica was multiplied by an emission factor of 0.854 (tons CO_2/MWh) to estimate the annual GHG

• Incorporation of a smart metering initiative. • Electricity demand is attended. • Reduction of Controlled and Monitored electricity service outages. • Decrease in voltage fluctuations. • Reinforcement of transmission infrastructure.		emission reductions in tons CO_2e per year. Grid emission factors for the Bartica Isolated system of Guyana (tons CO_2/MWh) from report Standardized baseline: Grid Emission Factors of Guyana Version 01.0, ASB0045-2019

Progress Indicators

Indicator	Unit	Baseline	Target	Progress
Price for electricity production per kilowatt hour.	$ USD/kWh	0.50	0.15	0.50
Tons of emissions per year reduced in the townships of Bartica, Mahdia and Lethem.	tons CO_2e/yr	0	3.147	0
Electricity not supplied due to system failures.	MWh	3,591	2,714	5,387.45
Share of electricity produced with Solar PV technology is introduced in the three townships.	%	0	27	2
Women beneficiaries of economic empowerment initiatives.	#	0	200	249
Controlled and monitored electricity service outages.	#/yr	6	1	3
Percentage of voltage variation.	%	5	1.06	4.85
Strengthened Oil and Gas Sector Framework.	#	0	1	1
Procedures for Public Service Announcement (PSA).	#	0	1	1

<table>
<tr><th>Name of Action</th><th colspan="6">Expanding Bioenergy Opportunities in Guyana</th></tr>
<tr><th>Type of Action</th><th>Status</th><th>Duration</th><th>Implementing Entity</th><th>GHG Coverage</th><th>Geographic Scope</th><th>Sectoral Scope</th></tr>
<tr><td>Enabling Activity</td><td>Completed</td><td>2008-2010</td><td>Inter-American Development Bank (IDB)</td><td>CO_2</td><td>National</td><td>Power Generation</td></tr>
</table>

Description and Objective

The general objective of the program is to provide assistance that will allow the Government of Guyana (GOG) to develop the bioenergy sector. The specific objectives of the program are: (i) improving the capacity of the GOG to identify and evaluate viable investment opportunities in the bioenergy production chain; (ii) develop a financial vehicle or instrument to promote investment opportunities and develop a strategy to harness Guyana's potential for bioenergy production; (iii) increase capacity building and the transfer of technology in order to build a critical mass of bioenergy technicians, operators, and demonstration Programs; and (iv) institutional strengthening to support Agro-energy Policy of Guyana; support for small scale bioenergy demonstration Programs and dissemination of results.

Quantitative Goals

- Development of a competitive, integrated agro-energy industry.
- Reduced CO_2 emissions through the use of bioethanol and biodiesel substituting for gasoline and diesel respectively, cogeneration with bagasse and methane abatement from biofuel wastewater treatment processes.

Steps Taken or Envisaged to Achieve Action

To achieve the objectives of the program it was structured in the following components:

- Component 1 – Development of a methodology for identifying viable investment opportunities, knowledge transfer, and preliminary identification of potential bioenergy programs.
- Component 2 – Design of a financial vehicle or instrument to develop viable investment opportunities and pilot implement a Strategy to promote Guyana's potential for bioenergy production.
- Component 3 – Capacity building and transfer of technology.
- Component 4 – Institutional strengthening to support the Agro-energy Policy of Guyana, support for small-scale bioenergy demonstration projects and dissemination of results.

Achieving these goals will provide Guyana with a platform from which to launch the industry and to support the development and financing of viable investment opportunities.

Estimated Outcomes	Estimated GHG Emission Reductions	Methodologies and Assumptions
• Lowered costs of sugar production for the development of a competitive, integrated agro-energy industry. • Production of biofuels with the surplus energy sold to the grid. • Reduced CO_2 emissions.	Not Applicable	Not Applicable

Progress Indicators

Indicator	Unit	Baseline	Target	Progress
Number of developed standard methodologies for program screening and evaluation including the design of the basic structure of a bioenergy program-evaluation unit within the Agro-energy Board of Guyana.	#	0	1	1
Number of assessments to determine the requirements to upgrade technical, operative, and managerial skills in relation to bioenergy production.	#	0	1	1

Number of assessments of program developers interested in investing in bioenergy programs in Guyana.	#	0	1	1
Number of designed financial investment instruments appropriate for Guyana including a comparative analysis of proven financial structures.	#	0	1	1
Number of designed sustainable strategies to promote Guyana's potential to attract private investment in bioenergy production.	#	0	1	1
Number of pre-investment studies (pre-feasibility studies, feasibility studies and/or environmental impact assessments) for identified programs.	#	0	5	5
Number of designed and implemented bioenergy training programs at technical, operative, and managerial levels.	#	0	1	1
Number of lectures, field visits, seminars, theoretical and practical courses related to bioenergy production in Guyana.	#	0	4	4
Number of institutions strengthened and support for the preparation and execution of the Agro-energy Policy of Guyana.	#	0	NA	NA
Number of designed, constructed and started demonstration plants for ethanol.	#	0	1	1
Number of conducted works shops or events to disseminate the findings of the program.	#	0	2	2

Name of Action	Enhancing Guyana's Access to GCF to Transition to Renewable Energy					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Enabling Activity	Completed	2019-2020	Global Green Growth Institute (GGGI)	Not Applicable	National	Power Generation

Description and Objective

Guyana renewable energy market is still at an early stage and power supply remains heavily dependent on imported fuels. To incentivize the deployment of renewable energy the Government is providing tax incentives to ensure that prices for renewables remain competitive with conventional imported resources. The objective is to support the development of potential utility scale renewable energy projects for public-private partnership and Green Climate Fund (GCF) funding. To facilitate the implementation of renewable energy projects, and ultimately the Country Programme being developed, potential national accredited entities from the energy sector will be assessed and the nomination by national designated authority (NDA) of two entities will be supported, while raising their awareness on GCF funding opportunities. As key Government partner, the private sector will be engaged in the process of prioritizing utility scale renewable energy projects and made aware of potential access to GCF through Private Sector Facility. Addressing barriers to scale up and make use of the country's abundant natural energy resources would help reduce the cost of power and pave the way for sustainable access to renewable energy.

Quantitative Goals

- Analysis of renewable energy solutions for the 12 main grids in Guyana and provided support to the government of Guyana in shortlisting 3-4 grids to prepare a pre-feasibility analysis of the viable renewable energy options.
- Strengthening of the project Public-Private Partnership (PPP) policy framework adopted by Guyana in 2018 to be able to work on energy projects.
- Provided support by GGGI Guyana to GEA in the design and tender of three PV-tied systems in the township of Bartica, Lethem and Mahdia.
- Support for the nomination of GCF accredited entities, recommendations to strengthen PPP policy to enable energy projects, and recommendations on changes in legislation to enable independent power producers (IPPs).
- Catalysed green investments: total of $10.90 million USD green investments catalysed ($8.6 million USD concessional loan from Inter-American Development Bank and executed by GEA and $2.3 million USD awarded by United Arab Emirates-Caribbean Renewable Energy Fund (UAE-CREF), to provide energy at 15% cheaper than business as usual (BAU).
- Provision of two capacity building activities in the form of GCF capacity building workshop to private sector and technical capacity building for GPL and GEA engineers.

Steps Taken or Envisaged to Achieve Action

The activities under this enabling activity are complementary with each other and builds on deliverables of approved readiness projects under the GCF. Furthermore, it will make use of awareness-raising and information materials developed through completed/ongoing readiness activities to be updated/improved appropriately to fit for use of potential national accredited entities from the energy sector and private sector stakeholders. Moreover, it will benefit from the GCF Accredited Entities Committee to be created under the readiness project being implemented by the Food and Agriculture Organization (FAO) as well as lessons learned from experience so far in supporting national agriculture entities for accreditation.

Estimated Outcomes	Estimated GHG Emission Reductions	Methodologies and Assumptions
• Developed country program by preparing a pipeline of renewable energy utility scale projects and pre-feasibility analysis for the shortlisted projects and preparing relevant concept notes. • Nominated Direct Access Entities and prepared gap assessment.	Not Applicable	Not Applicable

• Leveraged private sector investment into renewable energy projects: reviewed and recommended changes in regulation and proposal for innovative business models that leverage the private sector investment in renewable energy. • Increased awareness of GCF and its Private Sector Facility.		

Progress Indicators				
Indicator	**Unit**	**Baseline**	**Target**	**Progress**
Number of assessments for the feasibility of selected climate technologies for mitigation and adaptation and incorporated into planning process.	#	0	1	1
Number of NDA entities nominations.	#	1	2	2
Number of concept notes prepared for prioritised utility scale renewable energy projects and integrated in the Country Programme.	#	0	2	2
Number of proposals for levering private sector investments in renewable energy.	#	0	1	1

Name of Action	Guyana Utility Scale Solar Photovoltaic Program (GUYSOL)					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Project	Ongoing	2022-2027	Guyana Power and Light Inc. (GPL)	CO_2	Regions 2, 5, 6, 10	Power Generation

Description and Objective

The Guyana Utility Scale Solar Photovoltaic Program (GUYSOL) aims to support the diversification of Guyana's energy matrix towards the use of climate-resilient renewable energy sources in the electricity generation matrix. The specific objectives of the program are to: (i) avoid CO_2 emissions with the development of solar photovoltaic (PV) generation plants; (ii) lower the cost of electricity generation while supporting the country´s transition towards renewable energy-based generation; and (iii) improve the operation and management of the isolated systems of Essequibo and Linden and develop local skills for services related to solar PV generation systems. The GUYSOL program will install 33MWp of solar PV in 3 public grids: 15MWp in Linden, 8MWp in Essequibo coast and 10MWp in Berbice. The isolated grids in Linden and Essequibo will be upgraded with an Energy Management System. The program also aims to narrow the gender and diversity gaps in the renewable energy industry by implementing training and apprenticeship programs for women and people with disabilities.

Quantitative Goals

- Installation of 8 utility-scale solar PV systems totalling 33MWp of renewable power in 3 public grids as follows: 15MWp of Solar PV with a minimum of 22MWh (11MW, 2h) of battery storage for the Linden Isolated System; 8MWp of Solar PV with a minimum of 12MWh (6MW, 2h) of battery storage for the Essequibo Coast Isolated System; and 10MWp of Solar PV for the Demerara-Berbice Interconnected System, specifically in Berbice.

Steps Taken or Envisaged to Achieve Action

In 2022, the government of Guyana successfully obtained funding for the project through the Guyana-Norway Partnership, channelled through the Interamerican Development Bank (IDB), a planning workshop was held to update and validate the execution plan for the project, and the first request for proposals were developed and published for the execution of the eight solar farms; the preparation for environmental-social-governance analysis, and disaster risks evaluation/planning, and capacity building for GPL. As of mid-2023, the GPL published the first project summary documents, detailing the installation characteristics and socioeconomic and environmental risks and benefits of the project. In August 2023, the Energy Apprentices Programme was launched under the GUYSOL programme, recruiting eligible Guyana residents to fulfil 12-month apprenticeship positions in various roles, including civil engineers, electrical engineers, environmental/social officers, procurement and finance officers, and monitoring officers, contributing to the planning, execution, and operation of the solar projects.

Estimated Outcomes	Estimated GHG Emission Reductions	Methodologies and Assumptions
• Diversification of local economies and employment creation in renewable energies. • Increased resilience to the volatility of the global fuel market. • Enhanced energy security and affordability through decreased energy costs for local communities and a diversified climate-resilient and market-resilient electricity grid. • Significant reduction in government spending electricity subsidies which can be used for investment in other sustainable development initiatives, including system upgrades, digitisation, reliability, and the resilience of GPL's Transmission and Distribution networks. • Enhanced local technical capacities on renewable energies.	37,500 tons CO_2e / yr	According to the GUYSOL Project Summary Document, Linden is purposed to conserve 17,259 tons CO_2/yr (at 22,500 MWh/yr in power generation), Essequibo to conserve 9,390 tons CO_2e/yr (at 12,800 MWh/yr power generation), and Berbice to conserve 10,671 ton CO_2e/yr (at 16,000 MWh/yr power generation), assuming Berbice´s grid emission factor of approximately 0.661 tons CO_2e/MWh.

Progress Indicators				
Indicator	**Unit**	**Baseline**	**Target**	**Progress**
Number of utility-scale solar PV systems installed and operational.	#	0	8	0
Capacity of solar PV systems installed and operational.	MWp	0	33	0
Number of people with access to enhanced renewable, affordable, and reliable electricity.	#	0	265,000	0
Quantity of annual GHG emissions avoided.	tons CO_2e/yr	0	37.5	0
Avoided cost of power generation by 2027.	$ million USD	0	5.53	0
Proportion of women employed in new solar PV jobs.	%	0	70	0

Name of Action	Pilot Rice Husk Biogas Power Plant					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Project	Completed	2018-2021	Guyana Energy Agency (GEA)	CO_2, CH_4, N_2O	Regions 5 and 6	Power Generation

Description and Objective

This project comprised the installation of a pilot 32kW rice husk biogas generator to displace electricity consumed in rice mill as part of the Guyana Energy Agency´s Strategic Planning Framework starting in 2014. Rice husk, the outer most layer of the paddy grain, is a form of biomass and accounts for about 20% of the paddy's weight. Unlike the other by-products, rice husk is mostly seen as a waste disposal problem for many mills and is usually burnt as a form of waste disposal resulting in environmental concerns. In 2014, an estimated 184,052 tonnes of rice husk with an energy value of 212,021 boe was generated based on Guyana's rice production of 635,238 tonnes. Based on information collected in 2013, about 47% of the rice husk is used for paddy drying, parboiling and electricity generation while the remaining 53% is dumped/burnt as a means of waste disposal. The GEA seeks to encourage rice mills to generate electricity based on rice husk gasification technologies to enhance waste management of agricultural by-products, reduce the environmental degradation and GHG emissions, promote energy security, and reduce energy consumption costs among rice mill operators. The pilot demonstration unit seeks to demonstrate the feasibility of the technology, build awareness, and promote adoption by rice mill operators across the country.

Quantitative Goals

- Installation of a pilot 32kW rice husk biogas power plant to promote waste-to-energy generation in Guyana among rice mill operators.

Steps Taken or Envisaged to Achieve Action

In 2014, Guyana completed a comprehensive feasibility study identifying all potential rice husk gasification power plants that can be installed in the country, including a mapping of the location and quantities of biomass available at rice mills across Guyana. In 2018, The Energy and Resources Institute (TERI) provided financial and technical assistance support to successfully install a 32kW gas gasifier serving Regions 5 and 6, which became operational in 2021.

Estimated Outcomes	Estimated GHG Emission Reductions	Methodologies and Assumptions
• 32kW rice husk biogas power plant successfully installed and operational. • Increased awareness, capacity, and buy-in among rice mill operators to adopt rice husk gasification technologies for enhanced waste management and low-cost/low-emission energy generation.	101 tons CO_2e/yr	The pilot rice husk biomass power plant is purposed to generate 112 MWh/yr. A combined emission factor of approximately 0.9 tons CO_2e/MWh has been assumed to reflect the GHG reductions encompassing both the open-burning of rice husk, as well as the use of grid electricity from Regions 5&6, that has now been replaced from the self-generation of electricity at the rice husk biomass power plant.

Progress Indicators

Indicator	Unit	Baseline	Target	Progress
Progress in feasibility study completion.	%	0%	100%	100%
Number of pilot rice husk biomass power plants installed.	3	0	1	1
Installed capacity of rice husk biomass energy generation.	kW	0	20-30	32

Name of Action	Leguan 0.6MWp Solar PV Farm					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Project	Planned	2023-2025	Guyana Energy Agency (GEA)	CO_2	Region 3	Power Generation

Description and Objective

This project aims to install a 0.60 MW solar PV farm with a 0.80 MW storage capacity on a land area of 1 hectare (2.48 acres) and a new transmission line on the island of Leguan located in the Essequibo River in Region 3. The project aims to address the island's current deficiencies in terms of energy reliability by expanding the installed capacity of energy generation on the island, while also promoting clean energy use through the diversification of the electricity grid away from fossil fuels. Currently, Leguan tends to have issues related to the unreliability of power supply, whereby electricity is provided on a 24-hour basis by an isolated 1.23 MW grid relying on heavy fuel oil (HFO), owned and operated by the state electricity provider, GPL. In the medium term, GPL plans to link the Leguan grid to those of nearby islands using a subsea cable. At a design life of 20 years, the solar PV farm is expected to save more than 840 tons CO_2e/yr.

Quantitative Goals

- Installation of a 0.6MWp Solar PV farm in the Leguan regional grid, including a transmission distribution system to address current issues with energy reliability while reducing dependence on heavy fuel oil as energy supply.

Steps Taken or Envisaged to Achieve Action

In 2018, Guyana secured a $21 million USD concessional loan from the Inter-American Development Bank (IDB) for the project "Energy Matrix Diversification and Institutional Strengthening of the Department of Energy (EMISDE)", which encompassed the installation of renewable energy generation and enhanced transmission infrastructure, together with institutional strengthening, under which a total of $1.2 million USD was saved under the EMISDE. While the Leguan 0.6MWp Solar PV farm was not initially catered for under the loan, it is being funded through savings accrued under the EMISDE programme, as well as an additional concessional loan requested by the Government of Guyana and approved by the IDB. As of mid-2023, the GEA has initiated the tendering process for the environmental assessment and management plan for the solar PV power plant at Leguan, as well as the engineering, procurement, construction and installation, commissioning and turn-key delivery for the solar PV power plant at Leguan, including the battery energy storage system & transmission line. It is estimated that the solar PV farm will be operational starting 2025.

Estimated Outcomes	Estimated GHG Emission Reductions	Methodologies and Assumptions
• Increased energy reliability. • Reduced dependence on heavy fuel oil for electricity generation. • Enhanced transmission infrastructure. • Reduced CO_2 emissions.	841 tons CO_2e/yr	The Leguan Solar PV farm is purposed to generate 899 MWh/yr. An emission factor of 0.936 tons CO_2e/MWh has been assumed to reflect the GHG reductions attained by the use of solar energy compared to the consumption of the same amount of energy generated by conventional heavy fuel oil historically used at Leguan to date.

Progress Indicators

Indicator	Unit	Baseline	Target	Progress
Quantity of GHG emissions reduced at Leguan.	tons CO_2e/yr	0	899	0
Capacity of solar PV infrastructure installed and operational at Leguan.	MW	0	60	0
Number of environmental assessments for plant design and permitting.	#	0	1	1

Name of Action	Amaila Falls Hydroelectric Project Preparation Studies					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Enabling Activity	Completed	2010-2011	Inter-American Development Bank (IDB)	Not Applicable	Regions 3, 4, 5, 6, 10	Power Generation

Description and Objective

The enabling activity was conducted in preparation for the Amaila Falls Hydro Project. The studies included an (i) Environmental and Social Impact Assessment, (ii) Hydrology Review and (iii) Off-Taker and Market Assessment. The objective is to assess the feasibility of the hydro project according by analysing the adverse impacts to flora and fauna from the Amaila Falls Hydro Project and provide recommendations regarding monitoring as well as additional data collection or mitigation, if any.

Quantitative Goals

- Wet season Environmental Baseline Survey (ESB I)
- Dry season Environmental Baseline Survey (ESB II)

Steps Taken or Envisaged to Achieve Action

The Amalia Falls Hydro Project was approved by the Guyana Environmental Protection Agency (EPA) based on the Amaila Hydropower Project Environmental Impact Assessment (EIA) completed in 2002. However, additional environmental and social studies have been performed to assist in the final pre-construction planning process and to provide updated information on the environmental and social aspects. The primary objective of ESB I in April/May 2010 was to characterise flora and fauna of the project area during the dry season. However, conditions at the time of ESB I were more characteristic of a wet season than a dry season and therefore a complementary survey (ESB II) was undertaken during the dry season in March/April 2011.

Estimated Outcomes	Estimated GHG Emission Reductions	Methodologies and Assumptions
• Quantitative and qualitative information regarding characteristics of the flora and fauna communities in the area.	Not Applicable	Not Applicable

Progress Indicators

Indicator	Unit	Baseline	Target	Progress
Implementation of a flora and fauna study.	#	0	1	2

<table>
<tr><th>Name of Action</th><th colspan="6">Wakenaam 0.75MWp Solar Farm</th></tr>
<tr><th>Type of Action</th><th>Status</th><th>Duration</th><th>Implementing Entity</th><th>GHG Coverage</th><th>Geographic Scope</th><th>Sectoral Scope</th></tr>
<tr><td>Project</td><td>Ongoing</td><td>2019-Ongoing</td><td>Guyana Power and Light Inc. (GPL)</td><td>CO_2</td><td>Region 3</td><td>Power Generation</td></tr>
<tr><th colspan="7">Description and Objective</th></tr>
<tr><td colspan="7">In line with the Low Carbon Development Strategy (LCDS) 2030, this project will install a 750-kilowatt (0.75 MW) solar-powered system in Wakenaam Island which will benefit over 3,500 residents with access to clean and reliable energy and reduce the dependency of diesel for electricity generation. This development forms part of a macro plan to develop the island with the necessary infrastructure for it to lead in food production, and ultimately, bring economic prosperity to the people.</td></tr>
<tr><th colspan="7">Quantitative Goals</th></tr>
<tr><td colspan="7">• Generate approximately 1,044 MWh of solar-powered electricity annually.
• The addition of renewables to the energy mix will reduce approximately 5,919.57 tons CO_2e per year.</td></tr>
<tr><th colspan="7">Steps Taken or Envisaged to Achieve Action</th></tr>
<tr><td colspan="7">Once the solar-powered system is fully operational, it will improve the quality of life of the farming community located on Wakenaam Island.</td></tr>
<tr><th colspan="3">Estimated Outcomes</th><th colspan="2">Estimated GHG Emission Reductions</th><th colspan="2">Methodologies and Assumptions</th></tr>
<tr><td colspan="3">• Provision of affordable, stable, and reliable energy to benefit both households and businesses.
• Decrease in electricity generation costs.
• Avoidance of CO_2 emissions.
• Renewable energy solutions are introduced.</td><td colspan="2">940 tons CO_2e /yr</td><td colspan="2">The annual power generation of 1,044 MWh/yr is multiplied by an emission factor of 0.901 tons CO_2/MWh to estimate the annual GHG emission reductions. Grid emission factors for the Wakenaam Isolated system of Guyana (tons CO_2/MWh) from report Standardized baseline: Grid Emission Factors of Guyana Version 01.0, ASB0045-2019</td></tr>
<tr><th colspan="7">Progress Indicators</th></tr>
<tr><th colspan="3">Indicator</th><th>Unit</th><th>Baseline</th><th>Target</th><th>Progress</th></tr>
<tr><td colspan="3">Emissions per year reduced in Wakenaam Island.</td><td>tCO_2e/yr</td><td>0</td><td>5,919.57</td><td>5,919.57</td></tr>
<tr><td colspan="3">Installation of solar-powered system.</td><td>#</td><td>0</td><td>1</td><td>1</td></tr>
</table>

Name of Action	Small Hydropower Project for the Cooperative Republic of Guyana					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Project	Ongoing	2022-Ongoing	Guyana Energy Agency (GEA)	CO_2	Region 9	Power Generation

Description and Objective

To increase the share of renewable energy sources within Guyana's electrical generation system, in the context of sustainable energy development, the country is actively rehabilitating old hydropower plants and installing new hydropower plants. The objective of the Project is to provide a reliable and affordable supply of electricity to Lethem and nearby villages by construction of two small hydropower plants. The main components of the project include the construction of a new 1.5MW Kumu hydropower plant and the rehabilitation and upgrade of the defunct Moco Moco hydropower plant to 0.7MW capacity. The Moco-Moco 0.5 MW (2 x 0.25 MW) hydropower project, Region 9, was commissioned on November 22, 1999. The Moco-Moco hydropower station is a run-of-the-river, diversion-type with a high water head. The Moco-Moco hydropower plant supplied power to the community of Lethem and its environs. Severe rainstorms and subsequent landslide on July 5, 2003 resulted in a fractured penstock. This project aims to rehabilitate the defunct hydropower plant and increase the installed capacity to 0.7 MW. The project will provide electricity from an indigenous and renewable energy source to serve the demand of Lethem and its environs. This project forms a complementary suite of planned energy initiatives in the town, consisting of a hydropower plant and a solar PV farm. The proposed Kumu hydropower project entails the installation of a 1.5 MW hydropower plant and construction of a transmission line. The Kumu Creek, located in Region 9 (Upper Takutu-Upper Essequibo), is also part of the Amazon River System. The Kumu Hydropower Project will operate as a run-of-the-river type plant and its topographical specifications can accommodate the construction of a small reservoir on the top of the mountain plateau so as to maintain a constant water level for operation of the plant. The project will provide electricity from an indigenous and renewable energy source to serve the demand of Lethem and its environs.

Quantitative Goals

- Rehabilitated Moco-Moco hydropower plant with an installed capacity of 0.7 MW.
- Installed Kumu hydropower plant with a capacity of 1.5 MW.

Steps Taken or Envisaged to Achieve Action

The Kumu hydropower plant and the Moco Moco hydropower station will be a strong, reliable, and redundant power supplier and controller for existing and future demand. The combined operation of the Kumu and Moco Moco hydropower systems, together with the planned solar PV, can result in 100% of renewable energy generation in the power sector of Lethem.

Estimated Outcomes	Estimated GHG Emission Reductions	Methodologies and Assumptions
• 100% of renewable energy generation in the power sector of Lethem. • Decrease in electricity generation costs. • Avoidance of CO_2 emissions.	12,344 tons CO_2e / yr	The total capacity is 2.2 MW. The annual power generation of 14,454 MWh/yr is multiplied by an emission factor of 0.854 tons CO_2/MWh to estimate the annual GHG emission reductions. Grid emission factors for the Bartica Isolated system of Guyana (tons CO_2/MWh) from report Standardized baseline: Grid Emission Factors of Guyana Version 01.0, ASB0045-2019

Progress Indicators

Indicator	Unit	Baseline	Target	Progress
Installed capacity of Moco-Moco hydropower plant.	MW	0.5	0.7	NA
Functional Kumu hydropower plant.	#	0	1	NA
Installed capacity of Kumu hydropower plant.	MW	0	1.5	NA

<table>
<tr><th>Name of Action</th><th colspan="6">Hinterland Solar PV Farms</th></tr>
<tr><th>Type of Action</th><th>Status</th><th>Duration</th><th>Implementing Entity</th><th>GHG Coverage</th><th>Geographic Scope</th><th>Sectoral Scope</th></tr>
<tr><td>Project</td><td>Planned</td><td>2023-2025</td><td>Guyana Energy Agency (GEA)</td><td>CO_2</td><td>Regions 1 and 10</td><td>Power Generation</td></tr>
<tr><th colspan="7">Description and Objective</th></tr>
<tr><td colspan="7">The Guyana Energy Agency has dedicated funding from the national budget to increase utility-scale penetration of solar PV power in Regions 1 and 10 through the installation and commissioning for the following four solar PV farms: 1.4MWp Solar PV farm in Kwakawani regional grid, 0.9 MWp Solar PV farm in Port Kaituma regional grid, 0.3MWp Solar PV farm in Matthews Ridge regional grid, and 0.3MWp Solar PV farm in Ituni regional grid. The objective is to increase the national grid capacity to supply increasing energy demands through the electrification transition, whilst reducing GHG emissions and electricity costs from the current diesel-dependent regional grids.</td></tr>
<tr><th colspan="7">Quantitative Goals</th></tr>
<tr><td colspan="7">• Installation of a combined 2.9 MWp utility-scale solar PV capacity to reduce dependency of diesel for electricity generation at the Kawakami Port Kaituma, Matthews Ridge, and Ituni regional gids.</td></tr>
<tr><th colspan="7">Steps Taken or Envisaged to Achieve Action</th></tr>
<tr><td colspan="7">As of early 2023, the Guyana Energy Agency launched request for proposal for consultancy services for the preparation of detailed site investigation reports for the envisioned Kawakami, Port Kaituma, Mathews Ridge, and Ituni sites. The site investigation reports encompass drone imaging, topographic and geotechnical studies, as well as environmental impact assessments as part of the standard process to obtain authorization protocols by Guyana's Environmental Protection Agency. Once the projects have received authorization, work will begin on procurement and installations aiming to have these four solar PV sites fully commissioned and operational by mid-2025.</td></tr>
<tr><th colspan="3">Estimated Outcomes</th><th colspan="2">Estimated GHG Emission Reductions</th><th colspan="2">Methodologies and Assumptions</th></tr>
<tr><td colspan="3">• Provision of affordable, stable, and reliable energy to benefit both households and businesses.
• Decrease in electricity generation costs.
• Avoidance of CO_2 emissions.
• Renewable energy solutions are introduced to decrease dependence on fossil fuels as well as vulnerability to fossil fuel market instabilities</td><td colspan="2">3,046 tons CO_2e / yr</td><td colspan="2">The Kwakawani, Port Kaituma, Mattews Ridge, and Ituni solar PV farms are purposed respectively to generate 1,754 MWh/yr, 1135 MWh/yr, 307 MWh/yr, and 371 MWh/yr for a combined total of 3,567 MWh/yr. An emission factor of 0.854 tons CO_2e /MWh has been adopted to reflect the GHG reductions assuming this PV energy would replace current diesel-run generators.</td></tr>
<tr><th colspan="7">Progress Indicators</th></tr>
<tr><th colspan="3">Indicator</th><th>Unit</th><th>Baseline</th><th>Target</th><th>Progress</th></tr>
<tr><td colspan="3">Installed capacity of utility-scale solar PV systems in Regions 1 and 10.</td><td>MWp</td><td>0</td><td>2.9</td><td>0</td></tr>
<tr><td colspan="3">Number of utility-scale solar PV systems installed in Regions 1 and 10.</td><td>#</td><td>0</td><td>4</td><td>0</td></tr>
<tr><td colspan="3">Annual quantity of renewable energy generated in Regions 1 and 10.</td><td>MWh/yr</td><td>0</td><td>3,567</td><td>0</td></tr>
</table>

Name of Action	Solar PV Public Buildings Program					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Project	Completed	2014-2022	Guyana Energy Agency (GEA)	CO_2	National	Power Generation

Description and Objective

The Solar PV public buildings program is a multi-year programme managed by the GEA with public financing from the national budget seeking to enhance the distributed generation capacity of solar-powered electricity by installing grid-connected solar PV systems across public buildings in Guyana spanning schools, healthcare facilities, convention centres, libraries, radio stations, and government offices, as well as other government and public service buildings. The ultimate goal is to increase the diversification and reliability of the national electric grid while promoting by example the adoption of solar PV technology.

Quantitative Goals

- Develop a self-sustaining and efficient public buildings systems fully run by solar PV to reduce operational costs and associated GHG emissions from energy consumption.

Steps Taken or Envisaged to Achieve Action

Between 2014 and 2022, the Guyana Energy Agency has installed a over 6.3 MWp of rooftop solar PV systems in over 409 public buildings distributed across the country, spanning schools, healthcare facilities, radio stations, libraries, exhibition centres, and government buildings, among others, resulting. A total of 291 public buildings now completely run on solar PV power and result in an estimated $2.3 million USD energy savings each year. The GEA also assisted in upgrading and completing the electrical network infrastructure at some of these public buildings, along with installing outlets and energy-efficient LED lights to improve the lighting system of the buildings. Additionally, the GEA provided training on the operation and basic maintenance of the installed Solar PV Systems, to ensure their adequate operation and to build awareness and encourage uptake by their users.

Estimated Outcomes	Estimated GHG Emission Reductions	Methodologies and Assumptions
• Reduced operational costs for public buildings related to energy consumption. • Enhanced access reliable, on-site, clean electricity. • Promoting adoption of solar PV technology by leading by example from government operations. • Enhanced awareness and capacities among building users on solar PV technologies. • Reduced dependence on fossil fuels for energy purposes.	5,518 tons CO_2e / yr	It is assumed that the installed capacity of solar PV systems at public buildings would generate a cumulative 8,348 MWh/yr. Assuming an average emission factor for the national grid of Guyana of 0.661 tons CO_2e/MWh, the energy produced by these systems would prevent the generation of 5,518 tons CO_2 each year.

Progress Indicators

Indicator	Unit	Baseline	Target	Progress
Number of public buildings with solar PV systems.	#	0	Not Estimated	409
Installed capacity of solar PV systems in public buildings.	MWp	0	Not Estimated	6.35
Annual savings in energy bills at public buildings from onsite solar PV generation.	$ USD / yr	0	Not Estimated	2.3 million
Annual GHG reductions at public buildings from onsite solar PV generation.	tons CO_2e	0	Not Estimated	5,518

Name of Action	Promotion of Private Solar PV Rooftop Systems					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Project	Completed	2020-2022	Guyana Power and Light Inc. (GPL) and private actors	CO_2	National	Power Generation

Description and Objective

Promote the adoption of rooftop gird-connected solar PV technology by private consumers across Guyana to reduce operational costs and associated GHG emissions from energy consumption through a combination of policy and fiscal incentives allowing increased distributed generation of solar PV in the country.

Quantitative Goals

- Increased share of private consumers installing grid-connected solar PV systems.

Steps Taken or Envisaged to Achieve Action

Along with investments in transformational infrastructure, Government policy is to encourage individual consumers and businesses to invest in, and use, renewable energy through fiscal incentives and policies. The GPL has reported that by 2022, the total registered installed capacity of solar PV systems from private sources sums to 1.4 MWp. These have been made possible thanks to the following policies:

- Self-Generation: Private self-generation is allowed as per Guyana's legislation. Any consumer who wishes to interconnect their solar PV system into the public grids to eliminate the need for battery storage (solar PV on-grid) must submit an interconnection request and comply with the Interim Interconnection Requirements set by GPL.
- Grid Feed-In Mechanism: A grid feed-in mechanism is being advanced by GPL to establish the regulatory framework for consumers to supply excess energy to the grid, from renewable energy sources.
- Fiscal Incentives: Machinery and equipment imported for the purposes of generating and utilising renewable energy are eligible for Customs duty and Value-Added Tax Exemptions under existing laws. This includes solar panels, solar lamps, deep-cycle batteries, solar generators, solar water heaters, solar cookers, direct current (DC) solar refrigerators, DC solar freezers, DC solar air-conditioners, wind turbines, water turbines, and power inverters; and energy-efficient lighting, including compact fluorescent lamps and light-emitting diode (LED) lamps. There is also a one-off tax holiday of two years for corporation tax to importers of items for wind and solar energy investments.

Estimated Outcomes	Estimated GHG Emission Reductions	Methodologies and Assumptions
• Reduced operational costs for private buildings related to energy consumption. • Enhanced access reliable, on-site, clean electricity. • Promoting adoption of solar PV technology by demonstrating the technical and financial feasibility of solar PV technology adoption. • Enhanced awareness and capacities among building users on solar PV technologies. • Reduced dependence on fossil fuels for energy purposes.	1,431 tons CO_2e / yr	It is assumed that the installed capacity of private solar PV systems at public buildings would generate a cumulative 2,164 MWh/yr. Assuming an average emission factor for the national grid of Guyana of 0.661 tons CO_2e/MWh, the energy produced by these systems would prevent the generation of 1,431 tons CO_2 each year.

Progress Indicators

Indicator	Unit	Baseline	Target	Progress
Installed capacity of solar PV systems in public buildings.	MWp	0	Not Estimated	1.40
Annual GHG reductions at public buildings from onsite solar PV generation.	tons CO_2e	0	Not Estimated	1,431

Name of Action	Mabaruma 0.4MWp Solar PV Farm					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Project	Completed	2017-2020	Hinterland Electrification Company Inc. (HECI)	CO_2	Region 1	Power Generation

Description and Objective

The Mabaruma Solar Farm was described in the 2017 national budget as the first of several such farms which were to be established under the Hinterland Electrification Programme (HEP). At the time, a budgetary allocation of almost $1 billion was announced to implement a series of renewable energy and energy efficiency projects. This would include the installation of the first solar farm on a large scale in Mabaruma. When operational, the 400-kilowatt solar farm would afford an additional 17 hours of electricity to the 3,000 residents of Mabaruma. It will include a 134kWh battery storage and a 500kVA power transformer. A working solar farm in Mabaruma would provide the impetus for similar imminent renewable energy projects ambitiously highlighted in Guyana's First Voluntary National Review of the Sustainable Development Goals. These include planned solar PV farms at Bartica, Lethem, Mahdia, Port Kaituma, Kwakwani and Matthews Ridge.

Quantitative Goals

- The project is expected to generate approximately 560 MWh of electricity annually.
- The addition of renewables to the energy mix will reduce approximately 478 tons CO_2e / yr.

Steps Taken or Envisaged to Achieve Action

The Mabaruma solar farm has been in the works since 2017 under the former Government, as part of the Hinterland Electrification Project. The 400-kilowatt farm was designed and constructed by German company Meeco Group. Work on the project was supposed to have been completed by 2018. But over the years, the project was hampered by vandalism, non-delivery of items and faulty construction, which contributed to the project being damaged by a lightning strike. However, the project was finalised in 2020.

Estimated Outcomes	Estimated GHG Emission Reductions	Methodologies and Assumptions
• Provision of affordable, stable, and reliable energy to benefit both households and businesses. • Decrease in electricity generation costs. • Avoidance of CO_2 emissions. • Renewable energy solutions are introduced.	478 tons CO_2e / yr	The annual power generation of 560 MWh/yr is multiplied by an emission factor of 0.854 tons CO_2/MWh to estimate the annual GHG emission reductions. Grid emission factors for the Bartica Isolated system of Guyana (ton CO_2/MWh) from report [Standardized baseline: Grid Emission Factors of Guyana Version 01.0, ASB0045-2019]

Progress Indicators

Indicator	Unit	Baseline	Target	Progress
Emissions per year reduced.	tons CO_2e/yr	0	478	478
Installation of solar-powered system.	#	0	1	1
Installed capacity of solar PV farm.	MWp	0	0.4	0.4
Annual quantity of renewable energy generated.	MWh/yr	0	560	560

Name of Action	Gas to Energy Project					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Project	Ongoing	2023-Ongoing	Ministry of Public Works (MoPW)	CO_2	National	Power Generation

Description and Objective

The Gas-to-Energy project is purposed to establish infrastructure so natural gas can be transported from the offshore Stabroek Block's Liza oilfield to an integrated gas processing facility at Wales, on the West Bank of Demerara. The project will deliver natural gas liquids (NGL) and dry gas to the government of Guyana. A subsea pipeline will be installed on the seafloor to transport natural gas from the Liza field to an onshore pipeline at the West Coast of the Demerara river. The onshore pipeline will deliver the gas to an integrated facility at Wales, on the West Bank of Demerara. At this facility, a NGL processing plant will treat the gas to remove NGLs for commercialisation, and a 300 megawatts power plant will use the dry gas to generate electricity for domestic use. The pipeline would transport up to ~50 million standard cubic feet per day of natural gas to the facilities.

Quantitative Goals

- The project will provide the fiscal space to cut the cost of power by 50%.
- Replacing imported heavy fuel oil (HFO) with Guyana's natural gas as the main source of electricity generation will significantly reduce emissions.
- Through the project, cooking gas and fertiliser will be sold to locals at reduced rates, and sell the remaining NGLs to third parties.

Steps Taken or Envisaged to Achieve Action

ExxonMobil Guyana is responsible for the installation of the pipeline. The Guyana government will handle the integrated facility at Wales. Some preparatory work has commenced but the substantive construction will have to wait on a few things. On ExxonMobil's side, the company is waiting on all regulatory approvals. While it has already received environmental authorisation from the EPA, the company is waiting for the Guyana government to approve its proposed revisions to the Liza field development plan and production license. When this is done, Exxon and its partners will make their final investment decisions and continue the substantive work. On the government's side, it is still working on securing the loan from the Export and Import Bank US (EXIM Bank) to meet the rest of the cost. ExxonMobil and the Guyana government plan to deliver the power plant and pipeline by the fourth quarter of 2024, to allow for a reduction in the cost of electricity. The NGL facility is expected to be completed the following year.

Estimated Outcomes	Estimated GHG Emission Reductions	Methodologies and Assumptions
• A successful project has the potential to significantly reduce the cost of electricity in Guyana. • Reduce emissions through the shift to natural gas.	703,150 tons CO_2e / yr	The total capacity is 300 MW and 2,450,000 MWh/yr power generation. The power generation is multiplied by an emission factor of 0.287 tons CO_2/MWh to estimate the annual GHG emission reductions.

Progress Indicators

Indicator	Unit	Baseline	Target	Progress
Amount of natural gas delivered through the pipeline to the integrated facility at Wales.	ft^3	0	50,000,000	0
Installed capacity of the power plant.	MW	0	300	0
Electricity generation for domestic use.	KWh	0	NA	0
Reduced cost of electricity in Guyana.	$ G	NA	NA	0
Share of natural gas in the national electricity generation.	%	NA	NA	0

Energy Efficiency

Name of Action	EcoMicro Guyana					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Project	Completed	2018-2022	Institute for Private Enterprise Development (IPED)	CO_2	National	Energy Efficiency
Description and Objective						
The EcoMicro project is a technical assistance facility established to pilot green finance for Micro, Small and Medium Enterprises (MSMEs) across the Caribbean. By partnering with financial institutions (banks, credit unions, cooperatives, etc.) to develop new finance instruments to capitalize on opportunities in green financing, while adjusting their risk management models to climate change risk and incorporating climate impact assessment into their internal policies and operations. The project's goal is to facilitate green finance as a means to increase access to renewable energy and energy efficiency products. The project activities are broadly broken down into three key components as follows: (i) capacity development of finance institutions; (ii) access to clean and efficient energy products and services by MSME; and (iii) consolidating the green micro-finance ecosystem. The EcoMicro project for Guyana was funded by the Interamerican Development Bank (IDB) whereby the Development Alternatives Incorporated (DAI) Sustainable Business Group (SBG) worked with the Guyana Institute for Private Enterprise Development (IPED) to help Guyanese MSMEs grow through innovative green finance products. The direct beneficiaries of this project are 350 MSMEs across 8 of IPED's 13 Branches located in Pomeroon-Supenaam (Region 2), Demerara-Mahaica (Region 4), East Berbice-Corentyne (Region 6), and Upper Takutu-Essequibo (Region 9). These 8 branches account for 67% of their overall portfolio value and 62% of their overall client base. The project also aimed at training all 75 IPED staff in areas relating to designing and piloting of green finance, climate vulnerability and risk assessment, and institutional greening. IPED also received specialized technical assistance to design and pilot new green finance products to diversify their product offering, differentiate themselves from other financial institutions and attract new clients. IPED also benefited from institutional capacity building to analyse the vulnerability of its loan portfolio to climate change and incorporate climate risk management into future credit decisions, therefore reducing its portfolio at risk, as well as undertaking in-house renewable energy and energy efficiency measures to reduce their own operational GHG footprint.						
Quantitative Goals						
• Facilitating access for MSMEs to adopt renewable energy and energy efficiency technologies that complement, reduce the usage of, or substitute unreliable supplies of energy and displace energy from fossil fuels.						
Steps Taken or Envisaged to Achieve Action						
As part of the project, SBG conducted the following activities: – Landscape assessment and market analysis across four regions of Guyana, including coastal, river, and rainforest areas to assess demand for renewable energy and energy efficiency products among IPED clients. – Surveying a range of firms within IPED's portfolio, including agriprocessors, retail shops, hostelry, and catering businesses to better understand financing constraints, average energy usage, and opportunities to incorporate renewable energy and energy efficiency technologies and solutions. – Designing a digital tool for IPED's loan officers to screen climate risk as part of their loan underwriting process and assist IPED in developing an institutional greening policy. – Assisting IPED and its regional branch offices to develop green loan products.						

– Assist businesses to responsibly finance the purchase of renewable energy generation and energy-efficient technologies, including new or upgraded refrigeration units, solar panels, and optimal insulation materials. – Conducting a Technology Review that assessed the supply of renewable energy and energy efficiency technologies within the local market. – Through a stakeholder-driven analysis included, assessing strategic partnerships that would complement the comparative advantages of IPED and ensure alignment with national programs and objectives.		
Estimated Outcomes	**Estimated GHG Emission Reductions**	**Methodologies and Assumptions**
• Green financial products developed and launched to help MSMEs invest in GHG mitigation technologies. • IPED equipped with a climate risk evaluation tool to analyse and reduce the climate change vulnerability of its loan portfolio. • IPED´s environmental impact reduced. • Enhanced capacities at IPED to promote investments in green technologies while reducing climate change vulnerability.	Not Estimated	Insufficient information available to estimate the GHG emission reductions.

Progress Indicators

Indicator	Unit	Baseline	Target	Progress
Number of MSMEs adopting renewable energy and energy efficiency technologies.	#	0	350	14
Financing mobilized from IPED´s balance sheet for green strategies accessed by MSMEs clients.	$ million USD	0	1,000,000	42,155
Number of green finance products developed and made available to MSMEs.	#	0	2	2
Number of IPED employees training on renewable energy and energy efficiency finance products.	#	0	75	75
Proportion of credit decisions utilizing climate risk tool.	%	0%	100%	75%

<table>
<tr><th>Name of Action</th><th colspan="6">Transitioning to National Energy Security: Bartica as a Model Green Town</th></tr>
<tr><th>Type of Action</th><th>Status</th><th>Duration</th><th>Implementing Entity</th><th>GHG Coverage</th><th>Geographic Scope</th><th>Sectoral Scope</th></tr>
<tr><td>Enabling Activity</td><td>Ongoing</td><td>2017-Ongoing</td><td>Office of Climate Change (OCC)</td><td>Not Applicable</td><td>Region 7</td><td>Energy Efficiency</td></tr>
<tr><th colspan="7">Description and Objective</th></tr>
<tr><td colspan="7">Bartica is a small community situated on the Essequibo River, 80 km inland from the Atlantic Ocean. As part of Guyana’s pursuance of Green Economy as a development paradigm, the primary objective of this project is to establish a reliable point of reference for the existing state of energy use in Bartica from which the data generated will be used for future measurements and predictions for evidence-based decision making and pursuance of projects and programs. As such, the project aims to increase the capacity of planning for the Government of Guyana by carrying out energy audits and baseline studies in one model town, Bartica. The secondary objectives are the first tier interventions that are expected to stimulate and expedite a comprehensive and robust renewable energy uptake program in the New Bartica Township. This includes:
• The sensitization and awareness of the Bartica populace.
• Conducting household baseline study of the Bartica community.
• Complete an energy audit of public institutions, facilities and street lighting in Bartica.
• Energy efficiency pilot implemented with government agency.
• Transportation sector energy audit.</td></tr>
<tr><th colspan="7">Quantitative Goals</th></tr>
<tr><td colspan="7">• Reduced energy demand to reduce emissions and energy cost for consumers.
• Transitioning Bartica from a 100% fossil fuel based economy to more reliance on clean energy generation.</td></tr>
<tr><th colspan="7">Steps Taken or Envisaged to Achieve Action</th></tr>
<tr><td colspan="7">The main aim is to ensure that Bartica, as a new municipality, follows the green economy development paradigm. In this regard, data capture through various audits, building awareness, and completing demonstration/pilot type activities are critical. In this context, the technical activities as part of the project are split between different work packages:
• Work Package 1: Sensitization and Awareness
• Work Package 2: Conduct Household Baseline Survey of the Bartica Community
• Work Package 3: Complete an Energy Audit of public institutions, facilities and street lighting in Bartica
• Work Package 4: Transportation Sector energy audit
• Work Package 5: Energy Data Management Centre</td></tr>
<tr><th colspan="4">Estimated Outcomes</th><th>Estimated GHG Emission Reductions</th><th colspan="2">Methodologies and Assumptions</th></tr>
</table>

• Information for a competitive bid process for large scale renewable energy supply for Bartica. • Energy conservation and energy efficiency for energy and economic savings. • Enhanced streetlighting for security and safety. • Data of the local baseline energy characteristics and performance. • Reducing pollutants from vehicles and reduce the incidence and severity of respiratory and cardiovascular diseases.	Not Applicable	Not Applicable

Progress Indicators

Indicator	Unit	Baseline	Target	Progress
Content manual to effectively communicate details about project including benefits and plans.	#	0	1	1
Stakeholder workshops and community fora.	#	0	2	2
Baseline household data set.	#	0	1	1
Report on the dynamics of household appliances and energy consumption and use.	#	0	1	1
Report on energy audit of public institutions, facilities, and street lighting.	#	0	1	1
Localized study report on energy use in transport sector.	#	0	1	1
Recommendations on reduction of inefficiencies in transport sector in Bartica.	#	0	1	1
Energy data management centre operationalised.	#	0	1	1

Name of Action	Promotion of Energy Efficiency Measures in the Manufacturing and Service Sectors					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Project	Completed	2011-2013	Guyana Manufacturing & Services Association (GMSA)	CO_2	National	Energy Efficiency

Description and Objective

The GMSA energy efficiency project will pilot and promote the adoption of energy efficiency measures in the manufacturing and service sectors in 5 pilot companies, resulting in reductions in energy use and the cost to industry of energy. Additionally, it is envisaged that the results of the project will be used to influence policy changes at the national level that address the quality of supply and utilization of energy in the manufacturing and service industries. The project is critical to the development of enterprises in Guyana since it directly addresses the often-contentious issue of high energy costs. It sensitises companies especially in the manufacturing and services sectors to the best means of measuring and managing their energy distribution equipment/components and consumption, to make the most efficient use of their energy applications and simultaneously, employ the most effective methods of energy conservation.

Quantitative Goals

- Implementation of the energy efficiency programme in 5 pilot companies.
- Increase of the energy savings in the 5 pilot companies.
- Reduce at least 800 tons CO_2e in the 5 pilot companies.

Steps Taken or Envisaged to Achieve Action

The five pilot companies selected to represent the manufacturing and service sector were Sterling Products Ltd. representing the agro-processing sub-sector, Caribbean Containers which represents the packaging sub-sector, Demerara Mutual Life Insurance Company representing the services sector, National Milling Co. (NAMILCO), the Edward B. Beharry Group and Brass Aluminium & Cast Iron Foundry (BACIF). These pilot companies were guided across the business spectrum towards effectively managing their energy costs through the application of conservation methodologies, technological adaptations and best practice techniques.

Estimated Outcomes	Estimated GHG Emission Reductions	Methodologies and Assumptions
• To assess and audit energy consumption trends in pilot companies across five sub-sectors, in order to demonstrate how the adoption and implementation of energy efficiency technologies/measures can result in the reduction of high energy bills as a percentage of operation cost.	291 tons CO_2e / yr	During the implementation years of the project (2012-2013) a total of 582 tons CO_2e was reduced/saved. It is assumed that an equal share of GHG emission reductions occurred during these two years.

Progress Indicators

Indicator	Unit	Baseline	Target	Progress
5 energy efficiency programs implemented in pilot companies.	#	0	5	5
15 energy efficiency experts trained on energy audits acting as energy efficiency MSMEs.	#	0	15	33
Increased awareness among 100 private sector companies on the demonstrative benefits of adopting energy efficiency measures and promotion at the national level.	#	0	100	85
5 MSMEs benefitting from clean or efficient energy.	#	0	5	5
Energy saved in kwh.	kWh	0	NA	824,186
At least 800 tons CO_2, emissions reduced/saved.	tons CO_2e	0	800	582

Baseline survey conducted for at least 5 pilot companies and energy efficiency consuming appliances/components for the respective companies.	#	0	5	6
Guidelines for live-in plant monitoring and variance analysis developed for at least 5 pilot companies.	#	0	5	6
Development of sector benchmarks and action plans for implementation of energy efficiency program for at least 5 companies.	#	0	5	6
At least 15 technical staff from 5 pilot companies trained to effectively implement company action plans and monitor program.	#	0	15	30
Pilot assessment and audit study prepared and disseminated.	#	0	1	1
Host at least 2 national workshops to share the results of the pilots.	#	0	2	5

Name of Action	Project for the Introduction of Renewable Energy and Improvement of Power System in Guyana					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Project	Completed	2018-2022	Guyana Energy Agency (GEA)	CO_2	Region 4	Energy Efficiency

Description and Objective

The objective of the project is to improve the efficiency of the power systems by enhancing the quality of the substation equipment and distribution lines within the City of Georgetown and the surrounding areas. As well as, by installing and demonstrating a solar photovoltaic system and energy management system at the Caribbean Community (CARICOM) Secretariat, thereby contributing to economic development within Guyana. It has two components, namely the:

- Procurement of electric power distribution materials (293km of Cosmos Wire, 48 pole-mounted transformers and 2x1500kVA power factor compensators) and 2x5MVAr reactive power compensators for the Guyana Power & Light Inc. (GPL).
- Procurement of a 400kWp solar PV power generation system with battery storage and a Building Energy Management System (BEMS) for the CARICOM Secretariat.

The project will directly solve the problems of power loss and power supply reliability that GPL has, by installing reactive power compensators and procuring distribution equipment and materials. These components will greatly help to improve GPL's profitability and reduce CO_2 emissions emitted from thermal power plants. In addition, this project will materialise the renewable energy and energy conservation policy of CARICOM by installing a PV system and BEMS. Also, it is highly expected that the PV system and BEMS installed in the CARICOM secretariat building will showcase the technologies to CARICOM member countries and regions.

Quantitative Goals

- Enhancing power supply reliability and reducing technical loss by introducing reactive power compensator in the project target areas.
- Enhancing power supply reliability and reducing technical loss by improving distribution network in the project target areas.
- Renewable energy is supplied to CARICOM Secretariat main building by introducing PV system with battery.
- Promote energy saving by introducing BEMS with functions which visualize electricity usage and control air conditioner.

Steps Taken or Envisaged to Achieve Action

The GPL component was completed on September 29, 2021 and the one year defect notification period for the reactive power compensators expired on September 28, 2022. Regarding the CARICOM component, the 400kWp solar PV power generation system with battery was completed on January 11, 2022 but had to be taken out of operation on March 28, 2022 due to defective equipment (PV panels and battery modules). Following the completion of an investigation by the contractor and equipment manufacturers into the possible cause of the equipment failure, partial (200kWp) operation of the system was restored on August 6, 2022 pending receipt of the replacement equipment from Japan in January 2023. Meanwhile, the BEMS was completed on November 23, 2022 and additional O&M training for staff completed from November 21-22, 2022

Estimated Outcomes	Estimated GHG Emission Reductions	Methodologies and Assumptions
• Enhance the efficiency of electricity sector in Republic of Guyana through the installation of renewable energy and energy saving facilities.	429.65 tons CO_2e / yr	The total estimated annual energy is 650 MWh. The power generation is multiplied by an emission factor of 0.661 tons CO_2/MWh to estimate the annual GHG emission reductions.

Progress Indicators

Indicator	Unit	Baseline	Target	Progress
Introduction of reactive power compensator.	#	0	2	2
Improving distribution network.	km	0	293	293
Introduction of PV system.	#	0	1	1

Introduction of BEMS.	#	0	1	1

Transportation

Name of Action	Electric Vehicle Supporting Infrastructure					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Project	Completed	2019-2023	Guyana Energy Agency (GEA) and Guyana Power and Light Inc. (GPL)	CO_2	Regions 4 and 6	Transportation

Description and Objective

By 2030, Guyana aims to have made significant progress on the transition from a transportation system largely built around petroleum and diesel vehicles, to one which introduces other affordable and competitive transportation options including electric public and private ground transportation. To achieve such an ambitious target, Guyana has launched a pilot project to provide the necessary supporting infrastructure to enable electric vehicle (EV) adoption in the country by addressing enabling factors for adequate EV supporting infrastructure provision through a 3-prong approach: (i) providing access to cheaper and cleaner electricity to power EVs via comprehensive renewable energy diversification and electrification initiatives; (ii) providing access to EV charging stations; and (iii) reducing EV acquisition costs. This particular project focuses on components (ii) and (iii), whereby component (i) is achieved through the above-mentioned efforts under the energy sector.

Quantitative Goals

- Reduce supporting infrastructure barriers for EV adoption in Guyana through the construction of 6 public EV charging stations and the introduction of financial incentives to encourage private investment in charging station construction.

Steps Taken or Envisaged to Achieve Action

With 2022 budget support, GEA and GPL have partnered to install 6 public electric vehicle charging stations in Regions 4 and 6 as part of a pilot project to support the nascent electric-mobility sector. The 6 public electric vehicle charging stations were installed at: S & R Parking Lot, Guyana Energy Agency, Movie Towne, Giftland Mall, Massy at Providence, Little Rock Suites. The government of Guyana is also encouraging private providers who wish to establish charging to do so, through the removal of customs duty for the set-up of electric vehicle charging stations. Guyana's Ministry of Finance published the Budget Speech 2023, which was delivered on 16 January 2023 and included the following two measures to promote EV uptake, effective as of 1 January 2023: (1) EVs are exempt from customs duty, excise tax, and value-added tax (VAT); and (2) A 50% per year writing down allowance is provided for all businesses that invest in switching to EVs. To prepare locals for the automotive transition, the government has also been facilitating training for Guyanese auto-technicians in EV maintenance and repairs. Furthermore, the government has approved a policy to promote the procurement of electric vehicles for Government Ministries and Agencies, where appropriate,

Estimated Outcomes	Estimated GHG Emission Reductions	Methodologies and Assumptions
• Increased EV adoption throughout Regions 4 and 6 through enhanced access to EV charging infrastructure, coupled with favourable policy and financial incentives for public procurement and private purchase of EVs. • 6 public EV charging stations installed in Regions 4 and 6.	Not Applicable	Not Applicable

Progress Indicators

Indicator	Unit	Baseline	Target	Progress

Number of public EV charging stations installed.	#	0	6	6
Number of financial incentives provided for EV purchases.	#	0	5	5

Rural Electrification

Name of Action	Sustainable Business Models for Rural Electrification and Energy Access in Guyana					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Enabling Activity	Completed	2015-2019	Hinterland Electrification company Inc. (HECI)	Not Applicable	Regions 1, 2, 7, 8, 9	Rural Electrification
Description and Objective						
The Sustainable Business Models for Rural Electrification and Energy Access project aims to increase sustainable, affordable, and reliable access to renewable energy technologies to rural communities in regions 1, 2, 7, 8, and 9 of Guyana while ultimately improving the quality of lives for those living in the hinterland regions. This will allow for at least 6,000 homes across 25 hinterland communities to receive solar home systems. In this context, the general objective is to improve institutional capacities including training of sector staff and promote the use of renewable energy technologies in the urban areas and the Hinterlands, with the aim to: (i) implement sustainable business models for operation and maintenance; (ii) increase quality energy access in the country; (iii) reduce long-term operational costs of on-grid and off-grid electricity service; and (iv) contribute to sector sustainability and reduction of GHG emissions. Additionally, community members and other energy sector agencies will be trained in technical, operational, social and environmental aspects of the project.						
Quantitative Goals						
• Facilitation for the implementation of 6,000 solar home systems across 25 hinterland communities with a total capacity of 0.36MW. • Electrification of the 80% of rural areas in Guyana that have no electricity.						
Steps Taken or Envisaged to Achieve Action						
The project, which is being spearheaded by the Ministry of Public Infrastructure's Hinterland Electrification Unit (HEU), is a collaboration with the not-for-profit company, CARIBSAVE, and the Multilateral Investment Fund (MIF), a member of the Inter-American Development Bank (IDB) Group.						

Estimated Outcomes	Estimated GHG Emission Reductions	Methodologies and Assumptions
• Development of business models for solar for solar photovoltaic systems which will be installed in community buildings in the 25 communities. • Expansion of renewable energy sources leading to an overall positive impact on the environment and improvements to people's lives. • Increase of sustainable, affordable, and reliable access to renewable energy technologies to rural communities.	Not Applicable	Regarding the total capacity of the 6,000 solar home systems, it is assumed that each solar home system has a size of 60W as can be observed in several Hinterland villages.

Progress Indicators

Indicator	Unit	Baseline	Target	Progress

Number of implemented sustainable business models.	#	0	NA	NA
Share of rural areas in the Hinterland regions electrified.	%	20%	100%	NA
Number of implemented solar home systems in the Hinterland communities.	#	0	6,000	NA

Name of Action	Sustainable Energy Program for Guyana					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Project	Ongoing	2013-2023	The Hinterland Electrification Company Inc. (HECI) and Guyana Energy Agency (GEA)	CO_2	National	Rural Electrification

Description and Objective

The general objective of the program is to promote and support sustainable energy projects in Guyana, in order to contribute to Guyana's energy security, energy access, reduction of fossil-fuel dependence and provide additional opportunities to reduce GHG emissions. The specific objectives are: (i) to support the use of solar, small-hydro and wind energy resources; and (ii) create social awareness of sustainable energy. To promote and support sustainable energy programs in rural areas of Guyana. The specific objective of the first component is to foster the transition to alternative renewable energy and improve energy access in un-served and/or isolated communities with the following sub-components: (i) support to the design/installation/completion of renewable pilot projects; (ii) revision of the legal, institutional and regulatory framework of the electricity sector affecting the deployment of non-conventional renewable initiatives; and (iii) support the development of on-grid renewable projects to reduce fossil-fuel dependency. On the other hand, the second component focuses on supporting the ongoing creation of adequate knowhow, in order to guarantee the long-term sustainability of the implemented renewable energy projects.

Quantitative Goals

- Increased access to electricity throughout Guyana, targeting 90% of the population, while enhancing the penetration of solar, wind, and small-hydro energy sources.

Steps Taken or Envisaged to Achieve Action

Concerning the promotion of solar energy sources, a total of 154kW of off-grid solar PV systems were installed in 9 rural communities across Guyana estimated to benefit 7,000 residents directly and indirectly, all of which have been commissioned and are now operational. As well, a total of 180kW of grid-tied solar PV systems on 7 public buildings in the capital city of Georgetown, including secondary schools, tertiary institutions, and Ministries. Concerning the promotion of small-hydro energy sources, the program provided support to Kato village in Region 8, through the construction of a 150 kW run-of-the river power plant at the Kato waterfall site located on the Chiung River, a 13.8 kV primary distribution network from the power plant to the Kato Secondary School and thence to the Kato village, and a 120/220 V secondary distribution network in the Kato village. Construction progress has been slowed due to the effects of Covid-s9 pandemic compared to original program schedule, but are continued and improved. These small-hydro efforts from the Sustainable Energy Program would enable Regions 8 to transition to 100% renewable energy. Concerning the promotion of wind energy sources, in-depth data was collected at the Onverwagt Wind Measurement Station, with analysis indicating that there is sufficient wind resource for a utility-scale wind project in that area.

Estimated Outcomes	Estimated GHG Emission Reductions	Methodologies and Assumptions
• 7,000 residents across 9 rural communities given access to electricity generated from solar PV sources.	842 tons CO_2e / yr	It is assumed that the KATO hydropower lant would produce 968 MWh/yr, replacing a grid emission factor for Region 8 of 0.854 tons CO_2e/MWh. For electrification of urban and rural areas through PV systems, it is assumed 0 emissions are saved, as in the majority of cases these PV systems provide new

• Increased awareness and capacity for renewable energy project implementation and use. • Diversification of local economies and employment creation in renewable energies.		electricity access. Even in some cases, diesel generators for shops and houses are being replaced by the PV systems, there is insufficient information to estimate the value of associated GHG reductions. Further feasibility studies and preliminary design would need to be conducted for the wind sites for estimating their renewable energy and GHG reduction contribution.

Progress Indicators

Indicator	Unit	Baseline	Target	Progress
Proportion of population with energy access.	%	85	90	86
Installed capacity of solar PV systems for rural electrification.	kW	0	154	154
Installed capacity of solar PV systems in urban areas.	kW	0	180	180
Installed capacity of hydroelectric systems for rural electrification.	kW	0	150	150
Number of wind measurement stations analysed.	#	0	2	1
Number of trainings conducted.	#	2	7	6

Name of Action	Solar Home Systems					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Project	Ongoing	2021-Ongoing	Guyana Energy Agency (GEA)	CO_2	National	Rural Electrification

Description and Objective

The project, known as the '30,000 solar home systems' project, was designed to balance the energy gap between urban and rural areas, simultaneously propelling the nation towards sustainable, eco-friendly power sources. Under the project, a total of 30,000 homes across various regions of the country will receive 150-watt solar PV systems. The project's completion is anticipated in 2024, with successful implementation promising a significant leap forward in the country's renewable energy landscape.

Quantitative Goals

- Installation of thirty thousand (30,000) 150-watt solar home systems.

Steps Taken or Envisaged to Achieve Action

In 2020, 2021, 2022, and 2023, solar PV systems were installed at a number of public buildings across the hinterland regions. These included health centres, community centres, food processing, and educational facilities. For instance, in 2020, a 0.4 MW solar PV farm, the first in Guyana, was commissioned in Mabaruma, Region One (Barima-Waini). Following its operationalisation, solar PV farms were also commissioned at Lethem, Region Nine (Upper Takutu-Upper Essequibo) in 2022, and Bartica, Region Seven (Cuyuni-Mazaruni) in 2023. Furthermore, in 2023, a 0.5 MW solar PV farm is eyed for completion at Wakenaam, Region Three (Essequibo Islands-West Demerara), and a 0.65 MW solar farm is envisaged for completion in Mahdia, Region Eight (Potaro-Siparuni).

Estimated Outcomes	Estimated GHG Emission Reductions	Methodologies and Assumptions
• Provide electricity to off-grid households and micro enterprises, through individual Solar Home Systems.	5,003.71 tons CO_2e / yr	These 30,000 households total 4.8MW installed capacity. The figure represents energy produced by the solar panels, without which would have required fossil-based energy sources. The annual energy (MWh) is estimated through the following equation: 4800*4.8*365*0.85)/1000 The total estimated annual energy is estimated at 7,148.16 MWh. The power generation is multiplied by an emission factor of 0.7 tons CO_2/MWh to estimate the annual GHG emission reductions.

Progress Indicators

Indicator	Unit	Baseline	Target	Progress
Installation of solar home systems	#	0	30,000	NA

<table>
<tr><th>Name of Action</th><th colspan="6">Solar PV Mini-grids</th></tr>
<tr><th>Type of Action</th><th>Status</th><th>Duration</th><th>Implementing Entity</th><th>GHG Coverage</th><th>Geographic Scope</th><th>Sectoral Scope</th></tr>
<tr><td>Project</td><td>Ongoing</td><td>2021-Ongoing</td><td>Guyana Energy Agency (GEA)</td><td>CO_2</td><td>Region 1, 2, 7, 8, 9, 10</td><td>Rural Electrification</td></tr>
<tr><th colspan="7">Description and Objective</th></tr>
<tr><td colspan="7">The project includes the installation of 31 solar PV mini-grids with a total capacity of 919kW for public and community buildings. This includes solar PV mini-grids at Sebai, Karaburi, Kwebanna, Haimacabra, Baramita and Canal Bank of Region 1; Wakapao, Capoey Mission, St. Monica and Tapakuma, of Region 2; Waramadong, Paruima and Jawalla of Region 7; Kurukubaru of Region 8; Annai, Karasabai, Aishalton and Kraudarnau of Region 9; and Riversview of Region 10. Through this project, electricity will be provided to these communities with solar PV and battery storage. The mini-grid is an aggregation of several energy generators, powered by one main grid to disperse electricity to a small, local group of beneficiaries.</td></tr>
<tr><th colspan="7">Quantitative Goals</th></tr>
<tr><td colspan="7">The project is expected to generate approximately 1,369.32 MWh of electricity annually.
The addition of renewables to the energy mix will reduce GHG emissions.</td></tr>
<tr><th colspan="7">Steps Taken or Envisaged to Achieve Action</th></tr>
<tr><td colspan="7">Nine of these mini-grids have already been completed, with 28 communities set to benefit so far from this project.</td></tr>
<tr><th colspan="2">Estimated Outcomes</th><th colspan="2">Estimated GHG Emission Reductions</th><th colspan="3">Methodologies and Assumptions</th></tr>
<tr><td colspan="2">Provide affordable, stable, and reliable energy to benefit both households and businesses.
Avoidance of CO_2 emissions.
Renewable energy solutions are introduced.</td><td colspan="2">958.52 tons CO_2e / yr</td><td colspan="3">31 solar PV mini-grids with a total installed capacity of 919kW. Figure represents energy produced by the solar panels, without which would have required fossil-based energy sources. The annual energy (MWh) is estimated through the following equation:

$$919.5*4.8*365*0.85/1000$$

The total estimated annual energy is estimated at 1,369.32 MWh. The power generation is multiplied by an emission factor of 0.7 tons CO_2/MWh to estimate the annual GHG emission reductions.</td></tr>
</table>

Progress Indicators

Indicator	Unit	Baseline	Target	Progress
Solar PV mini-grids installed	#	0	31	9
Communities gaining access to renewable energy	#	0	NA	28

Name of Action	Moraikobai Micro-grid PV System					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Project	Completed	2018-2020	Guyana Energy Agency (GEA)	CO_2	Region 5	Rural Electrification

Description and Objective

The project included the installation of a 72kWp (0.072 MWp) solar micro-grid in Moraikobai which will provide electricity from a renewable energy source to supply approximately 270 households (approximately 1,000 persons). The project will allow an increase in the duration of daily electricity supply from 4 hours to 12 hours, avoid annual CO_2 Emissions of 70,199.57 kg (70.20 tons CO_2) and will generate about 97.36 MWh of energy annually.

Quantitative Goals

- The project is expected to generate approximately 97.36 MWh of electricity annually.
- The addition of renewables to the energy mix will reduce approximately 70.20 tons CO_2e / yr.

Steps Taken or Envisaged to Achieve Action

The system was completed and operational by the second quarter of 2020.

Estimated Outcomes	Estimated GHG Emission Reductions	Methodologies and Assumptions
• Provide affordable, stable and reliable energy to benefit both households and businesses. • Provide electricity to an off-grid community. • Avoidance of CO_2 emissions. • Renewable energy solutions are introduced.	70.20 tons CO_2e / yr	According to the 2019 annual report of the Guyana Energy Agency (GEA), the project will avoid annual CO_2 Emissions of 70,199.57 kg and will generate about 97.36 MWh of energy annually.

Progress Indicators

Indicator	Unit	Baseline	Target	Progress
Emissions per year reduced	tons CO_2e / yr	0	70.20	70.20
Installation of micro-grid PV system	#	0	1	1
Installed capacity of micro-grid PV system	MWp	0	0.072	0.072
Annual quantity of renewable energy generated	MWh/yr	0	97.36	97.36

Training and Development

Name of Action	Power Utility Upgrade Program					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Project	Completed	2014-2021	Guyana Power and Light Inc. (GPL)	CO_2	Regions 2, 3, 4, 5, 6, 9, 10	Training and Development

Description and Objective

The program aims to improve the efficiency and reliability of Guyana's power system through electricity loss reduction measures, improvements in the operational capabilities, and strengthening the management and corporate performance of the country's utility, GPL. As Guyana's energy demand increases, the distribution infrastructure will experience greater stresses, and in turn, this will challenge GPL's management and its ability to manage electricity supply. The Power Utility Upgrade Program is designed as a holistic, integrated approach to support GPL with financing for critical infrastructure investments and technical support for GPL's key business areas. This support should increase GPL's overall performance, reinforce GPL's operational capabilities, and the achievement of a sustained trend in overall loss reduction. As such, the programme aims to improve the safety and reliability of the GPL electricity distribution system by financing infrastructure specifically focused on the reduction of electricity losses, deploying a strong Corporate Development Program to manage GPL's operations and implement solutions to GPL's longstanding problems, while improving quality of service through: (a) the rehabilitation of the existing distribution network and associated equipment as part of a strategic loss reduction programme; and (b) the strengthening of GPL, in order to contribute to the enhancement of its corporate capacities, which will help to achieve a set of performance targets for GPL.

Quantitative Goals

- The program will rehabilitate approximately 830 kilometres or 40% of GPL's distribution network.
- Installation of 43,838 smart meters throughout the regions.

Steps Taken or Envisaged to Achieve Action

The Power Utility Upgrade Program engaged almost 4900 stakeholders in 176 communities across the regions of Guyana to make them aware of the activities as part of the programme, which included planting new poles, stringing of new conductors, upgrading the distribution network and installing new meters to reduce voltage fluctuations, reduce the frequency of power outages, eliminate all faulty network connections, sustain the life expectancy of the electrical appliances, and eliminate low voltage supply. This has allowed GPL to expand and equip the power system to take off and manage the forecasted electricity demand, and provide services, and operate at the required reliability levels of a modern power utility company.

Estimated Outcomes	Estimated GHG Emission Reductions	Methodologies and Assumptions
• Sustained trend in overall loss reduction. • Improved and accountable management performance within minimum international standards. • Modern, efficient, and reliable operational systems in GPL.	Not Estimated	Insufficient information available to estimate the GHG emission reductions.

Progress Indicators

Indicator	Unit	Baseline	Target	Progress
Rehabilitation of distribution network.	Km	0	830	830
Rehabilitation of distribution network.	%	0	40	40

Installation of smart meters.	#	0	43,838	43,838
Reduction of electricity losses.	%	31.4	25.86	25.86

Name of Action	Sustainable Operation of the Electricity Sector and Improved Quality of Service					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Project	Completed	2011-2017	Guyana Power and Light Inc. (GPL)	CO_2	National	Training and Development

Description and Objective

As part of the overall objective of the GPL to reduce losses in the Demerara Berbice Interconnected System (DBIS), the project aimed at improving the overall efficiency of GPL's electricity power system. In this context, the general objective of the program is to improve the overall efficiency of the system by: (i) achieving a lower level of electricity losses; (ii) improving operation and maintenance of the distribution network; (iii) improving understanding of the main technical, financial, social, environmental and operational issues; (iv) reducing the incidence of theft of electricity; and (v) gaining commitment to the sustainability of the power sector. The program has financed three major components: (i) capacity building and energy conservation; (ii) rehabilitation of the low voltage distribution network; (iii) commercial loss reduction actions.

Quantitative Goals

- The program's interventions addressed the issue of technical losses by replacing 122.33 km of network, including conductors, transformers and the installation of new meters.
- Actions to reduce commercial losses included preparing consumer indexes and mapping, increasing the number of legal customers in the rehabilitated Low Voltage network and informing 15,000 customers on the rational use of energy and culture of payment

Steps Taken or Envisaged to Achieve Action

In order to achieve the objective of the project, the operation financed (i) capacity building and energy conservation; (ii) rehabilitation of the distribution network; and (iii) commercial loss reduction actions.

Estimated Outcomes	Estimated GHG Emission Reductions	Methodologies and Assumptions
• Achieving a lower level of electricity losses. • Improving the operation and maintenance of the distribution network. • Improving understanding of main technical, financial, social, environmental, and operational issues. • Reducing the incidence of theft of electricity. • Gaining commitment to the sustainability of the power sector.	Not Estimated	Insufficient information available to estimate the GHG emission reductions.

Progress Indicators

Indicator	Unit	Baseline	Target	Progress
Sustained decreasing overall losses trend achieved.	%	31.3	24.7	29.65
Level of losses in the low voltage network reduced.	%	6.0	4.98	5.53
Implementation of the ITRON Meters and prepaid meter program.	%	0	100	100
Number of customers informed on efficient energy usage and culture of payment in targeted areas for rehabilitation.	#	0	15,000	15,000
Increased number of legal customers in the low voltage rehabilitated and reconfigured network.	#	53,460	66,000	2,468

Name of Action	Power Sector Support Program					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Project	Completed	2007-2012	Guyana Power and Light Inc. (GPL)	CO_2	National	Training and Development

Description and Objective

The Power Sector Support Programme (PSSP) was established to support the efforts of the Government of Guyana to promote a more sustainable and efficient energy sector. As such, the project included support activities in the electricity sector that will help promote the sustainable development of the energy sector and institutionalize policies and programs to (i) establish planning and priority setting in the sector; (ii) improve the enabling environment to encourage sustainable energy loss reduction and efficiency; (iii) provide institutional strengthening in order to assure regulatory capacity of the sector; (iv) strengthen the power utility provider (GPL) in order to address loss reduction on a sustainable basis, efficiency and quality of service; and (v) promote social awareness to curb loss reduction. Achieving these objectives will help to improve the financial stability of the company and the sector itself by bringing back "lost" customers, improving long term planning for the sector, and reducing losses that increase costs to all consumers. One of the desired effects of a successful program would also be an improved environment for new investment, thereby contributing to Guyana's competitiveness and growth.

Quantitative Goals

- Reduction of electricity losses to 25.5%.

Steps Taken or Envisaged to Achieve Action

The Program provided financing to execute the three components. Component 1 - Promote institutional, legal, and regulatory reforms. Component 1's objectives included a) strengthen the regulatory and legal framework to contribute to a more effective power sector with increased efficiency, transparency and accountability and b) contributing to more efficient and effective development of the power sector with a long-term strategy. Component 2 - Strengthen the Power Utility Company Capabilities. Component 2 sought to strengthen the utility's capabilities to manage a loss reduction program by contributing to improvements in corporate governance, transparency and accountability. Component 3 - Promote Sustainable Electric Loss Reductions. Component 3 objectives included a) coordinate consistent efforts to allow for effective overall electricity loss reduction and b) build consensus on the benefits of a sustainable power service.

Estimated Outcomes	Estimated GHG Emission Reductions	Methodologies and Assumptions
• Strengthened regulatory and legal framework to contribute to a more effective power sector with increased efficiency, transparency and accountability. • More efficient and effective development of the power sector with a long-term strategy. • Strengthened utility's capabilities to manage loss reduction program by contributing to improvements in corporate governance, transparency and accountability. • Coordination and consistency of efforts allow for effective overall loss reduction. • Building consensus on the benefits of a sustainable power service.	Not Applicable	Not Applicable. Emission reductions largely linked to energy efficiency measures captured under the Power Utility Upgrade Program: this includes capacity building, network rehabilitation or reconfiguration, upgrade and optimal relocation of distribution transformers at load centres, addition of new distribution transformers, interventions to pursue the reduction of commercial losses.

Progress Indicators				
Indicator	**Unit**	**Baseline**	**Target**	**Progress**
Updated legal and regulatory framework (PUCA/other related legislation) is fully enacted with operating regulations, where necessary, implemented for at least six consecutive months.	#	0	1	1
Development of a sector strategy.	#	0	1	1
Minutes of the board reflect procedures derived from new corporate administrative tools.	#	0	1	1
Electric losses are under 20.4% 5 years after program execution.	%	34.5	25.5	20.4
Customer survey results indicate increase of in willingness to pay and social awareness of full cost of electric losses.	#	0	2	2

Name of Action	Strengthening Capacity in Energy Planning and Supervision					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Enabling Activity	Completed	2012-2016	Inter-American Development Bank (IDB)	Not Applicable	National	Training and Development
Description and Objective						
In comparison with similar utility organizations, Guyana Power and Light Inc. (GPL) has a limited number of experienced staff and information resources, particularly within system planning and design, network operations, maintenance and system control and engineering services. The objective of this project is to strengthen capacity in the energy sector in Guyana through targeted support on training, technical and strategic planning, coordination, and supervision activities in government agencies. Specifically, the it provides for: (i) strengthening GPL's technical coordination unit with respect to energy projects; (ii) support to government agencies involved in the planning, data collection and analysis of energy data for the use of other energy sources in Guyana; (iii) strengthening of commercial demand-side management in GPL.						
Quantitative Goals						
• Establishing efficiently coordinated provision of energy services.						
Steps Taken or Envisaged to Achieve Action						
During the project, training will be provided to existing and new staff in: (i) operational management systems including Supervisory Control and Data Acquisition (SCADA) systems; (ii) power grid center systems; (iii) recording of data and management information related to interconnected system operation; (iv) analytical tools for operational management information and project management; and (v) procurement and financial support. Furthermore, technical advice and training will be delivered to promote improvements in data collection and analysis in order to facilitate coordination of energy demand and supply-side data between key governments agencies involved in monitoring the expansion of the energy sector in Guyana. Finally, it will assist in the design, execution, and monitoring of demand-side management, strengthening GPL's capabilities to adequately manage transparency and accountability of commercial operations, improved collection rate and reduced commercial losses.						

Estimated Outcomes	Estimated GHG Emission Reductions	Methodologies and Assumptions
• Strengthen operational performance, enabling agencies such as GPL, Office of the President (OPS), Office of the Prime Minister (OPM), Power Utility Commission (PUC) and the Guyana Energy Agency (GEA), among others, to optimise and function to their required capacity.	Not Applicable	Not Applicable

Progress Indicators

Indicator	Unit	Baseline	Target	Progress
Information management training for new and existing staff in GPL.	#	0	1	1
Technical assessment of coordination capacity.	#	0	1	1
Training for staff in government agencies.	#	0	2	2
Commercial expert contracted in GPL.	#	0	1	1

Forestry Sector

Name of Action	Institutional Strengthening for the Implementation of the LCDS 2030 under REDD+ Partnerships					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Enabling activity	Completed	2011-2017	Guyana Forestry Commission (GFC) and Office of Climate Change (OCC)	CO_2	National	Forestry
Description and Objective						
In July 2022, Guyana adopted the Low Carbon Development Strategy 2030 (LCDS 2030), an update from the original strategy set out in 2009. The LCDS 2030 aims at avoiding deforestation and maintaining forests, while growing the economy five-fold over 10 years and keeping energy emissions flat; investing in urban, rural and Amerindian development; protecting the coast and hinterland from climate change; creating jobs in a suite of low carbon sectors; aligning the education and health sectors with low carbon development; and integrating Guyana's economy with its neighbours. The LCDS sets out the following four inter-linked objectives: (i) value ecosystem services; (ii) invest in clean energy and stimulate low carbon growth; (iii) protect against climate change and biodiversity loss; and (iv) align with global climate and biodiversity goals. Under the first objective, Guyana sets out goals towards enhancing Reducing Emissions from Deforestation, Degradation and sustainable forest management (REDD+) partnerships. This project aimed to enhance the national institutional capacity in Guyana to address the impacts of climate change through the effective implementation of the LCDS 2030, and to assist Guyana in meeting its commitments under interim REDD+ partnerships. These commitments include the reduction of deforestation which translates into the avoidance of CO_2 emissions. The project was funded by result-based payments under Guyana-Norway partnership channelled through two ways: (i) the Guyana REDD+ Investment Fund (GRIF) and the Inter-American Development Bank (IDB) and (ii) direct engagement between Norad and Conservation International. The specific objective of the project was to strengthen the technical and administrative capacity of the three principal institutions responsible for implementing and monitoring, reporting, and verifying Guyana's LCDS 2030, namely the Office of Climate Change (OCC), the Project Management Office (PMO) and the GFC, through supporting the recruitment of specialized personnel with expertise in strategic fields, training and capacity building of permanent staff, and ensuring sufficient equipment and technical resources to ensure smooth running of the project. Additionally, the project aimed to conduct a diagnostic for future institutional strengthening which was to assess the institutional capacities of other Government agencies whose responsibilities are related to the LCDS and REDD+ activities.						
Quantitative Goals						
• Enhance national institutional capacity in Guyana to address the impacts of climate change via reduction of deforestation and while demonstrating its ability to earn the maximum portion of funds available via the GRIF.						
Steps Taken or Envisaged to Achieve Action						
On 9 November, 2009, Guyana and Norway signed a Memorandum of Understanding (MoU), agreeing that Norway would start to provide Guyana with result-based payments for forest climate services, whereby Norway intended to make performance-based contributions of up to $250 million USD by 2015 for results achieved by Guyana in generating the capacity to reduce emissions from deforestation and forest degradation, whilst creating a replicable model for REDD+. Guyana was set to be paid by Norway for performance on reducing GHG emissions from deforestation and forest degradation, and for progress made against enabling conditions including those relating to indigenous rights, consultation, and establishing a MRV system. In 2010, the IDB, the World Bank, Norway and Guyana developed the Guyana REDD+ Investment Fund (GRIF) in accordance with						

the LCDS, constituting the financial mechanism that allows results-based payments associated with the interim REDD+ program. Among the activities undertaken, the capacities of the GFC, OCC, and PMO were strengthened by recruiting and training specialized technical and administrative personnel; investor negotiations with OCC and PMO were facilitated; junior staff in the PMO were trained on project management; and a diagnostic was conducted on future institutional strengthening needs of government agencies whose responsibilities are related to the LCDS and REDD+ activities such as the EPA and the GGMC. Through these activities, the PMO reported that, as of 2017, the Government of Guyana has received four results-based payments totalling $190 million USD of the $220 million USD potentially available through the GRIF under the bilateral agreement with Norway for the 2009-2015 period, which have been allocated to fund future LCDS related projects. Over 156 communications and outreach activities on LCDS and REDD+ were conducted. Methodologies for determining the extent and scale of forest degradation were developed and a digital database of archived satellite data and national spatial data sets were established. Historical and current drivers and processes affecting forest carbon levels were assessed and implementation plans for long term measurements and monitoring of national forest carbon stocks were developed. Within the GFC, eight technical staff were trained in the area of forest carbon stocks and change assessments; fourteen field staff were trained in forest carbon monitoring systems; and six staff were trained in GIS and Remote Sensing. Multiple reports and areas of research were advanced by the GFC, including: Assessment Report in Current Drivers and Processes Affecting Forest Carbon; Report on Independent Forest Monitoring; Report on Identification of Non-Carbon Ecosystem Services for Integration into Guyana's National MRVS Assessment; Report on Shifting Agriculture; and Report on Assessment of Requirements of a Monitoring System for Carbon as well as Non-Carbon Variables. Technical capacities of forest based indigenous communities were also built to engage in community-based monitoring for forest resources (Community MRV).

Estimated Outcomes	Estimated GHG Emission Reductions	Methodologies and Assumptions
• Maintenance of forest cover by 85%. • Progressively decreased total level of deforestation across the five-year project implementation period from 0.056%, 0.054%, 0.079%, 0.068% to 0.065% respectively. • Full access to results-based payments potentially available through the GRIF to finance LCDS 2030 implementation. • Attainment of all LCDS 2030 goals.	Not Applicable	Not Applicable

Progress Indicators

Indicator	Unit	Baseline	Target	Progress
LCDS execution capacity of the OCC score.	%	55%	72%	90%
LCDS execution capacity of the GFC score.	%	76%	85%	90%
Stakeholder awareness of LCDS.	%	60%	90%	72%

Name of Action	Guyana-EU Forest Law Enforcement, Governance and Trade Voluntary Partnership Agreement					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Enabling activity	Ongoing	2012-2025	Guyana Forestry Commission (GFC)	CO_2	National	Forestry

Description and Objective

The Guyana-European Union (EU) Forest Law Enforcement, Governance and Trade (FLEGT) Voluntary Partnership Agreement (VPA) supports sustainable forest management, governance, and law enforcement in the trade of sustainable and legal timber products. The VPA aims to support governance reform and strengthen enforcement activities within Guyana´s forest sector, with commitments to improve transparency, accountability, legislative clarity, and other aspects of governance. Under the VPA, Guyana may issue FLEGT licenses on their timber exports under a national FLEGT Licensing Schemes based on a Legality Assurance System (LAS), ensuring that only legally produced timber produced in a sustainable manner are exported to the EU. The FLEGT VPA aims to foster business growth by shipping Guyana´s timber products to the EU and other global markets that are moving towards forest sustainability and new forest policies and laws.

Quantitative Goals

- Guyana-EU Forest Law Enforcement, Governance and Trade Voluntary Partnership Agreement finalized, in place, and fully operational.
- Empower Guyana´s forests to forge a green economy based on low levels of deforestation, reduced carbon emissions, and climate resilience.

Steps Taken or Envisaged to Achieve Action

In 2012, a policy decision was taken by the Government of Guyana to enter into formal negotiations with the EU on a FLEGT VPA. Guyana and the EU negotiated the terms of the VPA through a collaborative process with both Parties that shared the goal of fostering good forest governance and addressing illegality. Negotiations began through a multi-stakeholder process aimed at fostering national ownership, stakeholder engagement, wide participation, and a broad consensus to promote effective VPA implementation. Negotiations between the EU and Guyana began in December 2012, lasted for nearly six years, and were successfully concluded with the initialling of the agreement on 23 November 2018. The European Council adopted the Decision on the signing of the VPA with Guyana in October 2022. The final signing of the agreement took place at the UN Biodiversity Conference (COP 15) in Montreal on 15 December 2022, whereby the Minister for Natural Resources signed the agreement on behalf of Guyana and the EU was represented by the European Commissioner for Environment, Oceans and Fisheries and the Czech Deputy Minister of the Environment. It is intended that a period of preparedness will follow for 3-5 years to enable Guyana to effectively implement the VPA under EU-FLEGT by the issuance of FLEGT licences. Guyana has already begun taking significant steps to begin implementing the VPA under the period of preparedness, whereby Guyana enacted New Forest Regulations and gazetted the Code of Practice for Forests Operations in 2018, in addition to developing a national VPA Communication Strategy and held a virtual learning event for Forest Sector Operators (FSO) in 2020. To begin issuing FLEGT Licences, Guyana is upgrading existing the national Wood Tracking System (WTS) to develop a robust timber legality assurance also known as the Guyana Timber Legality System (GTLAS). The FLEGT Licensing Scheme will take effect when the GTLAS is successfully evaluated, and Guyana and the EU are satisfied that it functions as described in the VPA. Guyana also has a series of VPA Annexes which describe the practical components for implementing the core commitments in the VPA in detail. Further legal works are being conducted by Guyana including identifying and addressing possible gaps in the forest allocation process and the legal framework; stakeholder capacity-building; improving procedures for verifying legal compliance; developing approaches that ensure the traditional rights of Amerindian peoples are not impeded; and establishing independent audits, a complaints mechanism, and systems and procedures for information on the forest sector to be publicly available. Additional resources are required to build institutional and private sector capacity to meet other trade and supply conditions such as the Lacey Act, Forest Stewardship Council (FSC) certification, and other procurement requirements.

Estimated Outcomes	Estimated GHG Emission Reductions	Methodologies and Assumptions
• Reduced deforestation from illegal logging and its associated socioeconomic problems.	Not Estimated	Insufficient information available to estimate the

• Strengthened forest sector governance and improved regulatory frameworks with formalized multi-actor and multi-sector structures, including reinforced capacities of the GFC. • Modernized Wood Tracking System and Timber Legality System. • Increased transparency, reputation, and accountability. • Strengthened capacities among forestry sector stakeholders for sustainable forest management. • Sustainable economic growth and expansion securing Guyana's access to EU and other international Markets for sustainable timber products. • Enhanced community benefits through a sustainable livelihoods approach, including local communities, Forest Sector Operators, and Indigenous peoples.		GHG emission reductions.

Progress Indicators

Indicator	Unit	Baseline	Target	Progress
Level of transparency in the forestry sector.	%	53.0%	100%	71.3%
Level of implementation of sustainable forest management plans.	%	51.4%	100%	70.6%
Level of timber harvesting qualified as legal.	%	53.7%	100%	57.8%
Level of legal timber traded on the export market.	%	62.5%	100%	78.5%
Level of legal timber traded on the domestic market.	%	54.2%	100%	68.1%
Tax collection efficiency of the forestry sector.	%	41.7%	100%	52.4%

Name of Action	Guyana REDD+ Monitoring Reporting & Verification System (MRVS)					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Enabling activity	Ongoing	2010-2025	Guyana Forestry Commission (GFC)	CO_2	National	Forestry

Description and Objective

This activity has designed, implemented, and is currently improving the Monitoring, Reporting and Verification System (MRVS) for the forestry sector in Guyana as a key element to enable the performance-based payments of Guyana's REDD+, and support Guyana´s carbon markets through mechanisms such as ART-TREES. The design of the MRVS comprised three phases, each with a progressively ambitious objective as follows: Phase 1 had the goal to establish the MRVS, Phase 2 had the goal of consolidate and expand capacities for national REDD+ monitoring, and Phase 3 has the goal to maintain an efficiently functioning MRVS that meets international and national requirements and supports natural resources management in Guyana. The MRVS aims to establish a comprehensive, national system to monitor, report, and verify forest carbon emissions by tracking forest change due to both deforestation and degradation, by tracking change drivers and the interpretation of national coverage high-resolution satellite imagery.

Quantitative Goals

- A fully operational MRVS system is in place in line with REDD+, UNFCCC, and IPCC standards, with enhanced capacities for inter-institutional multi-dimensional use of its benefits, including access to international carbon markets as a source of sustainable income to fund domestic climate action, as well as to enhance monitoring and enforcement of forest-based activities in the country.

Steps Taken or Envisaged to Achieve Action

A climate and forest partnership between the Government of Guyana and the Government of Norway was established in 2009, which included the progressive development of the Guyana Monitoring Reporting and Verification System (MRVS). In 2009 Guyana brought forth a framework for a national MRVS and a roadmap for its phased development, improvement, and implementation. Under Phase 1 (2010 to 2015) Guyana´s MRVS was established for implementing REDD+ policies and to receive results-based compensation for such activities, while building capacity in the GFC to carry out forest cover and change monitoring and forest carbon monitoring, as well as fostering stakeholder awareness and participation in MRVS design and implementation. Under Phase 1, reference measures and interim indicators were developed and applied while aspects of the MRVS were under development and were to eventually be phased out and replaced by a complete forest carbon accounting system as methodologies are further developed. The continued development and implementation of Guyana's MRVS under Phase 2 (2016 to 2021) maintained its focus on the implementation and further development of the key technical areas of forest area change assessment and monitoring and forest carbon measurement and monitoring. Emphasis was placed on improvements in the emissions and removals reporting, and application of the system to improve forest management, achieving in 2018 the total forest carbon and removals accounting for the first time. Over the years, Guyana's MRVS has become an internationally acclaimed model and an enabler to enter voluntary international carbon markets. On 18 December, 2020, Guyana submitted an application to the Architecture for REDD+ Transactions (ART) Secretariat, and as of December 2022, ART has issued the world´s first TREES credits to Guyana, whereby each credit represents 1 ton CO_2e. A total of 33.47 million TREES credits for the five-year period from 2016 to 2020 were issued to Guyana. It is anticipated that an additional 7.5 million credits per year will be issued on average from 2021 to 2030 under the ART-TREES initiative. The country is allocating 85% of revenues from their sale to multi-community and national programs, and 15% to village-led sustainability plans for indigenous communities. Under Phase 3 (2022-2025), Guyana will further improve the MRVS to attain further participation in the ART-TREES initiative and fully adhere to emerging TREES standard. Hess Corporation has committed to purchase 37.5 million ART-TREES credits consisting of 12.5 million of the 33.47 million carbon credits issued for the period 2016-2020, and an additional 2.5 million per annum from the credits to be issued each year from 2021 to 2030, at a minimum unitary cost of $15, $20, and $25 USD per credit issued in 2016-2020, 2021-2025, and 2026-2030, respectively. In this Phase 3, the GFC and other land management agencies see a compelling need to monitor land cover change more frequently to extend the inter-sectoral benefits of the system beyond current use. MRVS Phase 3 will support the improvement of the necessary human and physical capabilities sustained by local institutions and create the platform for monitoring, reporting, and compliance verification under a market-based mechanism. This phase will continue to see routine annual reporting on forest carbon emissions and removals in compliance

with UNFCCC and IPCC requirements. Simultaneously, this phase will create complementary systems for reporting on REDD+ governance compliance requirements, such as supporting REDD+ forest sector safeguards, Guyana's Nationally Determined Contributions, and the UN Sustainable Development Goals 13 and 15. To date, eleven national assessments (2010 to 2021) have been conducted and issued by the GFC.		
Estimated Outcomes	**Estimated GHG Emission Reductions**	**Methodologies and Assumptions**
• Maintenance of low rates of deforestation and degradation leading to 33.47 million carbon credits issued over the 2016-2020 period and an additional 7.5 million credits expected to be issued per year over the 2021-2030 period. • Sustainable income generated to support 242 village-led sustainable development plans among indigenous communities. • Sustainable income generated to support LCDS 2030 implementation unlocking transformative investments in renewable and low-carbon energy generation; climate change adaptation and biodiversity loss; green job creation; health and education; and expanded protected areas.	108.47 million tons CO_2e	Guyana has been issued 33.47 million ART-TREES credits for the period 2016-2020, with an estimated additional 75 million credits to be issued for the period 2021-2030. Each credit being equivalent to 1 ton CO_2e, the total reduction over the 2016-2030 period is estimated at 108.47 million tons CO_2e.

Progress Indicators

Indicator	Unit	Baseline	Target	Progress
Number of ART-TREES credits issued.	#	0	108.47	33.47
Number of ART-TREES credits sold (actual and anticipated to 2030).	#	0	37.5 million	12.5 million
Value of ART-TREES credits sold (actual and anticipated to 2030).	$ USD	0	750 million	150 million

Name of Action	Forest Carbon Partnership Facility Project in Guyana					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Enabling activity	Completed	2014-2020	Guyana Forestry Commission (GFC)	CO_2	National	Forestry

Description and Objective

The objective of the technical cooperation assisted Guyana in its efforts to establish an enabling framework and build its capacity for REDD+ by providing financial and technical assistance aiming to (i) improve the organization of the country for REDD+ Readiness, including stakeholder consultations; and (ii) develop the Guyana REDD+ Strategy to facilitate Guyana's access to additional funding under performance-based incentives. In Guyana's case, REDD+ goals include mitigating climate change; conserving water resources and prevent flooding; reducing run-off and control soil erosion; reducing river siltation; protecting inland and coastal fisheries; investing in hydropower facilities; preserving biodiversity; and preserving cultures and traditions. The FCPF project had three components as follows: (i) Component 1 - institutional arrangements and consultations for REDD+ readiness; (ii) Component 2 - REDD+ strategy development and implementation framework; and (iii) Component 3 - monitoring and evaluation of readiness activities. The objective of Component 1 was to strengthen the efficacy, accountability, and transparency of the national readiness management and institutional arrangements and increase stakeholder consultation and participation in REDD+ strategy development and implementation. The objective of Component 2 was to build capacities for REDD+ Strategy implementation including capacities to (i) verify and characterize the key drivers of deforestation and forest degradation; (ii) design conservation and sustainable forest management activities that reduce emissions; (iii) identify how current land use, and forest law, policy and governance structures impact on the drivers of deforestation and forest degradation; and (iv) propose alternatives for mitigating the identified drivers and responding to impacts. The objective of Component 3 was to monitor and evaluate the FCPF project implementation.

Quantitative Goals

- Full REDD+ readiness status attained in Guyana through extensive stakeholder consultation and participation.
- REDD+ Strategy and Implementation Framework established together with its Environmental and Social Management Framework.
- All REDD+ activities in Guyana are monitored and reported effectively.

Steps Taken or Envisaged to Achieve Action

Guyana joined the World Bank's Forest Carbon Partnership Facility, and submitted its Readiness Plan Idea Note (R-PIN) in 2008 to initiate the REDD+ readiness preparation. In 2011, Guyana became a United Nations REDD Partner Country. In 2012 the government of Guyana prepared and approved its Readiness Preparation Proposal (R-PP) which was submitted to the FCPF that same year. Thanks to parallel activities concerning the development of the national MRVS, Guyana developed and submitted to the UNFCCC its National Forest Reference Level (FRL) for REDD+ in 2014 and a revised Reference Level in 2015. The activities addressed by the FRL are deforestation from conversion to agriculture, mining, and infrastructure expansion, and forest degradation from timber harvest. The FRL was developed using a Combined Reference Level Approach, in which the average rate of global tropical forest carbon emissions (0.435% / yr) is combined with the rate of annual emissions from forests in Guyana (2001-2012, 0.049% / yr) to obtain a reference level of 0.242%, that results in emissions of 46,301,251 ton CO_2/yr. In 2016, Guyana begun the implementation of the R-PP through the development of REDD+ strategy options, and the reinforcement of its institutional capacity to manage REDD+, including social and environmental safeguards. In 2019, Guyana produced its national REDD+ Strategy, Social Environmental and Strategic Assessment (SESA) and an Environmental and Social Management Framework (ESMF) which underwent extensive stakeholder consultation. With the final readiness Package (R-Package) being developed in August 2020, revised in March 2021, and endorsed in May 2021, Guyana culminated the FCPF REDD+ readiness process.

Estimated Outcomes	Estimated GHG Emission Reductions	Methodologies and Assumptions
• Institutional capabilities were built and mobilized to ensure successful execution of the R-PP.	Not Applicable	Not Applicable

• Enhanced information sharing and accessibility of information as well as implementation of public disclosure of consultation. • Guyana proposed a REDD+ Strategy in line with its NDC seeking to avoid 48.7 $MtCO_2e$ annually, while maintaining an annual rate of deforestation below 0.1% focusing on the major drivers of mineral mining, forestry, and agriculture, while adopting a principle of promoting biodiversity conservation and enhancement. • The REDD+ strategy was developed in an inclusive, participatory and transparent manner, ensuring multiple opportunities for learning about and influencing the REDD+ strategy design for all affected or interested stakeholder groups. • A Social Environmental and Strategic Assessment (SESA) and an Environmental and Social Management Framework is in place to ensure compliance with the Cancun REDD+ social and environmental safeguards. • Through parallel efforts, Guyana has developed a world-class forest monitoring system (MRVS) that has been independently verified for accuracy by reputable institutions, having produced twelve national assessments (2010 to 2022) to date. Further, Guyana has developed and submitted to the UNFCCC its National FRL for REDD+ in December 2014 and a revised FRL in September 2015.		

Progress Indicators

Indicator	Unit	Baseline	Target	Progress
Extent of consultation, participation, and outreach.	FCPF scale (0-5, whereby 5 is completed)	2	5	4
Extent of development of REDD+ Strategy.		0	5	5
Extent of development of REDD+ Implementation Framework.		0	5	4
Extent of assessment of environmental and social safeguards.		0	5	4
Extent of development of Environmental and Social Management Framework.		0	5	4
Stage of REDD+ Readiness.	Qualitative	R-PIN	R-Package	R-Package

<table>
<tr><th>Name of Action</th><th colspan="6">Securing a Living Amazon through Landscape Connectivity in Southern Guyana</th></tr>
<tr><th>Type of Action</th><th>Status</th><th>Duration</th><th>Implementing Entity</th><th>GHG Coverage</th><th>Geographic Scope</th><th>Sectoral Scope</th></tr>
<tr><td>Project</td><td>Ongoing</td><td>2022-2027</td><td>Environmental Protection Agency (EPA) / Protected Areas Commission (PAC)</td><td>CO_2</td><td>Region 9</td><td>Forestry</td></tr>
<tr><th colspan="7">Description and Objective</th></tr>
<tr><td colspan="7">Under the Amazon Sustainable Landscape Impact Program, this project aims to strengthen and improve landscape connectivity through the establishment of conservation areas (800,000 ha) and the management of productive areas (400,000 ha) within southern Guyana as a method to combat degradation, fragmentation, and unsustainable exploitation of forest resources due to unplanned land-use expansion and unsustainable land/water use from logging and mining sectors, new infrastructure (e.g. roads and trails), and wildlife harvesting. Key project components are four-fold. First, to fortify integrated protected landscape management, whereby focus is placed on the Kanuku Mountains Protected Area (KMPA) to strengthen its management together with the Indigenous communities who utilize resources of the protected area. Second, fortify integrated productive landscapes, whereby focus is placed on strengthening the management of the North Rupununi Wetland (NRW). Third, strengthen policies and incentives for protected and productive landscapes, including the revision of the Protected Areas Act in consultation with all key stakeholders. Fourth, capacity building and cooperation including monitoring and evaluation, communications, and cooperation with the wider Amazon Sustainable Landscapes Impact Program.</td></tr>
<tr><th colspan="7">Quantitative Goals</th></tr>
<tr><td colspan="7">• Strengthened protected area management effectiveness.
• Increased areas of forests and watersheds brought under sustainable land and water management practices.
• Strengthened regulatory frameworks for natural resource conservation/sustainable use.
• Strengthened monitoring, evaluation, and cooperation.</td></tr>
<tr><th colspan="7">Steps Taken or Envisaged to Achieve Action</th></tr>
<tr><td colspan="7">Approximately 169 persons from the communities of Fair View, Crashwater, Rewa and Apoteri, Iwokrama River Lodge, the North Rupununi District Development Board and the Kanaku Mountain Community Resource Group participated in consultations during November 2019 on barriers, threats, and potential opportunities that may arise as a result of the project. In June 2019, the Global Environment Facility (GEF) Council approved the project concept and the EPA in partnership with WWF-Guyana prepared the project document through extensive project stakeholder consultation so as to secure their maximum input in project design. As of May 2022, the GEF approved project for implementation, whereby Guyana secured a total $5.1 million for implementation.</td></tr>
<tr><th colspan="3">Estimated Outcomes</th><th>Estimated GHG Emission Reductions</th><th colspan="3">Methodologies and Assumptions</th></tr>
<tr><td colspan="3">• Kanuku Mountains Protected Area (KMPA) under enhanced management.
• North Rupununi Wetland (NRW) implementing and integrated wetland management strategy.</td><td>847,406 tons CO_2e</td><td colspan="3">The EX-ACT tool was used to calculate CO_2e reductions. The project is expected to improve practices in 1,800 ha of the KMPA during the lifetime of the project, contributing to 72,489 tons of CO_2e mitigated. It is expected that the project will move at least 1% of the NRW (or 15,128 ha) from very low degradation to no degradation over 5 years, which contributes to an additional 774,917 tons of CO_2e mitigated.</td></tr>
</table>

Progress Indicators				
Indicator	**Unit**	**Baseline**	**Target**	**Progress**
Area of protected landscapes created or under improved management for conservation and sustainable use.	ha	0	611,000	0
Area of productive landscapes under improved management practices.	ha	0	901,800	0
Number of community members with built capacities, training, exchanges, and participation in planning processes.	#	0	700	0

Cross-Cutting Sector

Name of Action	Amerindian Development Fund					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Project	Completed	2012-2016	Ministry of Amerindian Affairs (MoAA)	Not Estimated	National	Hinterland Development
Description and Objective						
The Amerindian Development Fund (ADF) was established to provide funding to support the low-carbon socio-economic development of Amerindian communities and villages, through the implementation of their Community Development Plans (CDPs) across agriculture, village infrastructure, tourism, manufacturing, village business enterprise, and transportation. The project aimed to strengthen the entrepreneurial and institutional capabilities of the village economies of Amerindian communities; improve linkages with the private sector to further develop value chains; and strengthen institutional frameworks to support local economies in low-carbon socio-economic development.						
Quantitative Goals						
• Strengthened entrepreneurial and Institutional capabilities of the village economy of Amerindian communities. • Improved linkages with the private sector to further develop value chains. • Strengthened institutional framework to support local economies.						
Steps Taken or Envisaged to Achieve Action						
Phase 1 (2012) of the ADF provided funding to 26 communities and villages in the amount of $753,877 USD for the implementation of their CDPs and capacity development of the Ministry of Amerindian Affairs was conducted. Under Phase 2 (2014) of the ADF approximately $3,658,663 USD was disbursed to154 communities and villages for the implementation of their CDPs. In all 154 communities, Community Development Officers (CDOs) were trained in monitoring and financial accounting techniques and Community Management Teams (CMTs) were trained to prepare budgets, financial reports and provided with business management, marketing, and leadership techniques training. Furthermore, Cluster Training Sessions were held for entrepreneurs on cattle management, fish culture, wood working, and business operations, among others. Work was completed to improve linkages with the private sector to further develop value chains and to strengthen the institutional framework to support local communities. As a result, beneficial connections with several agencies and institutions, including the Small Business Bureau (SBB); Guyana Livestock and Development Agency (GLDA); Guyana Tourism Authority (GTA); National Agricultural Research and Extension Institute (NAREI); Regional Democratic Councils (RDCs); New Guyana Marketing Corporation (NGMC); Guyana Technical Institute (GTI); Global Seafood Distributors; Georgetown Chamber of Commerce and Industry (GCCI); and the Guyana Energy Agency (GEA) were made. A CDP database was also elaborated over the life of the project and shared with various agencies and institutions, enlisting all grant recipients, types of CDPs, typologies, villages, tranches disbursed, dates, population, and other particulars. Phase 2 of the ADF project ensured to incorporate key lessons learned from Phase 1 for greater efficiency, impact and sustainability of CDPs, including: (i) community ownership and participation is fundamental to the preservation and respect for Amerindian rights, traditional knowledge and practices, and the implementation of this project; (ii) development of the village economy is critically linked to clustering, marketing, availability of economic opportunities, and other industry linkages, inter alia; (iii) modalities for the disbursement of funds should be mindful of risks, costs and delays in situations where communities cannot use bank accounts; (iv) it is fundamental to ensure access to, and account for the cost of, energy; and (v) logistical costs, risks, weather, and mitigation measures should be fully considered in the planning and delivery of activities.						

Estimated Outcomes	Estimated GHG Emission Reductions	Methodologies and Assumptions
• 180 Community Development Plans Supported. • 1,253 villagers trained for CDP management teams. • 1,662 low-carbon jobs sustained and/or created. • $4,412,540 USD in value of CDPs funded.	Not Estimated	Insufficient information available to estimate the GHG emission reductions.

Progress Indicators				
Indicator	**Unit**	**Baseline**	**Target**	**Progress**
Proportion of community ventures financed operational after 1st year.	%	0%	95%	15%
Proportion of CMTs regarded as effective in managing community business.	%	0%	70%	90%
Proportion of CDPs that are financially break-even.	%	0%	40%	13%
Number of partnerships developed in pursuit of community business development.	#	Limited	Several	Several
Number of CMTs trained to develop, manage, and execute business ventures.	#	27	187	154
Proportion of communities that have developed formal linkages between community-level enterprises and larger firms.	%	0%	50%	8%
Extent to which local government agencies are convening and brokering partnerships to support local economic development.	Qualitative	Somewhat involved in project implementation	Fully covering and brokering partnerships	Village leaders fully engaged in discussions

Name of Action	Support for Micro and Small Enterprise and Vulnerable Groups' Low-Carbon Livelihoods					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Project	Completed	2012-2018	Ministry of Business (MoB)	Not Estimated	National	Economic Development

Description and Objective

The project addressed two of the major bottlenecks that constrained the development of micro and small enterprises (MSEs) and the ability of vulnerable groups to build alternative low-carbon livelihoods in Guyana, namely (i) limited access to finance and (ii) limited technical and business skills. Access to finance was addressed through (i) a credit guarantee facility covering 40% up to 70% of the collateral requirements for low-carbon venture loans at participating financial institutions; (ii) an interest payment support facility which lowered interests from a range 0f 14-26% down to 6% for entrepreneurs approved for loans for low-carbon ventures; and (iii) a low carbon grant scheme to assist vulnerable persons with viable business propositions in low carbon sectors. A training voucher scheme enabled MSEs to obtain the skills they require at existing training institutions free of cost to them. The project targeted MSEs working in, or transitioning to, 17 low carbon sectors such as: low carbon agriculture and agro-processing; aquaculture; eco-tourism; sustainable business process outsourcing; bio-ethanol; energy efficient transportation and logistics; low carbon manufacturing activities; apiculture; low carbon energy production and/or distribution; sustainable professional and business services; sustainable internet and computer based services; sustainable culture; and sustainable publishing and printing.

Quantitative Goals

- Support carbon emission reductions by re-orienting the economy onto a low carbon path, through the creation of the necessary incentives and creation of jobs in MSEs under key sectors of Guyana´s Low Carbon Development Strategy 2030.

Steps Taken or Envisaged to Achieve Action

A total of 224 loans were approved for beneficiaries (61% males and 39% females) in low carbon sectors at a total approximate value of $4,399,138 USD and 591 grants were approved for entrepreneurs (38% males and 62% females) in low carbon sectors at an approximate value of $891,055 USD. Additionally, 4,482 persons were trained free of cost in several areas, including: basic business management skills, record keeping, packaging and labelling, a special course aimed at female entrepreneurs, climate smart agriculture, sustainable forestry, sustainable mining, videography, photography, cosmetology, cookery, and craft.

Estimated Outcomes	Estimated GHG Emission Reductions	Methodologies and Assumptions
• 24 low-carbon loans provided. • 591 low-carbon grants provided. • 2,101 low-carbon jobs sustained and/or created. • 4,482 persons trained in low-carbon sectors. • 17 low-carbon sectors supported. • $4,399,138 USD in value of low-carbon loans provided. • $891,055 USD in value of low-carbon grants provided.	Not Estimated	Insufficient information available to estimate the GHG emission reductions.

Progress Indicators

Indicator	Unit	Baseline	Target	Progress
Number of jobs created in low-carbon sectors	#	0	811	2,101
Number of loans approved to eligible MSEs	#	0	542	224
Number of grants approved to eligible MSEs	#	0	212	591
Number of MSE and vulnerable groups who have accessed technical and business skills	#	0	1,231	4,482

Name of Action	Amerindian Land Titling					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Project	Ongoing	2013-Ongoing	Ministry of Amerindian Affairs (MoAA)	Not Estimated	National	Hinterland Development

Description and Objective

Amerindians total approximately 14% of Guyana's population and currently own more than 15.65% of Guyana's territory, up from about 6% in the early 1990s. The Amerindian Land Titling (ALT) project seeks to enable Amerindians to secure their lands and natural resources with an overall goal towards sustainable self-driven socioeconomic development. The ownership of land empowers and allows Guyana's first peoples the liberty to engage in and promote investments towards their own social and economic advancement in a sustainable low-carbon manner. It is envisaged that titling of communities will strengthen land tenure security and expand the asset base of Amerindians, enabling improved long-term planning for their future sustainable development. The objective of ALT project is to facilitate and fast track the Amerindian Land Titling process. The project seeks to (i) have land titles issued and demarcation process completed for all Amerindian villages that submit requests, including those that request extensions; (ii) strengthen existing mechanisms to deal with unresolved land issues; and (iii) improve the communication and outreach efforts of the Ministry of Amerindian Affairs.

Quantitative Goals

- Land titles issued and demarcation process completed for all Amerindian villages that submit requests.
- Increased access to existing and alternative mechanisms for resolving land titling disputes.

Steps Taken or Envisaged to Achieve Action

The principle of Free Prior and Informed Consent (FPIC) is a fundamental and respected principle that is applied to ensure Amerindians are provided with enough information well in advance of planned or proposed activities to allow communities and villages to agree or consent to the execution land titling. To date, over 210 persons were trained in FPIC to ensure that not only do Amerindians understand their rights but importantly, for other stakeholders to recognise and understand those rights and practically apply the principle of FPIC during project implementation. A communication strategy was formulated under the project and associated activities involved the distribution of communication materials (including brochures and flyers, radio and television broadcasts), documentaries on titling activities, and workshops throughout communities and villages in the various regions. Many of the communication materials were translated into the different Amerindian languages. A grievance redress mechanism was established as an alternative for helping to resolve land titling disputes. A total of 23 persons have been trained as GRM liaisons, 254 community members have been trained in mediation and 378 persons were part of cluster awareness exercises on the core function of the GRM. To date, a total of 15 villages have issued with absolute grants, bringing the total number of Amerindian villages titled with absolute grants to 111. A total of 26 villages have been demarcated and 24 were issued with certificates of title, which has brought the total number of villages in Guyana demarcated and issued with Certificates of Titling to 101.

Estimated Outcomes	Estimated GHG Emission Reductions	Methodologies and Assumptions
• 111 villages with absolute grants. • 101 villages demarcated and issued certificates of title.	Not Estimated	Insufficient information available to estimate the GHG emission reductions.

Progress Indicators

Indicator	Unit	Baseline	Target	Progress
Number of villages issued absolute grants.	#	96	All	111
Number of villages issued certificates of titling.	#	77	All	101
Number of persons trained in mediation under FPIC.	#	0	210	210

Name of Action	ICT Access and E-services for Hinterland, Remote, and Poor Communities					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Project	Ongoing	2017-Ongoing	Office of the Prime Minister (OPM)	Not Estimated	National	Hinterland Development

Description and Objective

The objective of the project is to provide the necessary infrastructure, equipment, hardware, and software necessary to enable access to high-quality Information and Communications Technology (ICT) connectivity and accompanying electronic services to 200 Hinterland, Poor, and Remote Communities (HPRCs) across Guyana, as well as to provide capacity building for communities in the use of newly developed e-services. It is envisaged that the project will provide the supporting capacity to create linkages to generate inter-sectoral benefits in education, health, and business while fostering low-carbon technologies. The goals of the project include the development of a digital knowledge-based society, enhancement of national efficiency and competitiveness and the promotion of inclusive and sustainable growth and development.

Quantitative Goals

- Strengthened e-government policy environment and legislation.
- Increased broad access to ICT among hinterland, poor, and remote communities.
- Public e-services and information readily available to HPRCs.
- Enhanced capacity of HPRCs to use ICT and access e-services.

Steps Taken or Envisaged to Achieve Action

From 2021, ICT hubs are being established to benefit 200 communities and villages across Guyana, each equipped with printers, televisions, laptops, and software. To achieve this target, 90 Very Small Aperture Terminals (VSATs) were procured and installed in communities and villages to provide internet access to remote locations. Additionally, 180 solar systems were procured to provide the necessary energy to power the ICT equipment at the hubs and any additional equipment/appliances using the extra capacity, based on 100% renewable energy. Also, under the project, consultancies were commenced to conduct a comprehensive capacity assessment of the National Data Management Authority (NDMA); map current ICT deployment and capacities in the public sector; and to undertake a multidimensional capacity assessment of public institutions that will offer e-services, identifying gaps and bottlenecks in the process. The following reports were completed: i) Baseline Report focused on market research looking at Guyana's profile, education, health, business, and as-is analysis of technical infrastructure and regulation; ii) Technical Report looking at technology assessment, design options for Guyana, commercial assessment of solutions, proposed Guyana solution, rollout phases, stakeholder analysis, business models, implication for legislation and policy development, and an implementation plan, and iii) E-Services Readiness Assessment Report on important service needs, status quo of e-services readiness today, vision of e-services offered by government agencies, and description of selected e-services. Several communities have already benefited from the rollout of this project, specifically regions 9 and 7. A photovoltaic technician training programme was also completed as to build technical capacity within these HPRCs. A massive ICT training rollout will soon commence within these communities where a basic to advanced curriculum will be employed. These specific interventions will enhance the communication deficit within these communities, improve remote health and education management (including the Guyana Online Academy of Learning 20,000 scholarship programme) and access to government eservices.

Estimated Outcomes	Estimated GHG Emission Reductions	Methodologies and Assumptions
• 200 HPRCs with ICT Hubs. • 4,000laptops installed. • 200 e-services provided.	Not Estimated	Insufficient information available to estimate the GHG emission reductions.

Progress Indicators				
Indicator	**Unit**	**Baseline**	**Target**	**Progress**
Proportion of residents in HPRCs with access to ICT.	%	20%	90%	98,000 residents
Number of ICT hubs deployed in HPRCs.	#	14	200	200
Proportion of people in HPRCs using e-services.	%	0%	90%	98,000 residents
Number of online services offered by public institutions to HPRCs.	#	Limited	200	NE
Proportion of residents in HPRCs trained in ICT.	%	Limited	85%	NE

<table>
<tr><th>Name of Action</th><th colspan="6">Village Sustainability Plans</th></tr>
<tr><th>Type of Action</th><th>Status</th><th>Duration</th><th>Implementing Entity</th><th>GHG Coverage</th><th>Geographic Scope</th><th>Sectoral Scope</th></tr>
<tr><td>Enabling activity</td><td>Ongoing</td><td>2021-2025</td><td>Ministry of Amerindian Affairs (MoAA) / National Toshaos Council (NTC)</td><td>Not Estimated</td><td>National</td><td>Hinterland Development</td></tr>
<tr><th colspan="7">Description and Objective</th></tr>
<tr><td colspan="7">Under the Low Carbon Development Strategy 2030 (LCDS 2030), Guyana aims to lead sustainable development at village level with clear strategy in a continuous, predictable, and sustained manner. A dedicated 15% of carbon market revenues in Guyana (under the ART-TREES mechanism) are made available for bottom-up investments in the implementation of community-led low-carbon development programmes for indigenous peoples and local communities (IPLCs) set out in Village Sustainability Plans (VSPs), put together by communities themselves focused on sustainable income generation and socioeconomic upliftment to deliver on climate, energy security, and food security priorities. The VSPs are developed by the villages themselves under the principles of free, prior, and informed consent (FPIC) and should cover the period up to 2025 (or longer if the village choses), whereby the Government of Guyana and non-governmental organizations may aid villages in VSP preparation if this is requested. Because VSPs are led by villages, their specific format and content vary, but typically include a decision statement for the community and priority areas to deliver the vision including community infrastructure and communications (clean energy and ICT), livelihood opportunities (ecotourism and climate-smart agriculture), natural and environmental management, education, and health.</td></tr>
<tr><th colspan="7">Quantitative Goals</th></tr>
<tr><td colspan="7">• Operational benefit-sharing mechanism to direct 15% of carbon market revenues in support of bottom-up investments in the implementation of community-led low-carbon development programmes for indigenous peoples and local communities set out in Village Sustainability Plans.</td></tr>
<tr><th colspan="7">Steps Taken or Envisaged to Achieve Action</th></tr>
<tr><td colspan="7">The National Toshaos Council (NTC) is established by law under the Amerindian Act of 2006 and comprises all elected Toshaos of Guyana across its ten regions. In July 2022, the NTC adopted a resolution in support of Guyana´s LCDS 2030. The NTC’s participation was crucial in developing/proposing the benefit-sharing mechanism for dedicating 15% of carbon market funds such that all IPLCs could benefit equitably. A seven-month-long nation-wide consultation was done with over 200 Indigenous communities on the LCDS carbon credits benefit-sharing mechanism, conducted between November 2021 and June 2022. The NTC spearheaded the process of developing the outline Village Sustainable Plan (VSP) templates and guides by which communities were able to develop their VSPs for participating in the benefit-sharing programme. The NTC was also fully involved, in collaboration with the Ministry of Amerindian Affairs and LCDS Secretariat, in determining the key documents that needed to be submitted by the communities along with their plans, response letters to villages, development of Terms of reference for Finance and Planning Committee, and Finance Officer job descriptions. For the previous and current ART-TREES commitment periods, the village leadership have been invited to consult with members of the community to agree whether to participate in the benefit-sharing mechanism, and if so, to produce an Outline VSP by the end of 2022, and finalize and submit the completed Village Sustainability Plan by the end of June 2023, following the local decision-making processes of each village. In this process, the NTC supported and trained several villagers in the preparation of their outline VSPs across Regions 1, 2, 3, 4, 7, and 9. As of August 2023, 241 villages have produced their village plans, out of a total of 242 IPLCs in the country. In 2023, a total of $22.5 million USD was disbursed to designated Village Bank Accounts from Guyana’s first commercial sale of carbon credits to Hess Corporation. Further work is ongoing for the continuity of the programme.</td></tr>
<tr><th colspan="3">Estimated Outcomes</th><th colspan="2">Estimated GHG Emission Reductions</th><th colspan="2">Methodologies and Assumptions</th></tr>
<tr><td colspan="3">• 242 IPLCs with Village Sustainability Plans.
• 15% of carbon market benefits invested in community led low-carbon sustainable development initiatives.</td><td colspan="2">Not Estimated</td><td colspan="2">Insufficient information available to estimate the GHG emission reductions.</td></tr>
</table>

Progress Indicators				
Indicator	**unit**	**Baseline**	**Target**	**Progress**
Number of IPLCs with VSPs.	#	0	242	241
Proportion of revenues from Guyana´s carbon market invested in VSPs.	%	0	15%	15%
Cumulative disbursements to VSPs from Guyana´s carbon market.	$ USD	0	To be determined	22.5 million

Name of Action	Strengthened Monitoring, Enforcement and Uptake of Environmental Regulations in Guyana's Gold Mining Sector					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Project	Completed	2014-2017	Environmental Protection Agency (EPA) / Guyana Geology and Mines Commission (GGMC)	Not Estimated	National	Economic Development

Description and Objective

The main driver of deforestation and forest degradation in Guyana is mining, which leads to increased carbon emissions, as the impacts of uncontrolled mining on carbon stocks are believed to be comparable to the degradation of high forest to scrub/savannah, that is, approximately 200 tonnes of carbon per hectare. The objective of the project to reduce ecosystem loss and ecosystem functionality in priority small- and medium-scale gold mining operations through a two-prong approach tackling the sector´s main barriers encompassing noncompliance with mining-related environmental regulations and illegal mining; insufficient personnel and institutional capacity to enforce the environmental regulatory framework; and insufficient capacity to implement environmental codes of practice among miners. The first approach was to strengthen monitoring and enforcement of mining-related environmental regulations and codes of practices, by increasing capacity of EPA and GGMC staff and fortifying inter-institutional coordination mechanisms for enhanced monitoring and enforcement of priority areas, including the improvement of regulations and codes of practice and satellite tracking mechanisms. The second approach was to build capacities and promote uptake of conservation practices by miners.

Quantitative Goals

- Strengthened enabling environment for monitoring and enforcement of mining-related environmental regulations and codes of practice.
- Enhanced capacities for uptake of mining practices that promote conservation.

Steps Taken or Envisaged to Achieve Action

A joint compliance unit for small- and medium-scale mining and a functioning Natural Resources Advisory Committee (NRAC) was established, which has proven useful for its influence on a cabinet decision and initiating bridges for joint work on compliance with non-state actors. Key tools were developed including simplified codes of practice for GGMC staff and practitioners and environmental monitoring check lists for both EPA and GGMC. The project revised and simplified the mining codes of practice; produced learning materials; created Standard Operating Procedures (SOPs), and checklists for joint monitoring; implemented a legal review with EPA; undertook a mining school institutional review, produced a proposed curriculum and developed and disseminated simplified learning materials and public awareness tools. Furthermore, close work was conducted with the Guyana MRVS to access satellite imagery for GGMC and EPA officers to support tracking of environmental infractions or illegal mining.

Estimated Outcomes	Estimated GHG Emission Reductions	Methodologies and Assumptions
• Increased monitoring and enforcement capacities leading coupled with enhanced awareness to decreased number of environmental infractions and/or illegal mining contributing to lower deforestation and lad degradation rates among small and medium gold mining operations.	Not Estimated	Insufficient information available to estimate the GHG emission reductions.

Progress Indicators

Indicator	Unit	Baseline	Target	Progress
Level of capacity of GGMC and EPA to enforce mining-related environmental regulations and codes of practice for small and medium scale gold mining.	UNDP capacity score	0	1	2

Area monitored for compliance with EPA mining-related environmental regulations.	ha	0	50% over baseline	629,304
Area monitored for compliance with GGMC mining-related environmental regulations.	ha	0	50% over baseline	755,693
Proportion of total high priority areas monitored using satellite tracking.	%	0	75	75
Number of courses or seminars implemented through Mining School that integrate environmental considerations.	#	1	5	5
Proportion of miners observed by field officers who are complying with the environmental regulations and codes of practice.	%	0	30	36
Proportion of small and medium scale gold miners participating in project seminars who report an increased awareness of mining related environmental regulations.	%	0	75	100

Name of Action	Caribbean Renewable Energy Development Programme					
Type of Action	**Status**	**Duration**	**Implementing Entity**	**GHG Coverage**	**Geographic Scope**	**Sectoral Scope**
Project	Completed	2004-2015	Caribbean Community (CARICOM)	CO_2	Regional	Power Generation

Description and Objective

This project aims at removing barriers to renewable energy utilisation in the Caribbean. Through specific actions to overcome policy, finance, capacity, and awareness barriers it is estimated that the contribution of renewable energy sources to the region's energy balance will be significantly increased. At the time, renewable energy provided less than 2% of the region's commercial electricity. It is estimated that due to the planned barrier removal activities the share of renewable energy could reach 5% by 2015. This would imply annual reductions of CO_2 emissions by some 680,000 tons. The project activities concentrate on: (1) strengthening of regional energy sector institutions; (2) government advisory with regards to Renewable Energy (RE) and Energy Efficiency (EE) policies; (3) preparation of RE and EE projects for investment decisions; (4) capacity building activities and public awareness campaigns. Participating countries: Antigua and Barbuda, the Bahamas, Barbados, Belize, British Virgin Islands, Cuba, Dominica, Grenada, Guyana, Jamaica, St Kitts and Nevis, St Lucia, St Vincent and the Grenadines, Suriname, Trinidad and Tobago and Turks and Caicos. Apart from reducing GHG emissions, the project has the following development objectives:

- Establish the foundation for a sustainable renewable energy industry; and
- Create a framework under which regional and national renewable energy projects are mutually supportive.

Quantitative Goals

- Mitigate GHG emissions from the use of fossil fuels in the Caribbean by removing barriers to the utilisation of renewable energy.

Steps Taken or Envisaged to Achieve Action

To achieve the project objectives, several project activities are designed and divided into four groups as follows:

- Supporting the implementation of policies, legislation and regulations that create an enabling environment for renewable energy development;
- Demonstrating innovative financing mechanisms for renewable energy products and projects and building the capacity of financial institutions and renewable energy firms in their application;
- Building the capacity of selected players in the renewable energy field; and
- Putting in place an improved regional renewable energy information network.

Estimated Outcomes	Estimated GHG Emission Reductions	Methodologies and Assumptions
• Remove the barriers to increased use of renewable energy in the Caribbean thus reducing the Region’s dependence on fossil fuels.	Not Applicable	Not Applicable

Progress Indicators

Indicator	Unit	Baseline	Target	Progress
Percentage of renewable energy in commercial energy use.	%	NA	NA	NA
National targets for renewable energy defined RE integrated into utility planning.	#	NA	NA	NA
Establishment of power purchase agreements for RE projects.	#	0	NA	NA
Investment resources leveraged directly by the project.	USD	0	NA	NA
Total amount invested in RE projects in the region.	USD	NA	NA	NA
Number of participants in different capacity building initiatives related to RE.	#	0	NA	NA

Supply of RE related training in the region.	#	0	NA	NA
Number of users accessing the information system.	#	0	NA	NA
Availability of updated RE information in the region.	#	0	NA	NA

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