Ghana's Third Biennial Update Report to United Nations Climate Change

Republic of Ghana

Environmental Protection Agency (EPA)

August, 2021

Theme: Bridging to the Enhanced Transparency Framework Regime under the Paris Agreement

With kind support from

GEF

UN environment programme

Third Biennial Update Report to the
United Nations Framework Convention on Climate Change

The report is available for download on the EPA website address www.epa.gov.gh

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Foreword

It is with pleasure and honour to present the Third Biennial Update Report (BUR3) to the Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC). The document outlines the latest information and actionable plans on the country's efforts to promote development in line with the UN's Sustainable Development Goals (SDG's). The report covers a wider range of climate change mitigation activities, biodiversity conservation and REDD+ etc.

In addition, Ghana continues to implement policies and measures in renewable energy resources, clean domestic cooking, and restriction of gas flaring in upstream petroleum operations and E-waste management systems. Most of the Government's flagship programmes, such as planting for food and jobs, one district one factory and youth in afforestation, aim to boost green industrialisation and rural development and build resilience to climate change impacts. Even though some successes have been achieved, efforts are still required to realise fully the Nationally Determined Contributions (NDCs) goals the country has set for itself under the Paris Agreement.

It is important to note that BUR3 is in conformance with the reporting obligations under the UNFCCC and provides some scientific insights for the design and implementation of climate change policies at all levels of society and across stakeholder groups. It is hoped that academia, researchers, civil society organisations and industry players and the broader private sector would find the report useful and reliable reference material and guidance. The Government of Ghana will continue to consolidate the modest gains made thus far and pledges to ensure more rigorous implementation of climate actions and report their effects as the Government vigorously pursues its long–term and broader sustainable development agenda.

Hon. Dr. Henry Kwabena Kofofu, *Esq*
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Acknowledgement

The Environmental Protection Agency is happy to publish Ghana's third biennial update report in line with UNFCCC decision 2/CP.17, paragraph 41 (a). The BUR3 covers updated information up-to-date information on climate actions from 1990 to 2020. The EPA Climate Change Unit coordinated the compilation of the BUR3, which started in 2019. In this round of BUR, Ghana has sought to address, to the extent its capacities will allow, most of the comments and capacity building needs identified in the technical assessment of the BUR2. Efforts have been made to incorporate new datasets and approaches to improve the overall quality of this current report.

On behalf of the Ghana Government, the Environmental Protection Agency is thankful to all who contributed to the preparation of this report. We are grateful to Global Environment Facility (GEF) for providing financial support for preparing and compiling the BUR3. Th Government also appreciates the technical and managerial support we received from the UN Environment and its Global Support Programme team.

The EPA extends its sincere gratitude to all the international partners who provided technical support during the preparation and the review of this report. The EPA is also thankful to UNDP and the Donors of the Nationally Determined Contribution Support Programme NDC-SP, DTU and the Donor of the Initiative for Climate Action Transparency (ICAT) and Coalition for Rainforest Nations and Donor of the Result-base REDD+ (RRR+) projects for the complementary technical assistance. Furthermore, the Agency wishes to thank the various national working group members, consultants and other state institutions that participated in the preparation of the BUR3.

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Abbreviations

ACE	-	Action for Climate Empowerment
AD	-	Activity data
ADCOM	-	Adaptation Communication
AFOLU	-	Agriculture, Forestry and Other Land Uses
AR4	-	Fourth Assessment Report
BC	-	Black Carbon
BRT	-	Bus Rapid Transit
BUR	-	Biennial Update Report
CAP	-	Coronavirus Alleviation Plan
CARES	-	COVID-19 Alleviation and Revitalisation of Enterprises Support
CBAM	-	Carbon Border Adjustment Mechanism
CBIT	-	Capacity Building Initiative on Transparency
CCOs	-	Climb Operation/Approach
CCU	-	Climate Change Unit
CDM	-	Clean Development Mechanism
CH_4	-	Methane
CLIMFINTRACK	-	Climate Change Finance Tracking tool
CO_2	-	Carbon Dioxide
CPESDP	-	Coordinated Programme for Economic and Social Development Policies
CRM	-	Cylinder Recirculation Model
CTCN	-	Climate Technology Centre and Network
DVLA	-	Driver and Vehicle and Licensing Authority
EB	-	Executive Board
EC	-	Energy Commission
EEAs	-	Energy Efficiency Advisors
EF	-	Emission Factor
EPA	-	Environmental Protection Agency
ERCST	-	European Roundtable Climate Change and Sustainable Transition
ERPA	-	Emission Reductions Payment Agreement
EU-AITF	-	European Union Africa Infrastructure Trust Fund
FCPF	-	Forest Carbon Partnership Facility
FOLU	-	Forestry Other Land Uses
FPDS	-	Forest Plantation Development Strategy
FREL	-	Forest Reference Emission Levels
FREL	-	National Forest Reference Level
GACMO	-	Greenhouse Gas Abatement Cost Model
GAPTE	-	Greater Accra Passenger Transport Executive
GCARP	-	Climate Ambitious Reporting Program
GCF	-	Green Climate Fund
GDP	-	Gross Domestic Product

GEF	-	Global Environment Facility
GHG	-	Greenhouse Gas
GJAM	-	Green Jobs Assessment Model
GMP	-	National Gas Master Plan
GNGC	-	Ghana National Gas Company
GST	-	Global Stocktake
GWh	-	Gigawatt Hour
HDI	-	Human Development Index
HFCs	-	Hydrofluorocarbon
HFO	-	Heavy Fuel Oil
HPMP	-	HFC Phase-out Management Plan
ICA	-	International Consultation and Analysis
ICA	-	International Consultation and Analysis
ILO	-	International Labour Organisation
IMO	-	International Maritime Organisation
IPCC	-	Inter-governmental panel on Climate Change
IPCC	-	Intergovernmental Panel on Climate Change's
IPPU	-	Industrial Products and Product Use
ITMOs	-	Internationally Transferred Mitigation Outcomes
KCA	-	Key Category Analysis
kCER	-	kilotonnes Certified Emission Reduction
LCO	-	Light Crude Oil
LEAP	-	Low Emission Analysis Platform
LED	-	Light Emitting Diode
LPG	-	Liquefied Petroleum Gas
LULUCF	-	Land Use Land Use Change and Forestry
MEA	-	Multilateral Environmental Agreement
MESTI	-	Ministry of Environment, Science, Technology and Innovation
MiDA	-	Millennium Development Authority
MPG	-	Modalities Procedures and Guidlines
MRV	-	Monitoring Reporting and Verification
MSW	-	Municipal Solid Waste
$MtCO_2e$	-	Million Tonne Carbon Dioxide Equivalent
MWh	-	Megawatt Hour
N_2O	-	Nitrous oxide
NAG	-	Non-Associated Gas
NAP	-	National Adaptation Plan
NC4	-	National Communication
NCCC	-	National Climate Change Committee
NCEP	-	National Clean Energy Access Programme
NDA	-	National Designated Authority
NDC	-	Nationally Determined Contribution

NFP	-	National Focal Point
NIR	-	National Inventory Report
NMTDP	-	National Medium- Term Development Plan
PFCs	-	Perfluorocarbons
POA	-	Programme of Activity
PV	-	Photo Voltaic
PVTS	-	Private Vehicle Test Stations
QA/QC	-	Quality Assurance/Quality Control
RA	-	Reference Approach
REDD+	-	Reducing Emissions Deforestation and Forest Degradation
RTEMS	-	Real-Time Energy Monitoring System
SA	-	Sectoral Approach
SARPs	-	Standard and Recommended Practices
SDGs	-	Sustainable Development Goals (SDGs
SLCPs	-	Short-Lived Climate Pollutants
SOPs	-	Standard operating procedures
SUNREF	-	Sustainable Use of Natural Resources and Energy Finance
T2	-	Takoradi Thermal 2
TA	-	Technical Assessment
TT1PS	-	Tema Thermal 1 Power Station
TTE	-	Technical Team of Expert
UNDP	-	United Nations Development Programme
UNEP	-	United Nations Environment Programme
UNFCCC	-	United Nations Framework Convention on Climate Change
VALCO	-	Volta Aluminium Company
VCS	-	Verified Carbon Standard

Executive Summary

ES. Executive Summary

ES 1. Mandate for preparing biennial update reports

All developing countries, including Ghana, were mandated by paragraph 41 (a) of decision 2/CP.17 to submit their first BUR by December 2014 and every two years afterwards, according to paragraph 41 (f). In 2016, Ghana prepared its first BUR in July 2017 and successfully underwent the mandatory International Consultation and Analysis (ICA). Ghana submitted its BUR2 in 2019, covering information on national greenhouse gas emissions from 1990 to 2016 and other relevant information on climate change actions up to 2016. The 2021 BUR3 is a sequel to the BUR2 and provides updated information up to 2020. It is also the of reporting under the MRV arrangements under the Convention and provides the direction for the transition to the enhanced transparency framework under the Paris Agreement (PA) pursuant to Article 13 of the PA and decision 18/CMA1

ES 2. Update of national circumstances and institutional arrangement

Ghana is a lower-middle-income West Africa nation that contributes 0.1% to global greenhouse gas emissions and falls in top climate-vulnerable countries in Africa. Ghana also prioritises climate change issues despite the many pressing development imperatives such as poverty eradication, provision of adequate, affordable health services, clean water, and access to clean and affordable energy. It is for this reason that Ghana's national development and the COVID-19 recovery programmes outline measures to mitigate climate change as well as addressing its adverse impacts thereof. Table ES 1 presents an overview of the state of Ghana.

Table ES 1: State of national circumstances of Ghana

Indicators	Description of indicators
Territory	The land area of 238,539 km^2 and coastline of 560km^2 Divided into 16 administrative regions and further into 260 districts.
Population	Estimated 30.2 million people in 2019, with 56.7% living in urban areas[1] Global climate risk index score of 53.33 and ranked 42 out of 130 in 2019[2] Multidimensional poverty index (on the scale of 0 to 1) of 0.247. Over 12 million inhabitants in savanna drylands and coastal belt are the most vulnerable to climate change.
Climate	Tropical, warm, and dry along the southeast coast. Hot and humid in the southwest; hot and dry in the north.
Ecology	Agro-ecological zones - Wet Evergreen, Rain Forest, Deciduous Forest. Transitional, Coastal savanna, Guinea savanna and Sudan savanna.
Water Resources	Freshwater covers nearly 5% of the total land area. (11,800km^2). The Volta, South Western and Coastal River systems have a total annual run-off of 54 billion m^3.
Energy Resources	Breakdown of final energy consumption in 2019 • Petroleum products – 3,794 ktoe (48%)

[1] https://data.worldbank.org/country/GH

[2] https://germanwatch.org/sites/default/files/Global%20Climate%20Risk%20Index%202021_1.pdf

	• Biomass – 2,981.3 ktoe (37%) • Electricity – 1,1991.1 ktoe (15%) National electricity mix profile in 2019 • Total installed generation capacity: hydro (1580 MW), thermal (3549 MW) and renewable (42.6 MW) Installed renewable generation capacity (78.6 MW): • off-grid – solar (7.3MW), wind (0.020 MW) • on-grid – distributed solar (24.3 MW), utility-scale solar (42.5 MW), W2E (0.1 MW and hydro (4MW) • mini-grid – solar (0.314 MW), wind (0.011 MW)
Land Resources	Agricultural area (1,000 ha), 2019 estimates • Cropland – 5,431.1 • Fallow land Forest area (1,000 ha), 2019 estimates • total forest – 6,930.9 • close forest - 1,256.1 • open forest - 5,674.8
Mitigation potential, policies and actions, and low carbon transition programmes	Greenhouse emissions profile • Total emissions in 2019 - 59 $MtCO_2e$ • Projected total emissions in 2030 without measures – 100 $MtCO_2e$ • Projected total emissions in 2030 with measures – 75.1 $MtCO_2e$ • Projected total emissions in 2030 with additional measures – 31.2 $MtCO_2e$ Low carbon transition strategies • Mitigation commitments in the revised nationally determined contribution. • Sustainable Financing Framework to issue Green Bonds, Social Bonds, Sustainability Bonds, and Green and Social Loans to finance green and social projects. • Renewable Energy (Amendment) Act, 2020 • Sustainable Energy for All Country Action Plan; National LPG Promotion Policy National Gas Policy; Rural LPG Promotion Programme are all geared toward achieving clean cooking outcomes. • National Gas Master Plan (GMP) to facilitate gas commercialisation and gas infrastructure development for a vibrant downstream market • National Energy Policy highlights energy efficiency and conservation in homes, offices, and industries. • National programme to introduce an alternative technology to HFCs • Forest Plantation Development Strategy and REDD+ strategy • Electric mobility, fleet renewal, efficient vehicle inspections, non-motorised transport, and rail-based transit.
National Adaptation	• Ghana National Climate Change Adaptation Strategy (2012) • National Adaptation Plan Framework in 2018.

interventions/programmes	• Ghana plan of action for disaster risk reduction and climate change adaptation (2012) • National Climate-Smart Agriculture and Food Security Action Plan (2016-2020) • National Adaptation Plans (ongoing) • Ghana National Framework for Climate Services, 2019 • Preparation of Ghana's First Adaptation Communication to UNFCCC
Programmes to address impacts of implementation of response measures	• Ghana Case Study conducted by the European Roundtable Climate Change and Sustainable Transition (ERCST) in collaboration with Ghana EPA. • Training on the social and employment implications of climate policies and NDC. • Green Jobs Assessment Model for Ghana conducted by International Labour Organisation (ILO) and the EPA

The Ministry of Environment, Science, Technology, and Innovation (MESTI) formulate climate policies and supervises the implementation of the multilateral environmental agreements (MEA). MESTI also host the National Climate Change Committee (NCCC). As the technical arm of the MESTI, the EPA is responsible for the technical coordination of the implementation of climate programmes and climate reporting under the Convention and the Paris Agreement. The EPA thus manages the compilation of national communications, biennial update reports and the greenhouse gas inventory. Within the EPA, the Climate Change Unit (CCU) coordinated the BUR3 based on the EPA Act 490. The CCU worked closely with more than twenty national organisations/institutions to compile the current BUR. These organisations/institutions were grouped under three thematic working groups.

ES 2. Update of national greenhouse gas inventory

Ghana has consistently been preparing complete time series of annual greenhouse emissions in conformance with the stipulated reporting guidelines. For this reporting cycle (2021), the national greenhouse gas inventory covers the period from 1990-2019, in fact meeting the N-2-year reporting requirement as per the enhanced transparency framework. Where N is the year of reporting. Recalculations have been conducted on GHG emission estimates from 2006 - 2016 for selected categories as new datasets became available and as well as changes methodological approaches. The national GHG inventory was conducted using the methodological guidance in the 2006 IPCC Guidelines for National GHG Inventories. The GHG inventory incorporates anthropogenic emissions by sources and removals by sinks of Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O) and Fluorocarbons (F-gases) in the Energy, Industrial Process and Product Use (IPPU), Agriculture, Forestry and Other Land Uses (AFOLU) and Waste sectors.

As it waits for IPCC to complete the methodology work on Short-lived Climate Pollutants (SLCPs), Ghana has voluntarily calculated SLCP emissions using the EMEP/CORINAIR Emission Inventory Guidebook

ES 2.1 Greenhouse emission results

Ghana's total greenhouse gas emissions stood at 58.56 $MtCO_2e$ (million tonnes carbon dioxide equivalent) in 2019 and are 16% more than the 2016 levels. The Energy sector has consistently been the most significant emission source since 2016. In 2019, 46.6% of the total national emissions came from the Energy sector and were followed by the FOLU (25.5%), Agriculture (17.9%), Waste (7%) and IPPU(3%) sectors. When the emissions/removals from FOLU are excluded from the national totals, the overall emissions were 43.64 $MtCO_2e$ in 2019, with the Energy sector as the most significant source (Table ES 2). The emission spikes in 2011 and 2017 relate strongly with the increase in gas flaring in the offshore fields.

Table ES 2: Trends of greenhouse gas emission by sectors

Emission sources/sinks	Total emissions ($MtCO_2e$)						Percentage Change
	1990	2000	2010	2012	2016	2019	[2016-2019]
National Emissions with FOLU	24.78	25.59	37.88	41.86	50.47	58.56	16%
National Emissions without FOLU	10.20	12.29	24.35	28.34	37.10	44.04	19%
1. Energy	2.87	4.07	12.80	14.91	22.36	27.3	22%
2 Industrial Processes and Product Use	1.96	0.90	0.94	2.02	1.68	1.73	3%
3 - Agriculture, Forestry, and Other Land Use	18.82	18.97	21.25	21.83	22.80	25.41	11%
4 Waste	1.13	1.65	2.89	3.10	3.63	4.12	13%

Carbon dioxide (CO_2) is the most dominant direct greenhouse gas on a gas-by-gas basis and is followed by methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs). With 41.93 Mt, CO_2 constituted 71.6% of the overall national greenhouse emissions in 2019. The rest of the emission was CH4 (14%), N_2O (12.5%), and HFCs plus PFCs (commonly referred to as F-gases) make up the difference of 1.9%. Ghana performed trend and level assessments on the GHG emission results to identify key categories. The 2019 trend assessment produced twenty-five key category sources and removals with net emissions of 51.2 $MtCO_2e$. Without including the emissions from forestry and other land use (FOLU) category, in the national total, there are twenty key categories with a total emission of 41.7 $MtCO_2e$. The KCA trend assessment resulted in twenty-one sources and removals.

ES 3. Mitigation actions and their effects

ES.3.1 Emission projections and assessment of mitigation actions

Using the GACMO and LEAP models, GHG emission in the country is projected to almost double to 100 $MtCO_2e$ by 2030 as a result of meeting development imperatives. The expected rise in emissions is likely to be driven by expanding fossil-fuel intensive manufacturing and electricity generation, rising motorisation, gas flaring, and solid waste disposal. Thirty-three mitigation actions with the potential to reduce 68.1 $MtCO_2e$ of GHG emissions have been identified within the Energy, Transport, Industry, Oil and gas, IPPU, FOLU and Waste sectors. In this BUR3, Ghana has presented 14 mitigation actions to reduce current emissions across energy, forestry, waste, transport, and Refrigeration and Aircondition (RAC). It covers technology, fiscal and regulatory instruments, capacity development and awareness measures. Of the 14 measures, Ghana reported actual emission reductions for 12 since implementation started within the reporting period.

The implementation of the 12 measures has led to 25.33 Mt/year GHG mitigation outcomes representing a 43% reduction compared to the 2019 GHG emissions. When the emission reductions from FOLU and Large hydro dams are excluded, the total mitigation outcomes stood at 24.63 Mt/year and 20.84 Mt/year, respectively. Furthermore, the 12 mitigation measures have delivered significant sustainable development co-benefits in terms of jobs, investment, increase renewable energy generation and cost-savings

Table ES 3: Breakdown of the mitigation effect and co-benefits arising from national mitigation actions

Mitigation variables	Value	Unit
Total mitigation measures being reported	14	No
of which being implemented	12	No
of which are planned	2	No
GHG savings	25.33	Mt/yr.
GHG savings without large hydro-dam	20.84	Mt/yr.
GHG savings without FOLU	24.63	Mt/yr.
GHG emissions reduction potential in REDD+	2,429.17	Mt/yr.
Fuel cost saving	94-109	US$ million
Investments	1,317.26	US$ million
Jobs created	588,906	No of people
Renewable energy produced	82.2	GWh/per year

ES.3.1 Information on international carbon markets

Four CDM projects have been registered in Ghana covering composting, oil field flaring reduction, single cycle to combined cycle plant and landfill gas flaring. They are expected to generate 3,026 kCER per year in the first crediting period. Ghana is also involved in 43 registered POA CDM projects that have generated 4,973.9 $ktCO_2$/year of CERs in 1st crediting period. Ghana has taken an early leap into the implementation of Article 6 of the Paris Agreement related to market-based cooperative approaches that involve the use of internationally transferred mitigation outcomes towards the meeting of the nationally determined contributions of the partnering countries.

Ghana is cooperating, under two Article 6.2 pilots projects, with the Governments of Switzerland and Sweden. The two pilots projects are at different stages of development in renewable energy, landfill gas management and improved cookstoves. Ghana continues to implement result-based payment Cocoa-Forest REDD+ Programme under the World Bank's FCPF. The Forestry Commission is currently compiling the first monitoring report to trigger payment under the scheme.

ES 4. Domestic monitoring reporting and verification system

Below are the highlights of the key achievements in the operationalisation of Ghana's Climate Ambitious Reporting Programme (GCARP) as its domestic reporting and monitoring system since 2016:

- The EPA and National Development Planning Commission (NDPC) have developed an NDC indicator tracking template for line ministries to collect data and report the progress of sector NDC actions.
- The EPA has developed an NDC accounting tool for anthropogenic GHG emission consistent with the Guidance for accounting for Parties' nationally determined contributions, referred to in decision 1/CP.21, paragraph 31.
- Ghana is preparing its National Adaptation Plan (NAP) with financial support from GCF through UN Environment.
- Ghana is preparing an Adaptation Communication (ADCOM) to inform synthesis reporting for the Global Stocktake (GST) under the Paris Agreement ahead of the 26th UN Climate Change Conference of the Parties (COP26) in November 2021
- The Ministry of Finance has developed a Climate Change Finance Tracking tool (CLIMFINTRACK) to help capture relevant end-of-year outturns on climate-relevant expenditures in the national budget.
- Forestry Commission has developed a Foundational Platform for REDD+ FREL to support the regular preparation of the REDD+ FREL.
- The Forestry Commission has started work to establish a forest monitoring system to improve the forest monitoring capacities.
- The EPA has incorporated GHG inventory data requirements into the Annual Environmental Reporting template for the industries.

ES. 5 Information on support received; constraints and gaps, and related financial, technical, and capacity needs

5.1 Information on support received

Ghana track information on climate finance commitments at the international and national budgets between 2015 and 2020. Ghana obtained the international climate finance commitment from the OECD/DCC database and EPA annual surveys. The Ministry of Finance also tracks climate finance using the CLIMFINTRACK system. This system makes it possible to track the budget codes for all implementation of climate-related activities of Ministries (national) and local government levels.

The OECD/DAC and the EPA annual survey captured information on development-related financial commitments for six hundred projects (600) with a value of US$ 8.82 billion between 2015 and 2020. When ENI/Vitol's financial investments into the Natural Gas Field Development was excluded from the calculations, the total financial commitments for the period amounted to US$1.54 billion over the same period. Grants and debt instruments are the main financial tools used by the financial providers accounting for 56% and 38% of the total financial commitment for the reporting period.

The breakdown of the US$ 1.54 billion development-related financial commitments shows that 46% went into mitigation projects and while the rest were for adaptation (34%) and mitigation/adaptation (20%) projects. Out of the 599 projects, 191 with the financial commitment value of US$ 574 million were in the climate principal marker category. There were 351 projects in the significant climate marker category with a financial commitment of US$ 525 and additional 57 projects with climate components amounting to US$ 440.

The CLIMFINTRACK has tracked the approved national budget of 48,707 projects with climate outcomes in MDAs and MMDAs between 2015-2020. The projects have an approved budget value of Gh¢ 12 billion (Equivalent to US$ 2.1 billion) for the same period at an annual average of Gh¢2 billion (Equivalent to US$ 350.9 million). The majority (52%) of the projects fall in the category of low climate policy coherence. About 37% of the projects have high coherence, followed by 11% of projects with medium coherence.

Following the approval of the BUR2 project proposal, Ghana received funding support totalling $352,000 through UN Environment as the implementing agency. The Global Environment Facility (GEF) funding under the Enabling Activities portfolio was the only direct funding Ghana received to prepare the third BUR. However, there were a number of technical assistance programmes that were received during the period. Below are some of the main additional technical assistance Ghana received in preparing the BUR3:

- CfRN and Ghana RRR+ Phase II support developing Ghana's second Forest Reference Levels and GHG inventory for the FOLU sector.
- UNEP-DTU ICAT Project uses the GACMO tool to assess mitigation action and effect and uses an in-built MRV template to systematically track and monitor climate measures.
- UNDP NDC Support programme on the development of the Ghana NDC tracking tool and energy sector MRV system. Ghana's NDC tracking tool is excel-based that use will be used for NDC accounting established Article 4.13 of the Paris Agreement.
- CfRN and FAO Training: Quality Control for Collect Earth Database to prepare a land-cover map for Ghana.
- Training (including in-person and remote) on the Building of Sustainable National Greenhouse Gas Inventory Management Systems in Ghana organised by the UNFCCC with support from the Swedish International Development Agency (Sida). Under the same programme, some national experts received training and certification on the Greenhouse Gas Inventory under the UNFCCC/GHGMI collaboration.

- FAO's Knowledge Transfer/ Capacity Building Programme on Forest Reference Levels for Ghana.
- Support from Ghana's CBIT Project on the training of national experts on GHG inventory, assessing institutional arrangement and data management.

Regarding updates on technology transfer, Ghana wishes to refer to the information reported in Chapter 6 of the Fourth National Communication in 2020[3]. It covers information on the progress of implementing the previous technology assessments and areas that need additional efforts.

ES 5.2 Constraints and gaps

Ghana has identified the following as the key financial and capacity constraints encountered during the preparation of the BUR

- Lack of transparency on reporting non-financial support for training and technical assistance is difficult to monitor and report non-monetary support. Many institutions receive training and technical assistance support from donors without financial disclosure because the source of funding is part of the global budget. When such situations arise, it becomes difficult to report because the recipient organisation lacks full access to the funding and accounting information.

- Funding for climate change activities, including preparation of BURs, is mostly donor-driven and project-based. Ghana's contribution to the BUR preparation is mainly through in-kind support. The current funding gap for the BURs is a challenge for the continuous preparation of the report and the subsequent consideration stage.

[3] https://unfccc.int/sites/default/files/resource/Gh_NC4.pdf

Chapter 1

BUR reporting context

1. Background to the Biennial Update Report

1.1 Overview of the reporting

Climate change is a pressing development issue in Ghana. For this reason, the current medium-term development policy framework fully incorporates actions that need to be implemented to meet the Nationally Determined Contributions (NDCs) that Ghana has committed to under the Paris Climate Agreement. There is also explicit linkages between the national development plan and the UN Sustainable Development Goals (SDGs). In this regard, Ghana is implementing domestic measures to promote climate-compatible development to unlock the investment opportunities to benefit Ghana's sustainable development agenda. Internationally, Ghana mobilises global finance to support implementing its commitment to the UNFCCC and its Paris Agreement. The third Biennial Update Report (BUR3) preparation is a follow up to the most recent Fourth National Communication published in 2020 and the NIR report of 2020

As a Non-Annex 1 Party to the UNFCCC, Ghana is mandated by decision 2/CP.17, paragraph 41 (a) to submit its first BUR by December 2014 and every two years afterwards, according to paragraph 41 (f). Consistent with our national circumstances and the support received for reporting, Ghana prepared its first BUR in July 2015 and successfully underwent the mandatory International Consultation and Analysis (ICA) in August 2016. In the same vein, consistent with decision 2/CP.17, Ghana submitted its BUR2 in 2019 and completed the report consideration stage within six months.

The Environmental Protection Agency (EPA) coordinated the preparation and compilation of Ghana's BUR3. The BUR3 has been prepared following the guidelines of decision 2/CP.17 for Parties not included Annex 1 to the Convention as a stand-alone report for submission to the UNFCCC secretariat. The BUR3 contains the output of the two years of gathering information on GHG emissions sources, estimation of GHG emissions levels and trends, assessment of mitigation actions and their effects in the context of sustainable development, and tracking of climate support. More than 40 experts from over 20 public and private organisations, CSO and academia were involved in the BUR3 preparation. The information in the BUR3 have been structured as follows:

- Background – this frames the scene by providing the legal basis of the BUR.
- National circumstances – Provides an overview of the current state of Ghana, the prospects, and its implications for climate change. It also captures the updates of institutional arrangements.
- National greenhouse gas inventory - This section of the report captures the national GHG inventory management processes covering the period from 1990-2019, including the emissions estimates in terms of their levels, trends, and key sources/removals
- GHG mitigation actions and their effects - provides an overview of the historical GHG emissions, projections, emission reduction goals and the strategies for achieving them.
- Domestic MRV system - updates on the operationalisation of Ghana's domestic MRV.
- Constraints, gaps, and related financial, technical, and capacity needs and support received.

Chapter 2

National circumstances and institutional arrangements

2. National circumstances

2.1 State of Ghana

In the West African sub-region, Ghana is a democratic state with about 30.2 million people and principally an agrarian economy. In the last 30 years, the economy expanded more than four times, consequently halved poverty to 23% by 2016 [4][5] and urbanisation. Ghana's sustained economic growth has been influenced by the inflows of proceeds from commodity exports (gold, cocoa, timber, and recently crude oil). In 2019, out of US$22 billion international trade value, gold account for 50%, followed by crude oil (22%), cocoa (11%) and other merchantable (17%)[6]. But the cost of environmental degradation the valued at approximately US$ 6.3 billion. Much of the rural livelihoods depend on natural resources. Statistics show that 71% of rural people are employed in agriculture, forestry, and fishing (World Bank, 2020).

The devastating effects of COVID-19 made the economy grow by only 1.1% in 2020, a 6.5% shortfall before the pandemic. Besides COVID-19, Ghana is saddled with development challenges associated with rising public debt, employment, urbanisation, and illegal mining. Climate change presents an additional long-term development risk that Ghana is addressing in the tight fiscal constraints. Despite the economic challenges, climate change remains a priority in Ghana. That is why its recent national development policy outlines climate change as a priority area for action. The highly ambitious climate actions in the updates Nationally Determined Contribution have shown the commitment to tackle climate on all fronts. Table 1 presents the update of the state of Ghana.

Table 1: Ghana at a glance

Indicators	Description of indicators
Territory	The land area of 238,539 km^2 and coastline of 560km^2 Divided into 16 administrative regions and further into 260 districts.
Population	Estimated 30.2 million people in 2019, with 56.7% living in urban areas[7] Global climate risk index score of 53.33 and ranked 42 out of 130 in 2019[8] Multidimensional poverty index (on the scale of 0-1) of 0.247. Over 12 million inhabitants in savanna drylands and coastal belt are the most vulnerable to climate change.
Climate	Tropical, warm, and dry along the southeast coast. Hot and humid in the southwest; hot and dry in the north.
Ecology	Agro-ecological zones - Wet Evergreen, Rain Forest, Deciduous Forest. Transitional, Coastal savanna, Guinea savanna and Sudan savanna.
Water Resources	Freshwater covers nearly 5% of the total land area. (11,800km^2). The Volta, South Western and Coastal River systems have a total annual run-off of 54 billion m^3.

[4] https://openknowledge.worldbank.org/handle/10986/33726
[5] https://www2.statsghana.gov.gh/docfiles/publications/GLSS7/Poverty%20Profile%20Report_2005%20-%202017.pdf
[6] https://oec.world/en/visualize/tree_map/hs92/export/gha/all/show/2019/
[7] https://data.worldbank.org/country/GH
[8] https://germanwatch.org/sites/default/files/Global%20Climate%20Risk%20Index%202021_1.pdf

Energy Resources	Breakdown of final energy consumption in 2019 • Petroleum products – 3,794 ktoe (48%) • Biomass – 2,981.3 ktoe (37%) • Electricity – 1,1991.1 ktoe (15%) National electricity mix profile in 2019 • Total installed generation capacity: hydro (1580 MW), thermal (3549 MW) and renewable (42.6 MW) Installed renewable generation capacity (78.6 MW): • off-grid – solar (7.3MW), wind (0.020 MW) • on-grid – distributed solar (24.3 MW), utility-scale solar (42.5 MW), W2E (0.1 MW and hydro (4MW) • mini-grid – solar (0.314 MW), wind (0.011 MW)
Land Resources	Agricultural area (1,000 ha), 2019 estimates • Cropland – 5,431.1 • Fallow land Forest area (1,000 ha), 2019 estimates • total forest – 6,930.9 • close forest - 1,256.1 • open forest - 5,674.8
Mitigation potential, policies and actions, and low carbon transition programmes	Greenhouse emissions profile • Total emissions in 2019 - 59 $MtCO_2e$ • Projected total emissions in 2030 without measures – 100 $MtCO_2e$ • Projected total emissions in 2030 with measures – 75.1 $MtCO_2e$ • Projected total emissions in 2030 with additional measures – 31.2 $MtCO_2e$ Low carbon transition strategies • Mitigation commitments in the revised nationally determined contribution. • Sustainable Financing Framework to issue Green Bonds, Social Bonds, Sustainability Bonds, and Green and Social Loans to finance green and social projects. • Renewable Energy (Amendment) Act, 2020 • Sustainable Energy for All Country Action Plan; National LPG Promotion Policy National Gas Policy; Rural LPG Promotion Programme are all geared toward achieving clean cooking outcomes. • National Gas Master Plan (GMP) to facilitate gas commercialisation and gas infrastructure development for a vibrant downstream market • National Energy Policy highlights energy efficiency and conservation in homes, offices, and industries.

	• National programme to introduce an alternative technology to HFCs • Forest Plantation Development Strategy and REDD+ strategy • Electric mobility, fleet renewal, efficient vehicle inspections, non-motorised transport, and rail-based transit.
National Adaptation interventions/programmes	• Ghana National Climate Change Adaptation Strategy (2012) • National Adaptation Plan Framework in 2018. • Ghana plan of action for disaster risk reduction and climate change adaptation (2012) • National Climate-Smart Agriculture and Food Security Action Plan (2016-2020) • National Adaptation Plans (ongoing) • Ghana National Framework for Climate Services, 2019 • Preparation of Ghana's First Adaptation Communication to UNFCCC
Programmes to address impacts of implementation of response measures	• Ghana Case Study conducted by the European Roundtable Climate Change and Sustainable Transition (ERCST) in collaboration with Ghana EPA. • Training on the social and employment implications of climate policies and NDC. • Green Jobs Assessment Model for Ghana conducted by International Labour Organisation (ILO) and the EPA

Source: Energy statistics, 2020, World Bank Country Data, Forestry Commission and FAOSTAT

Table 2: Progress of socio-economic indicators in Ghana

Indicators	1990	2000	2010	2016	2019
Gross Domestic Products (GDP) ($ billions)	6.6	4.9	32.2	42.8	66.9
GDP per capita (current US$)	398.6	258.5	1,299.3	1,931.4	2,202.1
Agriculture value added (% of GDP)	48.4	35.3	28	20.9	17.3
Industry value added (% of GDP)	16.8	25.4	18.0	28.2	31.9
Service value added (% of GDP)	37.9	28.8	48.2	43.1	44.1
Human Development Index (HDI)	0.45*	0.49	0.57	0.6	0.61
Gini Index	38.4	40.1	42.4	43.5	
Merchandise exports (current US$, billion)	0.89	1.67	7.96	11.13	15.66

*Missing data. 1991 data repeated for 1990 Source: World Bank Data on Ghana

2.2 National policies that support climate change

Ghana continued to implement economic transformation policies to better the well-being of the citizens and, at the same time, deliver climate protection outcomes. Despite the country's fiscal challenges and pressing economic needs, climate change has featured prominently in the latest national development policy. In addition, the Government has led sustained efforts to integrate climate change into the national, sector and district development plans. Ghana is already implementing climate change programmes to promote renewable energy, lower deforestation, support the adoption of clean cooking, pursue low carbon electricity generation, build resilience in the savannah dryland, and invest in sea defence infrastructure.

The flagship programmes on planting for food and jobs, free senior high school, one-village-one-dam, and the one-district-one-factory are geared towards boosting green industrialisation and rural development and building resilience to the impacts of climate change. These policy initiatives contribute positively to the attainment of the SDGs. Since the submission of the second Biennial Update Report, Ghana has made strides in the following policy areas to contribute to building the climate-resilient and low carbon future we want:

- Ghana at 100 Framework.
- Ghana Beyond Aid, which has a vision of transforming Ghana into a green manufacturing and high-value services economy.
- Coordinated Programme of Economic and Social Development Policies ("CPESDP") 2017-2024[9] and its associated National Medium- Term Development Plan (NMTDP) to domesticate the SDGs and the Paris Agreement.
- Coronavirus Alleviation Plan (CAP) and the medium-term COVID-19 Alleviation and Revitalisation of Enterprises Support (CARES) program in 2020 to minimise the impact on households and businesses.
- The Petroleum Exploration and Development Act, 2016 (Act 919) aimed at restricting gas flaring in petroleum exploration and development.
- Establishment of the SDG delivery and green funds in 2019 with the target to raise US$100 million and US$200 million, respectively.
- Agreement to deliver six million tonnes of greenhouse gas emissions reduction under the Ghana Cocoa Forest REDD+ Programme with the World Bank in 2019.
- Adoption of the Renewable Energy Master Plan in 2019.
- Enactment the Renewable Energy (Amendment) Act, Act 1045 to establish a competitive procurement scheme and a net metering scheme regarding electricity generated from renewable energy sources in 2020. The amended act also makes it mandatory for fossil-based whole electricity suppliers, producers of fossil fuels and any company that contribute to greenhouse gas emission to invest in non-utility renewable energy to offset greenhouse emissions.
- Ratification of the Kigali Amendment in August 2019 to pave the way for implementing the national programme to phase out HFCs.
- Development and adoption of ISO standards for clean cookstoves and clean cooking solutions and developed regulations (and labelling scheme) for improved biomass cookstoves.

[9] http://www.mop.gov.gh/wp-content/uploads/2018/04/Coordinated-Programme-Of-Economic-And-Social-Development-Policies.pdf

- Launching the "drive electric initiative" in 2019 to promote electric vehicles on roads to create demand and drive the productive utilisation of excess electricity in the system[10,11]. In this regard, the Energy Commission has started work on developing standards and regulations for charging stations.

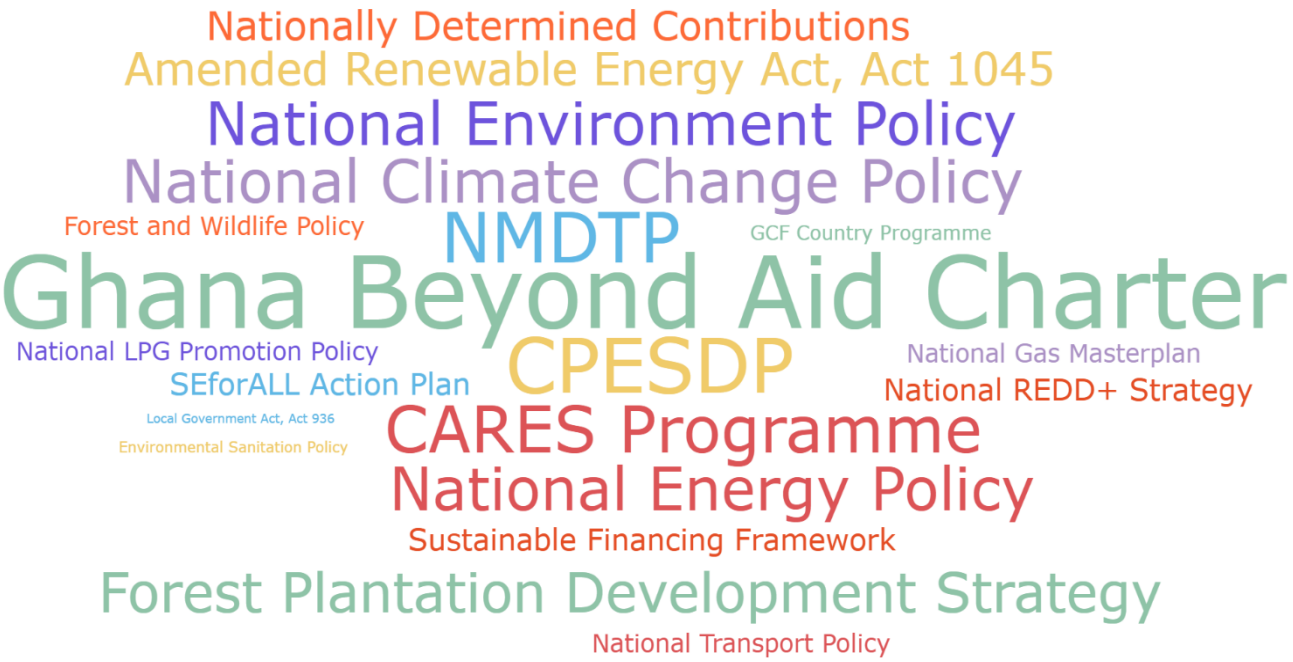

Figure 1: Policies, strategies, and legislation that support climate change in Ghana

3. Institutional arrangements

3.1 Climate change institutional arrangement

The Ministry of Environment, Science, Technology and Innovation (MESTI) formulate climate policies and supervise the implementation of the Multilateral Environmental Agreements (MEA). MESTI also coordinates the National Climate Change Committee (NCCC) as the multi-sectoral task force on climate change. In addition, the EPA is responsible for the technical coordination of the implementation of climate programmes. On the international front, Ghana has been active within the UNFCCC after ratifying the Convention, Kyoto Protocol and its Doha Amendment, and the Paris Agreement ever since institutions have been assigned to oversee the operationalisation of instruments from the UNFCCC. Figure 2 provides a snapshot of the array of institutions engaged in the implementation of Ghana's obligations under the Convention and the Paris Agreement.

[10] http://www.energycom.gov.gh/public-notices/107-drive-electric-initiative
[11] https://energynewsafrica.com/index.php/2020/11/19/ghana-boom-for-electric-vehicles-industry-as-ecg-pobad-partner-for-electricity-supply/

- EPA serves as the UNFCCC Focal Point (NFP).
- EPA is also the designated body for Climate Technology Centre and Network CTCN) and Action for Climate Empowerment (ACE).
- MESTI served as the National Designated Authority (NDA) for the Clean Development Mechanism (CDM).
- Ministry of Finance is the National Designated Authority (NDA) for the Green Climate Fund.
- Climate Change Unit at the Forestry Commission is the National REDD+ secretariat.
- Ecobank is the GCF accredited National Implementing Entity.

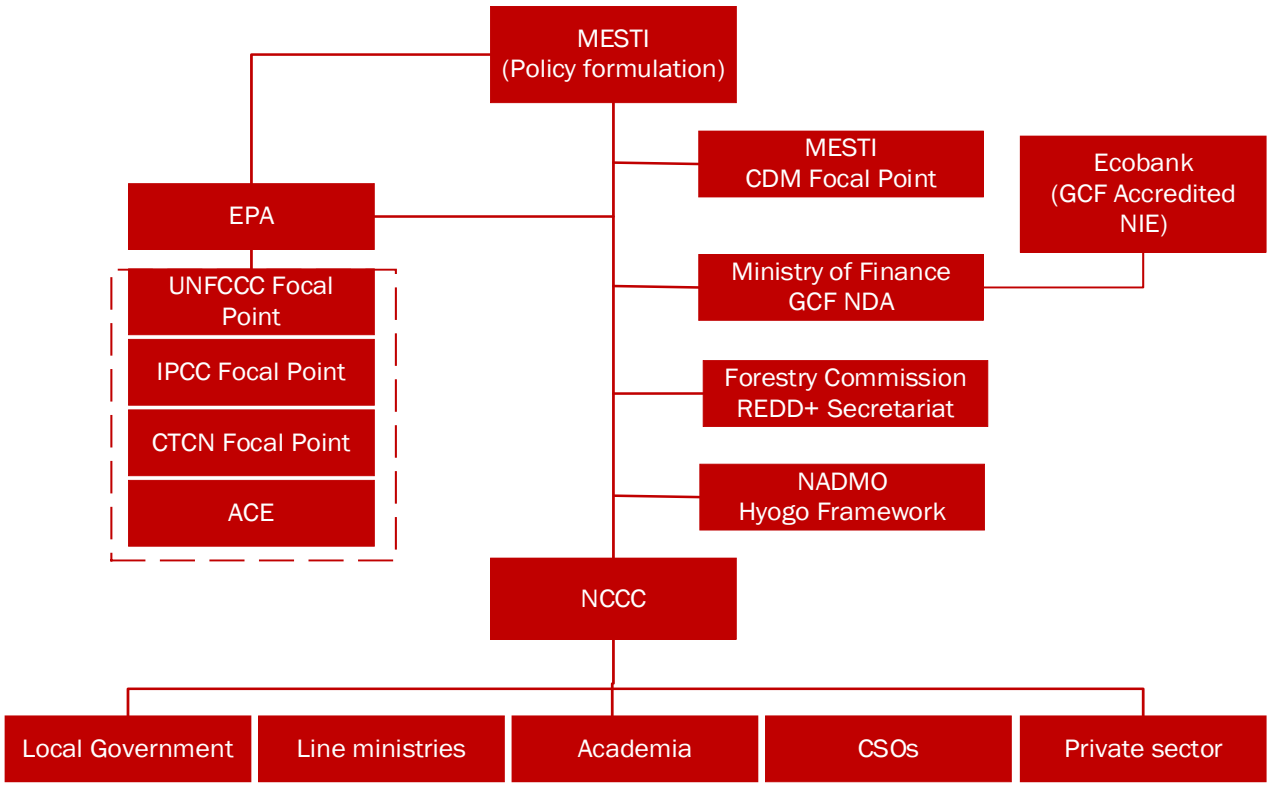

Figure 2: Overview of the institutions involved in the implementation of the UNFCCC in Ghana

3.2 National arrangement for preparing Biennial Update Reports

The EPA manages the compilation of national communications, biennial update reports and the greenhouse gas inventory. Within the EPA, the Climate Change Unit (CCU) coordinated the Third Biennial Update Report (BUR3) based on the mandate of the EPA Act 490. The CCU worked closely with more than 20 organisations to compile the current BUR, which constituted three thematic working groups. MESTI is also responsible for the official approval and endorsement of BUR and onward submission to UNFCCC. Support for preparing this BUR3 was provided by the Global Environment Facility (GEF) through the UN Environment. UNDP's NDC support programme and the UNEP's CBIT project provided additional technical support to the BUR3 preparation through workshop exchanges and institutional mobilisation.

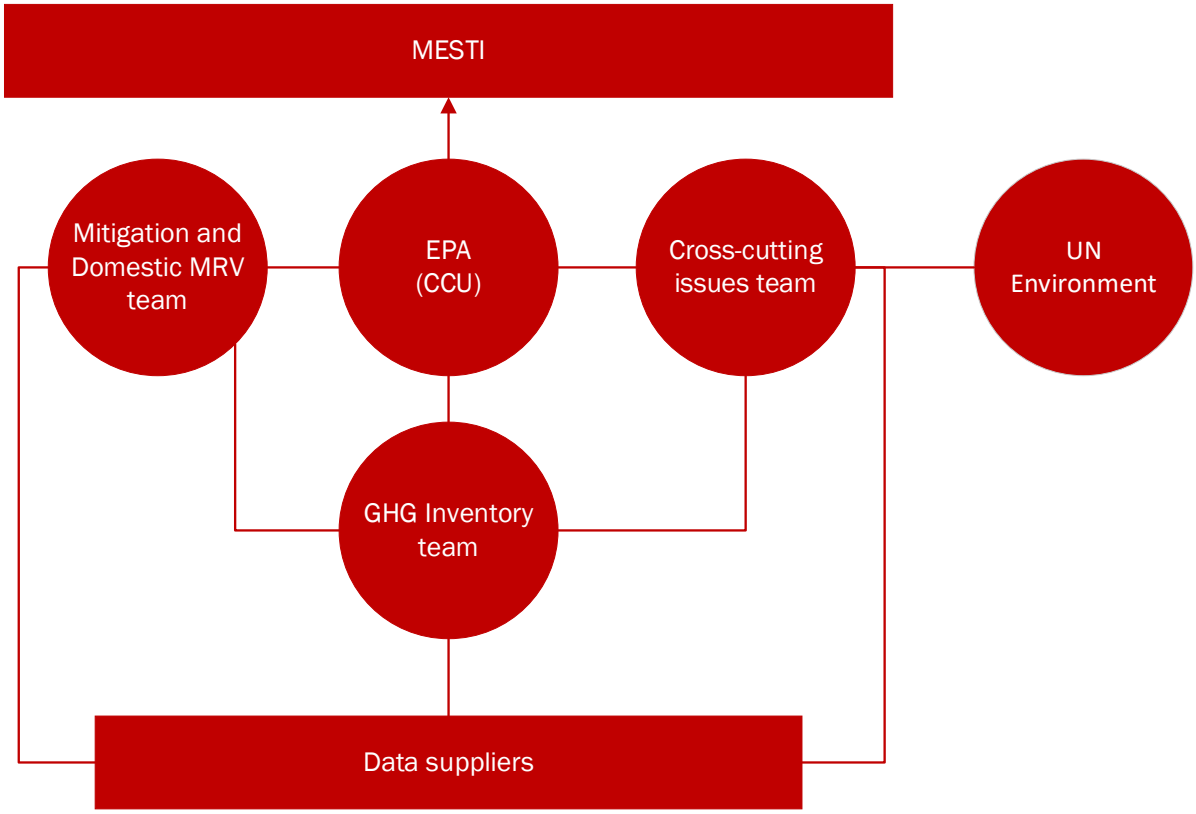

Figure 3: Institutional arrangement for the continuous preparation of Biennial Update Reports

Below are some changes and achievements in the institutional arrangement since the BUR2:

- Continuous training of experts from line ministries as an incentive to sustain their interest and add value to career progression.
- Developed an NDC accounting tool to track the progress and achievement of NDCs.
- Energy Commission consolidated its GHG inventory and mitigation assessment team into a single energy sector climate reporting team.
- Energy Commission has also incorporated GHG inventory reporting into its annual work plan and budget.
- Tema Oil Refinery is the new institution involved in the Energy Sector GHG inventory.

Chapter 4

National Inventory of Anthropogenic Emissions of Sources and Removals by Sinks Greenhouse Gases Not Controlled by the Montreal Protocol

4.1 Updates of National GHG Inventory

4.1.1 Overview of the National GHG Inventory

The summary updates of the national GHG inventory results in the BUR3 are reported consistent with decision 2/CP.17 and according to the "Guidelines for the preparation of national communication from Parties not included in Annex I to the Convention contained in the annexe to decision 17/CP.8. Full details of the results, the methodologies and the steps followed will be provided in the fifth National Inventory Report (NIR 5). The national GHG inventory updates come from the recalculations of the previous results and new estimates in recent years. The current inventory covers the period 1990-2019. Recalculations have been conducted on GHG emission estimates for 2006 - 2016 for selected sectors due to the availability of new datasets and methodological changes. In addition, the latest inventory GHG inventory estimates for 2016 - 2019 have been added. The IPCC Fourth Assessment Report (AR4) 100-year time horizon GWPs was used to report the CO_2 equivalent of the emissions.

The updates of the national GHG inventory were conducted using the methodological guidance in the 2006 IPCC Guidelines for National GHG Inventories. The GHG inventory incorporates anthropogenic emissions by sources and removals by sinks of Carbon Dioxide (CO_2), Methane (CH4), Nitrous Oxide (N_2O) and Fluorocarbons (F-gases) in the Energy, Industrial Process and Product Use (IPPU), Agriculture, Forestry and Other Land Uses (AFOLU) and Waste sectors. The EPA coordinates the overall preparation of the national GHG inventory as the "single national entity". As the coordinating body in the GHG inventory, the Agency collaborates with many stakeholders to compile the national GHG estimates. Within the EPA, the Climate Change Unit (CCU) is the national inventory entity and is directly responsible for managing the entire inventory process. The CCU ensures that the delivery of the inventory is timely, of good quality, and above all meets international standards. The EPA also serves as the generalist to the entire process by performing recalculations, key category analysis, management of QA/QC practices and improvement plans. Four national working groups are responsible for completing the Energy, IPPU, AFOLU and Waste sectors.

4.1.2 Short description of GHG inventory steps

The GHG inventory involved the following steps, which are captured in detail in a pictorial form in Figure 4, including responsible institutions/organisations:

- Identification of major data sources, activity data (AD) collection and processing.
- Selection of applicable IPCC estimation tier and choice of Emission Factor (EF).
- Estimation and recalculation of direct GHG emissions, including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and fluorocarbons and local air pollutants.
- Compilation of individual sector emissions into total GHG emissions by sectors and gases, followed by key category analysis by level and trends.
- Follow agreed QA/QC and uncertainty management practices.
- Improved documentation and upload all datasets on an online database.

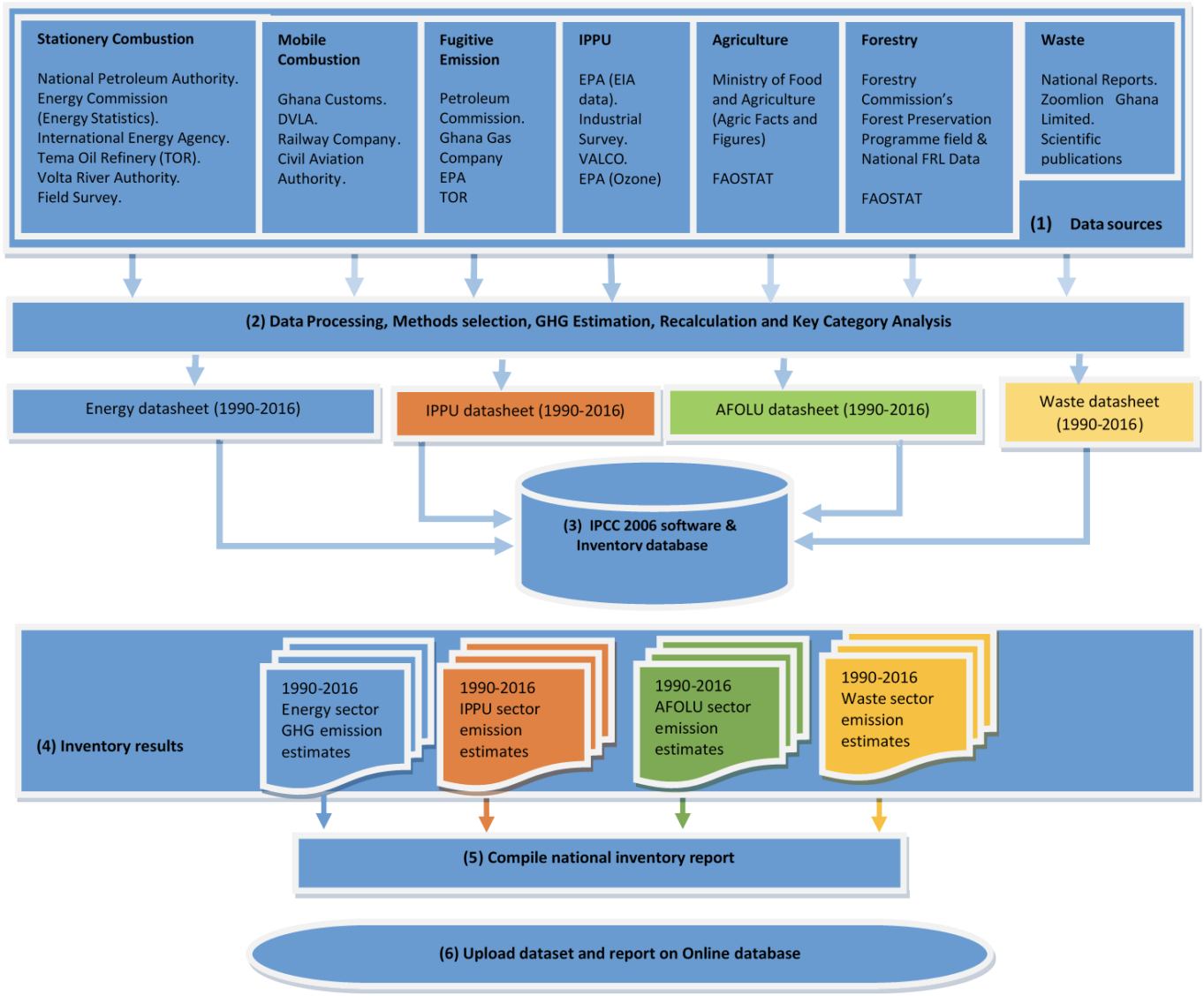

Figure 4: Steps followed in the National GHG inventory

4.1.3 Brief description of approaches to methodological choices

The methods described in 2006 IPCC was used to compute emissions/removals for each category. The choice of methods for the calculation followed the decision tree illustrated in IPCC, 2006. In most sectors, tier 1 IPCC methodology is used, but a higher tier methodology is used when disaggregated national data exist. The availability of facility-level data from Volta Aluminium Company (VALCO) and Land-use changes enabled the use of tier 2 methodology and country-specific emission factors to estimate emissions from Aluminium production and the Land categories. Overall, Ghana's GHG inventory methods have seen some improvements towards a combination of tier 1 and tier 2 estimation that capture new country-specific activity data (ref. Table 3). As it waits for IPCC to complete the methodology work on short-lived climate pollutants (SLCPs), Ghana has voluntarily calculated SLCPs emissions using the EMEP/CORINAIR Emission Inventory Guidebook.

Table 3: Methodological tiers and emission factors for emission/removal categories

IPCC Code	Emisison sources/Removal Categories	CO_2		CH_4		N_2O		PFCs		HFCs	
		Meth	EF	Meth	EF	Meth	EF	Meth	EF	Meth	EF
1.A	Fuel Combustion	T1,T2	D, CS	T1,T2	D, CS	T1,T2	D, CS				
1.A1	Energy Industries	T1	D	T1	D	T1	D				
1.A2	Manufacturing Industries and Construction	T1	D	T1	D	T1	D				
1.A3	Transport	T1,T2	D, CS	T1,T2	D, CS	T1,T2	D, CS				
1.A4	Other Sectors	T1	D	T1	D	T1	D				
1.B	Fugitive Emissions			T1	D						
1.B1	Solid Fuels			NO	NO						
1.B2	Oil and Natural Gas			T1	D						
1.B3	Other Emission from Energy Production			NO	NO						
2.A	Mineral Products	D	D	NE	NE	NE	NE				
2.B	Chemical Industry	NO	NO	NO	NO	NO	NO				
2.C	Metal Production	T2	PS	NE	NE	NE	NE	T2	PS		
2.D	Non-Energy Products from Fuels and Solvent Use	T1	D								
2E	Electronics Industry	NO	NO	NO	NO	NO	NO				
2.F	Product Uses as Substitutes for Ozone Depleting Substances									T1	D
3.A	Livestock			T1	D		D				
3.B	Land	T2	CS	T1	D						
3C	Aggregate sources and non- CO_2 emissions sources on land	T1	D								
4.A	Solid waste disposal	T1	D	T1	D	T1	D				
4.B	Biological Treatment of Solid Waste			D	D	D	D				
4.C	Incineration and Open Burning of Waste			TI	D	T1	D				
4.D	Wastewater Treatment and Discharge	T1	D	TI	D	T1	D				

Key: CS= Country-Specific, PS= Plant-Specific, NE = Not Estimated, NO=Not Occurring, D = Default IPCC methodology and emission factor, EF = Emission Factor, Meth=Methods, T1, T2 - Levels of Tiers

4.1.3 National Greenhouse Gas Inventory Results

4.1.3.1 Greenhouse gas inventory trends

Ghana's total greenhouse gas emissions stood at 58.56 $MtCO_2e$ (million tonnes carbon dioxide equivalent) in 2019 and are 16% more than the 2016 levels. The Energy sector has consistently been the most significant emission source since 2016 (Figure 5). In 2019, 46.6% of the total national emissions came from the Energy sector and were followed by the FOLU (25.5%), Agriculture (17.9%), Waste (7%) and IPPU (3%) sectors. When the emissions/removals from FOLU are excluded from the national totals, the overall emissions were 43.64 $MtCO_2e$ in 2019, with the Energy sector as the most significant source. The emission spikes in 2011 and 2017 relate strongly with the increase in gas flaring in the offshore fields. Commercial production started in 2011, and in 2017 additional gas production fields came online.

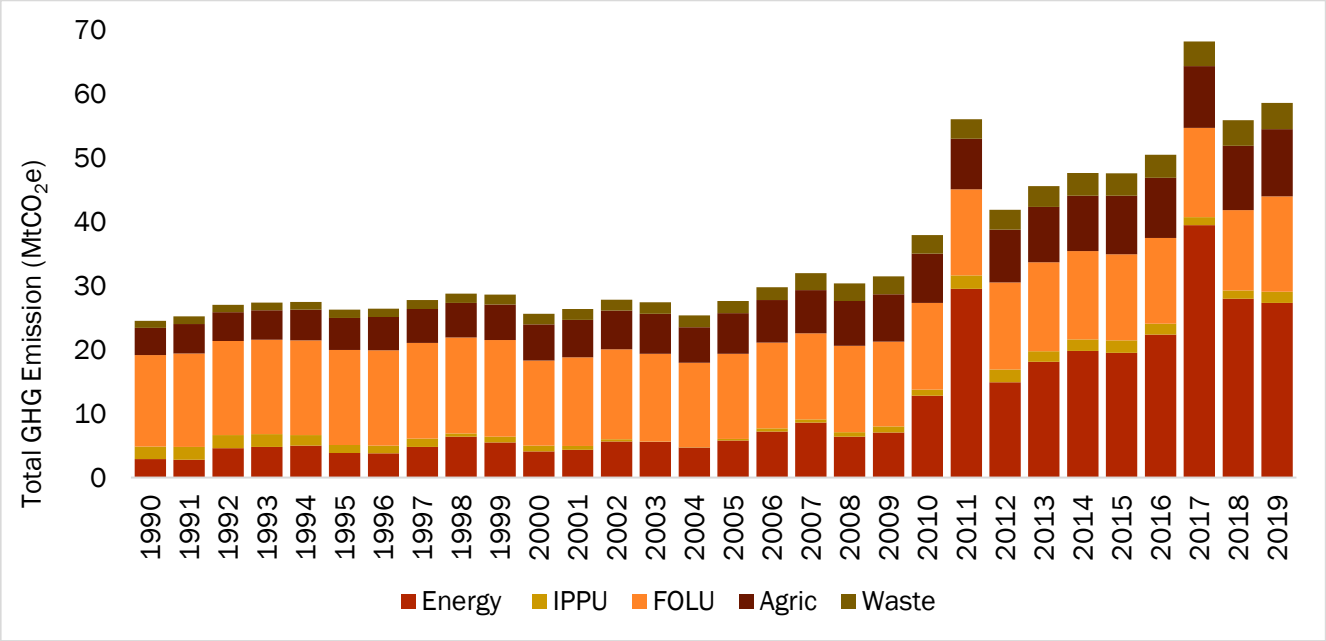

Figure 5: Total national GHG emissions trends according to sectors for the period 1990-2019

All the sectors recorded varying degrees of increases in greenhouse emissions between 2016 and 2019. The energy sector experienced a high increase of 22%, then by waste (14%), Agriculture (12%), FOLU (11%) with IPPU being the least with 3% over the same years. CO_2 is by far the most dominant direct greenhouse gas on a gas-by-gas basis and is followed by CH_4, N_2O, HFCs, and PFCs. With 41.93 Mt, CO_2 constituted 71.6% of the overall national greenhouse emissions in 2019. The rest of the emission breakdown is CH_4 (14%), N_2O (12.5%) and F-gases (1.9%). Table 4 provides the GHG emissions profile for 2019 by types of gases. The energy sector constituted the largest share of CO_2 emissions. It contributed 26.38 Mt (being 62.9%) of all CO_2 emissions. FOLU made the second-largest source of CO_2, accounting for 35% of the emissions in 2019. Road transport, gas flaring, and electricity generation within the energy sector contributed 34%, 30%, and 24%, respectively, to the overall CO_2 emissions. The agriculture and waste sectors are the main sources of CH_4 emissions. Within Agriculture, Livestock contributes 82.3% of the CH_4 emissions. For NO_2 emissions, 86% were from Aggregate sources and non-CO_2 emission sources on land category (Table 5). All the F-gases are emitted from the IPPU sector. Within the IPPU sector, HFCs were from the product uses as a substitute to ODS, whereas the PFCs were from the metal industry.

Table 4: Common reporting Table B for greenhouse gas emissions in 2019

	Emissions (Gg)			Emissions CO2 Equivalents (Gg)			Emissions (Gg)				
Categories	Net CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	NOx	CO	NMVOCs	BC	SO2
Total National Emissions and Removals	41,933.2	328.0	24.6	593.8	521.6	NE	204.6	1276.7	273.4	448.6	18,653.2
1 - Energy	26,377.8	23.1	1.2	-	-	-	204.6	863.2	273.4	448.6	18,653.2
1.A - Fuel Combustion Activities	18,482.6	18.3	1.0	-	-	-	204.6	863.2	273.4	448.6	18,653.2
1.B - Fugitive emissions from fuels	7,895.1	4.8	0.1	-	-	-	-	-	-	-	
1.C - Carbon dioxide Transport and Storage	-	-	-	-	-	-	-	-	-	-	
2 - Industrial Processes and Product Use	615.8	-	-	593.7	521.6	-	-	-	-	-	
2.A - Mineral Industry	531.7	-	-	-	-	-	-	-	-	-	
2.B - Chemical Industry	-	-	-	-	-	-	-	-	-	-	
2.C - Metal Industry	82.1	-	-	-	521.6	-	-	-	-	-	
2.D - Non-Energy Products from Fuels and Solvent Use	2.1	-	-	-	-	-	-	-	-	-	
2.E - Electronics Industry	-	-	-	-	-	-	-	-	-	-	
2.F - Product Uses as Substitutes for Ozone Depleting Substances	-	-	-	593.8	-	-	-	-	-	-	
2.G - Other Product Manufacture and Use	-	-	-	-	-	-	-	-	-	-	
3 - Agriculture, Forestry, and Other Land Use	14,924.0	166.4	21.2	-	-	-		413.5			
3.A - Livestock	-	136.9	-	-	-	-					
3.B - Land	14,517.4	-	-	-	-	-					
3.C - Aggregate sources and non-CO_2 emissions sources on land	406.6	29.5	21.2	-	-	-		413.5			
4 - Waste	15.6	138.6	2.2	-	-	-					
4.A - Solid Waste Disposal	-	62.9	-	-	-	-					
4.B - Biological Treatment of Solid Waste	-	2.2	0.13	-	-	-					
4.C - Incineration and Open Burning of Waste	15.6	5.3	0.1	-	-	-					
4.D - Wastewater Treatment and Discharge	-	68.1	1.9	-	-	-					
Memo Items (5)											
International Bunkers	648.67	0.0065	0.0096	-	-	-					
1.A.3.a.i - International Aviation (International Bunkers)	625.84	0.0044	0.0095								
1.A.3.d.i - International water-borne navigation (International bunkers)	22.83	0.0022	0.0001								
1.A.5.c - Multilateral Operations	-	-	-	-	-	-					

4.1.3.2 Trends of Short-lived climate pollutants

Short-Lived Climate Pollutants are powerful greenhouse gases and local air pollutants emitted through economic activities. Tackling SLCPs emissions has both global climate and local air quality benefits. Therefore, Ghana has reported on an inventory of GHG and non-GHG SLCP covering CH_4, BC and HFC for 1990-2019. Figure 6 shows direct SLCPs (CH_4, BC and HFC) trends for 1990-2019.

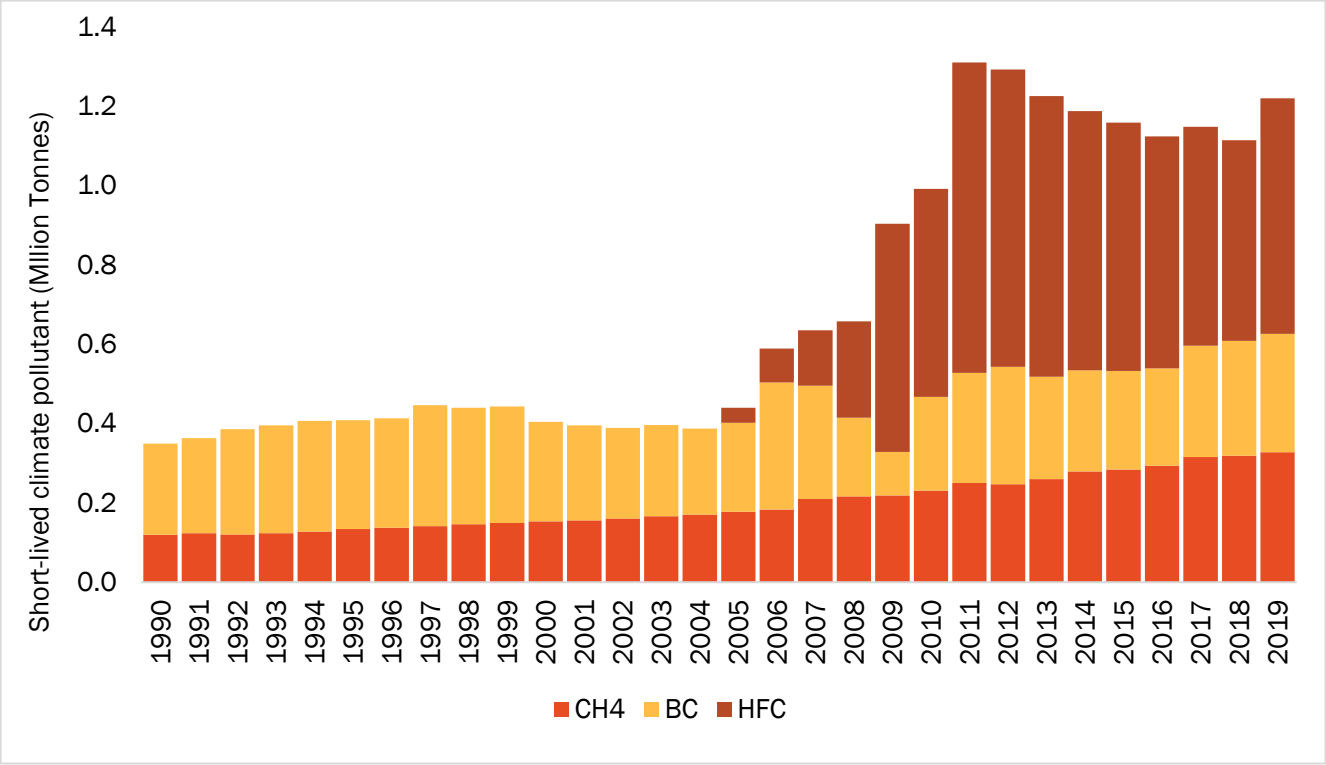

Figure 6: Chart showing the trends of SLCP (CH_4, BC, and HFC) for the period 1990-2019

Methane had consistently been the most dominant SLCPs throughout the time series. In 2019, the methane emissions amounted to 327.9 Gg. Most of the methane came from agriculture and waste disposal. More than half (51%) of the total methane levels were associated with animal husbandry practices, mainly through enteric fermentation. The waste sector was the second-largest source of methane in Ghana. In 2019, the methane emissions from waste disposal accounted for 42.2% of the national total. Solid waste disposal and domestic wastewater contributed to 45% and 49% of the methane emissions in the waste sector. In the Energy sector, residential cooking with solid biomass contributed most (70%) to methane emissions.

Black Carbon (BC) emissions increased by 21.4%, from 245.3 Gg in 2016 to 297.7 Gg in 2019. All the BC emissions were from biomass fuel for cooking (62.7%) and diesel engine vehicles (28.4%) under the energy sector. HFC emissions are mainly associated with Products Uses as Substitutes for ODS in the IPPU sector. HFC consumption increased slightly by 2% compared to the figures in BUR1, which declined by 22% between 2012 and 2016. Therefore, the marginal increase in HFC emission is associated with a rising trend in HFC consumption.

Table 5: Emission trends and percentage changes according to emission sources/sinks

Sectors/Categories	Total Emissions ($MtCO_2e$)					Percentage change
	1990	2000	2012	2016	2019	[2016-2019]
National Emissions with FOLU	**24.50**	**25.60**	**41.84**	**50.47**	**58.56**	**16.0%**
National Emissions without FOLU	**10.20**	**12.29**	**28.33**	**37.10**	**44.05**	**18.7%**
1 - Energy	2.86	4.07	14.90	22.35	27.30	22.1%
1A1, 1A2, 1A4 (Stationery combustion)	1.16	1.74	6.12	7.62	10.02	31.5%
1A3 Transport (Mobile combustion)	1.70	2.33	7.52	6.33	9.23	45.8%
1B2 - Oil and Natural Gas (Fugitive emission)	NO	NO	1.26	8.403	8.052	-4.2%
2 Industrial Processes and Product Use	1.96	0.90	2.01	1.68	1.73	3.1%
2A Mineral Industry	0.01	0.04	0.52	0.35	0.53	54.1%
2C Metal Industry	1.95	0.86	0.73	0.75	0.60	-19.2%
2D Non-Energy Products from Fuels and Solvent Use	NE	0.00200	0.00206	0.00211	0.00208	-1.3%
2F Product Uses as Substitutes for ODS	NE	NE	0.75	0.58	0.59	1.6%
3 - Agriculture, Forestry, and Other Land Use	18.54	18.97	21.83	22.80	25.41	11%
3A Livestock	1.50	1.83	2.53	3.03	3.42	13.0%
3B Land	14.30	13.30	13.52	13.37	14.52	8.6%
3C Aggregate sources and non-CO_2 emissions sources on land	2.74	3.84	5.78	6.41	7.47	16.5%
4 Waste	1.13	1.65	3.10	3.63	4.12	14%
4.A Solid Waste Disposal	0.31	0.57	1.18	1.38	1.57	14.4%
4.B Biological Treatment of Solid Waste	0.10	0.07	0.07	0.10	0.09	-11.7%
4C Incineration and Open Burning of Waste	0.03	0.04	0.08	0.09	0.17	92.5%
4D Wastewater Treatment and Discharge	0.69	0.97	1.78	2.06	2.29	10.9%

NE: Not Estimated, NO: Not Occurring

4.1.3.3 Drivers of the national GHG emission trends

The observed changes in the emission trends are linked to the recalculations and increasing carbon-intensive economic activities. The specific reasons for the recalculations and the overall impacts on the previous emissions are provided in the recalculations section of the report. The increasing greenhouse emission trend is associated with economic activities, the strong reliance of the Ghanaian economy on the exports of hydrocarbons, precious minerals, timber and cocoa. The production, processing and utilisation of these commodities and the rising urban population significantly influence Ghana's GHG emissions. The extraction of timber, gold and cocoa cultivation has been associated with high deforestation in the country. In addition, oil and gas production, processes and flaring instigate the release of fossil carbon.

Below are some of the indicators on the drivers of the greenhouse emission trends in Ghana:

- **Rising urban population** - urban population increased by 11% from 15.6 million in 2016 to 17.2 million in 2019 at a rate of 3.4% per annum.

- **Increased municipal solid waste -** municipal solid waste generation has increased by 7%, from 5 million in 2016 to 5.4 million in 2019.

- **Exponential growth in vehicle population** – the cumulative vehicle population, has more than doubled (147%) from 2.1 million in 2016 to 5.1 million in 2019

- **Increasing commodity export value** - Merchandise export value of cocoa beans, gold, timber products and crude oil increased by 46% from US$ 8,4 to US$ 12.3 billion between 2016 and 2019[12].

- **High deforestation rate** - Total Forest cover loss between 2019 and 2015 stood at 746,563 ha per annum.

- **Increasing shift to natural gas-based in the energy mix –** In 2019, oil (38.3%) and biomass (37.8%) dominate the primary energy supply compared to natural gas of 18.2% and renewable (hydro and solar) of 5.7%. However, between 2016 and 2019, natural gas recorded the highest growth of 149%, followed by renewables of 12%, whereas oil declined 23% and biomass remained unchanged. In terms of electricity generation, hydro share reduced from 43% to 39.9%, while the thermal and solar components increased from 57% to 59.8% and 0.2% to 0.3%, respectively. For thermal components, while fuel oil consumption declined by 48%, natural gas almost tripled over the same period.

- **Consistent decline in gas flaring** – the percentage of gas flared of total gas production decreased from 14% in 2016 to 4% in 2019.

12 https://www.bog.gov.gh/wp-content/uploads/2020/03/Statistical-Bulletin-December-2019-1.pdf

4.1.3.4 Identification of Key Categories

Key Category Analysis (KCA) for 2019 was based on the level assessment. The trend assessment was used to identify key categories for 2012 and 2019 emissions. The 2012 base year for trend analysis to ensure consistency with inventory timelines. The 2019 trend assessment produced twenty-two key category sources and removals with net emissions of 49.2 $MtCO_2e$ (Table 6). Without the FOLU category's emission, there are eighteen key categories with a total emission of 41.7 $MtCO_2e$. The KCA trend assessment, twenty-one sources and removals were identified in Table 7.

Table 6: Level assessment key category list in 2019

IPCC Category	Gas	Contribution to level	Cumulative
3.B.2.b - Land Converted to Cropland	CO_2	27.33%	27.33%
1.A.3.b - Road Transportation	CO_2	12.83%	40.16%
1.B.2.b.ii - Flaring	CO_2	11.29%	51.45%
1.A.1.a.i - Electricity Generation	CO_2	8.88%	60.33%
3.C.4 - Direct N_2O Emissions from managed soils	N_2O	6.68%	67.01%
3.A.1 - Enteric Fermentation	CH_4	4.63%	71.64%
3.B.3.b - Land Converted to Grassland	CO_2	3.72%	75.36%
4.D - Wastewater Treatment and Discharge	CH_4	2.44%	77.80%
3.B.1.a - Forest land Remaining Forest land	CO_2	2.28%	80.07%
3.B.1.b - Land Converted to Forest land	CO_2	2.13%	82.20%
4.A.1 - Managed Waste Disposal Sites	CH_4	1.80%	84.00%
1.A.2 - Manufacturing Industries and Construction	CO_2	1.74%	85.74%
3.C.5 - Indirect N_2O Emissions from managed soils	N_2O	1.72%	87.46%
1.A.1.c.ii - Other Energy Industries	CO_2	1.46%	88.92%
3.B.5.b - Land Converted to Settlements	CO_2	1.03%	89.95%
2.F.1 - Refrigeration and Air Conditioning	HFC	0.85%	90.80%
4.D - Wastewater Treatment and Discharge	N_2O	0.83%	91.63%
1.A.4.b - Residential	CO_2	0.82%	92.46%
2.C.3 - Aluminium production	PFC	0.75%	93.20%
2.A.4.d - Other (please specify)	CO_2	0.71%	93.91%
3.C.3 - Urea application	CO_2	0.58%	94.50%
3.C.1 - Emissions from biomass burning	N_2O	0.56%	95.05%

Table 7: List of key categories using trend assessment for the period 2016-2019

IPCC Category	Gas	Base year estimate (Ex,o)	Latest year estimate (Ex,t)	Contribution to trend (%)	Commulative Total of trend (%)
1.B.2.b.ii - Flaring	CO_2	1,240.16	7,895.12	29.0	29
3.B.2.b - Land Converted to Cropland	CO_2	19,115.19	19,115.19	23.3	52.3
1.A.1.a.i - Electricity Generation	CO_2	3,328.71	6,209.91	9.1	61.4
3.B.1.a - Forest land Remaining Forest land	CO_2	(2,708.98)	(1,591.14)	8.4	69.8
1.A.1.c.ii - Other Energy Industries	CO_2	198.41	1,018.71	3.5	73.3
3.B.3.b - Land Converted to Grassland	CO_2	(2,600.77)	(2,600.77)	3.2	76.5
4.A.1 - Managed Waste Disposal Sites	CH_4	507.08	1,258.35	2.8	79.3
4.A.2 - Unmanaged Waste Disposal Sites	CH_4	660.38	314.59	2.4	81.7
1.A.2 - Manufacturing Industries and Construction	CO_2	1,243.26	1,217.80	1.6	83.3
2.F.1 - Refrigeration and Air Conditioning	HFC	750.04	593.76	1.6	84.9
3.C.3 - Urea application	CO_2	48.56	406.62	1.6	86.5
2.C.3 - Aluminium production	PFC	661.51	521.57	1.5	87.9
1.A.3.b - Road Transportation	CO_2	7,309.03	8,971.45	1.3	89.3
3.C.1 - Emissions from biomass burning	N_2O	505.37	389.68	1.2	90.4
3.B.1.b - Land Converted to Forest land	CO_2	(1,374.13)	(1,491.24)	1.1	91.6
3.C.1 - Emissions from biomass burning	CH_4	488.41	382.11	1.1	92.7
3.C.4 - Direct N_2O Emissions from managed soils	N_2O	3,514.41	4,670.11	1	93.7
3.A.1 - Enteric Fermentation	CH_4	2,397.43	3,239.32	0.93	94.6
3.B.5.b - Land Converted to Settlements	CO_2	719.86	719.86	0.88	95.5

4.1.3.5 Recalculations of previously submitted inventory data

Ghana has performed calculations on the 1990-2016 emission estimates for various reasons. The following are the main reasons for the recalculations:

- Use of appropriate conversion factors for quantities of gas flaring.
- Inclusion of new 2019-2015 land cover matrix.
- Replacement of confirmed fuel consumption figures in the energy statistics.
- Update of a new dataset on the manufacture of charcoal.

The recalculations led to an average 2.4% decrease in the previous emissions trends, with the largest increase of 49% in 2011 and afterwards (Figure 7).

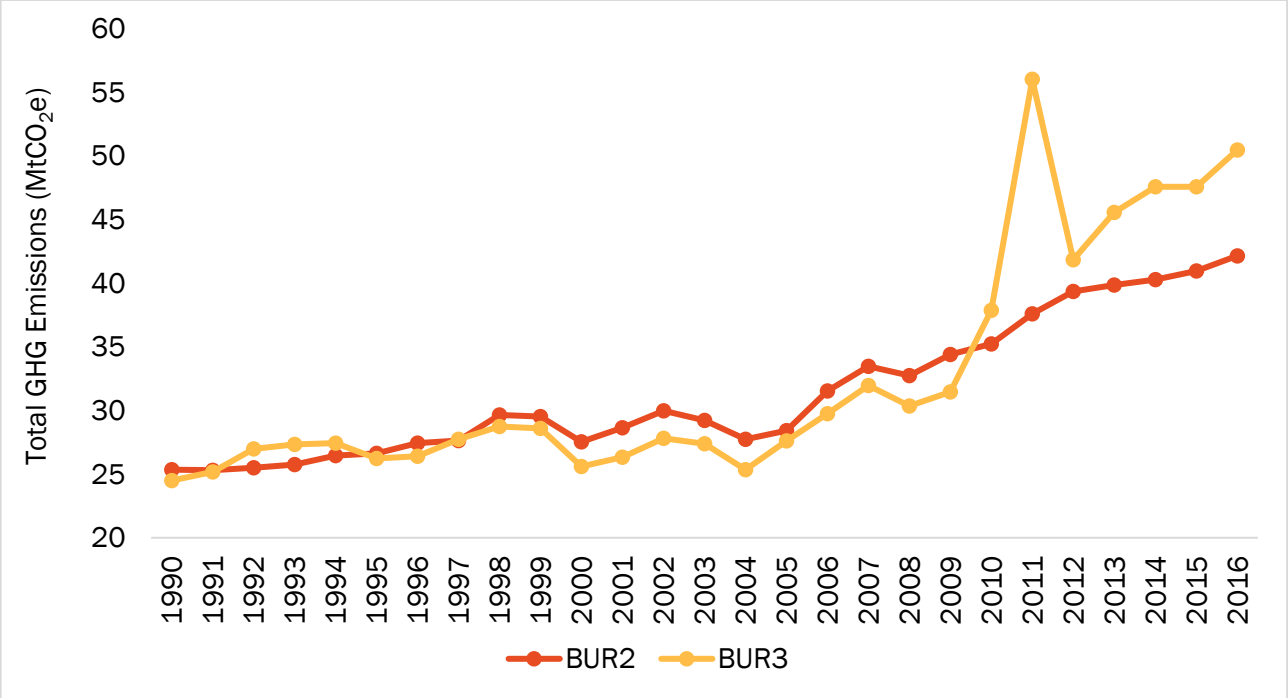

Figure 7: Comparison of differences between total national emissions in BUR2 and BUR3

4.1.3.6 Completeness checks

Ghana's greenhouse gas inventory covers sectors and activities outlined in IPCC 2006 guideline that takes place in Ghana's territory during the inventory period. The emissions from the distribution of oil products (1B.2a.iii.5), Liming (3C.2), Harvested wood products (3D. i), Use of Electrical Equipment (2G.1b) and Disposal of Electrical Equipment (2G.1bc) are not part of the inventory due to lack of activity data. All the direct gases - CO_2, CH_4, N_2O and PFCs (CF_4 and C_2F_6) and HFCs have been covered for the entire time series (1990-2019). SF6 emissions from the use and disposal of electrical equipment have not been estimated. The inventory does not include activities that are not captured in the official records published by State institutions. For example, unreported fuel use, household animals not captured in the livestock census, unaccounted harvested wood, etc.

4.1.3.7 Comparison of carbon dioxide emissions from fuel combustion

Ghana has estimated CO_2 emissions using the Reference Approach (RA) and Sectoral Approach (SA) methods. Table 8 presents RA and SA CO_2 emission and differences in the results over the inventory time series. The differences in CO_2 emissions between RA and SA ranges from 0% to 11%. Generally, RA CO_2 emissions are higher than SA CO_2 emissions in the entire time series. The observed inconsistencies in RA and SA CO_2 due to the statistical differences among petroleum products and observed variations associated with secondary data used to derive the stock change. Since submitting the BUR2, Ghana took steps to improve fuel allocation formulae in the energy balance, which has corrected the large inconsistencies recorded in the previous report.

Table 8: Comparison of the differences in CO_2 emissions estimated using RA and SA

Years	Reference Approach [Mt]			Sectoral Approach [Mt]			Difference [Mt]			
	Liquid	Solid	Gas	Liquid	Solid	Gas	Liquid	Solid	Gas	Total
1990	2.52	-	-	2.43	-	-	4%	0%	0%	4%
1991	2.41	-	-	2.33	-	-	3%	0%	0%	3%
1992	4.21	-	-	4.10	-	-	3%	0%	0%	3%
1993	4.22	-	-	4.17	-	-	1%	0%	0%	1%
1994	4.57	-	-	4.55	-	-	0%	0%	0%	0%
1995	3.36	-	-	3.31	-	-	2%	0%	0%	2%
1996	3.29	-	-	3.27	-	-	1%	0%	0%	1%
1997	4.34	-	-	4.21	-	-	3%	0%	0%	3%
1998	6.18	-	-	5.99	-	-	3%	0%	0%	3%
1999	5.09	-	-	4.89	-	-	4%	0%	0%	4%
2000	3.67	-	-	3.52	-	-	4%	0%	0%	4%
2001	4.08	-	-	3.79	-	-	8%	0%	0%	8%
2002	5.17	0.02	-	5.05	0.02	-	2%	0%	0%	2%
2003	5.05	0.03	-	4.98	0.03	-	2%	0%	0%	2%
2004	4.45	0.03	-	4.19	0.03	-	6%	0%	0%	6%
2005	5.40	0.04	-	5.36	0.04	-	1%	0%	0%	1%
2006	6.60	0.02	-	6.25	0.02	-	6%	0%	0%	6%
2007	7.87	0.04	-	7.69	0.04	-	2%	0%	0%	2%
2008	6.29	0.03	-	6.07	0.03	-	4%	0%	0%	4%
2009	7.31	0.01	-	7.26	0.01	-	1%	0%	0%	1%
2010	9.79	0.02	0.79	9.17	0.02	0.80	7%	0%	0%	6%
2011	8.71	0.02	1.87	8.65	0.02	1.79	1%	0%	4%	5%
2012	11.91	0.01	0.94	11.76	0.01	0.91	1%	0%	2%	4%
2013	12.15	0.01	0.68	11.68	0.01	0.66	4%	0%	3%	7%
2014	10.77	0.00	1.45	10.29	0.00	1.45	5%	0%	0%	5%
2015	9.90	0.00	2.83	9.46	0.00	2.60	5%	0%	9%	13%
2016	11.20	0.03	1.70	11.00	0.03	1.57	2%	0%	8%	10%
2017	12.92	0.00	2.78	12.27	0.00	2.62	5%	0%	6%	11%
2018	13.10	0.00	3.52	13.13	0.00	3.29	0%	0%	7%	7%
2019	13.56	0.00	4.82	13.13	0.00	4.58	3%	0%	5%	9%

4.1.3.8 Quality Assurance/Quality Control

Within Ghana's greenhouse inventory system, the EPA has the responsibility to generally oversee the QA/QC procedures in the inventory and performed the following routines:

- Ensures that the sector teams follow the QC checklist,
- Collect and review completeness checklist submitted by the sector inventories;
- Facilitate all technical reviews of the inventory both in-country and at the international level.
- Follow up with the implementation of the recommendations in the previous review.
- Revive the roles of the QA/QC lead institution

Ghana has prepared and adopted the use of a new QA/QC plan. In this inventory, the team followed the tier 1 general QC procedures (Table 9).

Table 9: List of QC procedures followed in the inventory

QC tasks	Description of specific tasks	Responsibility
Internal consistency	Ensured that the total GHG emissions equal the sum of the individual emissions from the sectors and categories.	EPA
	Confirmed the total GHG emissions equal the sum of the emissions by gas.	EPA
	Compared data in the tables to calculation spreadsheets and to the text to confirm that all reported emissions estimates, activity data and emission factors are the same.	EPA
	Ensured that parameters used in multiple categories (e.g., the population of livestock or Quantity of Lubricant use) are consistent across categories	EPA
	Confirmed that the emissions data is reported in a manner consistent with the calculation tables in the non-Annex 1 National Communications Reporting Guidelines	EPA
	Confirmed that the selection and application of the estimation methods were consistent with IPCC guidelines.	EPA
Documentation	Created back-ups of all documentation in hard and soft copies and uploaded files in the datahub	All sectors webmaster
Data gathering, input, and checks	Checked assumptions and criteria for the selection of activity data and emission factors are well documented	EPA
	Checked for transcription errors in data input and reference	EPA
Calculation Checks	Check methodological and data changes resulting in recalculations	EPA
	Check that emissions/removals are calculated	EPA
	For each category, compared current inventory estimates to previous estimates, if available. If there are significant changes or departures from expected trends, re-check estimates and explain any difference. Significant changes in emissions or removals from previous years may indicate possible input or calculation errors	EPA

4.1.3.9 Planned improvement list

QA is an important part of the overall QA/QC procedures. In the BUR3, Ghana continued to address some of the recommendations from the second ICA. It underwent an informal review that was scheduled in the near term. Table 9 presents the overview of the planned improvement list informed by recommendations from the second ICA and the informal technical review of the inventory.

Table 10: Status of implementation of GHG inventory improvement list

Topics	Description of issues	Status
Recommendations from second ICA summary report		
Consistency between BUR and NIR	Ensuring consistency in the values reported across tables in the BUR and the NIR	Resolved. All figures and notation in the tables in the BUR3 and NIR5 are consistent
Use of notation keys	The use of notation keys was not always consistent with the UNFCCC guidelines for the preparation of NCs from non-Annex I Parties	Resolved. Appropriate notation keys have been in background and summary Table
Annual changes in carbon stocks	Reporting the information on annual changes in carbon stocks for different land uses and land-use conversions	Not resolved. Plan to gather information on annual changes in carbon stocks in the BUR4.
Dairy and non-dairy cattle	Separate emissions from manure management from dairy and non-dairy cattle	Being resolved. In the meantime, it has been assumed that all cattle are non-dairy
KCA	Setting a key category threshold to 95 per cent and clearly explaining the reasons for selecting the base year for the trend analysis would facilitate a better understanding of the information reported	Resolved. Check the KCA section of this report.
Improvement lists		
Transport	Survey to update the existing 2005 data on fuels allocation to the various vehicle classes	Not started due to lack of funds.
Energy statistics	Conduct a survey to update and review existing patterns and share of fuel consumption in all sectors of the economy	Not started due to lack of funds.
FOLU	Reprocess land-use maps and LUC matrices Integrate maps on perennial crops (mainly cocoa and rubber) in land-use maps and recalculate	Resolved. 2019 map produced that separated forest from cocoa plantations
Agriculture	Apply enhanced characterisation of livestock.	Being resolved. Need funds to conduct a study.
IPPU	Conduct industrial survey in-country to identify all possible sources according to the IPCC Guidelines for formal and informal sources and ensure data is collected and sources maintained for future inventories.	Not started due to lack of funds.

	Improvement in estimates on non-energy use and feedstock to ensure internal consistency.	Being resolved. Addressing the inconsistencies of the figures on non-energy use of fuel and feedstock between IPPU and energy will continue in the next BUR.
Waste	Revise solid waste generation rates and waste stream fractions with new datasets	Not started due to lack of funds.
	Revise fraction of solid waste biologically treated through composting	
	Revision of the fraction of solid waste incinerated and openly burnt	
	Update existing survey data on industrial and domestic waste	

Chapter 5

Greenhouse gas mitigation actions and their effects

5.1 Update of Mitigation Actions

5.1.1 Mitigation planning and policy efforts

The information in this section of BUR3 is the update of those reported in Ghana's Fourth National Communication (NC4). It provides a new update on the policy and regulatory changes relevant for GHG mitigation, progress and achievement of mitigation actions, challenges and steps envisaged to sustain and enable mitigation efforts. Ghana's greenhouse gas mitigation strategy focuses on achieving sustainable development outcomes and aligns to the pathway towards a low carbon future. That is why the central Government has outlined broad mitigation policies areas in the national development plans as follows:

- Sustainable financial framework
- SDG responsive budgeting
- Low carbon electricity supply
- Scaling-up renewable energy
- Clean cooking and lighting
- Sustainable urban transport, electric mobility, and rail transit
- Lowering deforestation and restoration of degraded areas
- Energy efficiency in households, commerce, and industry
- Innovative waste management
- HFC phase-down and
- Natural gas recovery and utilisation and restriction in gas flaring

5.1.2 Greenhouse gas emissions projections

5.1.2.1 Approach to emission projections

Emissions projections depict the most plausible future GHG emissions trajectory reflecting the consequences of current and planned policies. It also serves as the baseline relative to which the aggregate effects of mitigation actions are evaluated. Ghana presents emissions projections according to sectors and expressed in carbon dioxide equivalent (CO_2e) using the 100-year global warming potentials contained in the Intergovernmental Panel on Climate Change's (IPCC) Fourth Assessment Report. The sectors covered are as follows:

- Energy (power plants, transport, direct combustion, and fugitive emissions)
- Industrial processes and product use
- Agriculture
- Land
- Waste

The projection covers 2019 (base year) and 2030 as the target year and is based on the currently implemented and adopted mitigation policies as variously outlined in the national development documents such as Ghana @100 framework, Ghana Beyond Aid Charter, COVID-19 Alleviation and Revitalisation of Enterprise Support, CPESDP and NMTDP.

5.1.2.2 Ghana's emission projections

In the next decade, it is projected that Ghana's emissions will increase by 70% to 100 $MtCO_2e$ by 2030 from 59 $MtCO_2e$ in 2019. Without land category, the emissions are likely to go up by 87% over the same period. The expected rise in emissions is likely to be driven by the expansion of fossil-fuel intensive manufacturing and electricity, urban road transport, gas flaring, and solid waste disposal.

Table 11: Summary of emission projections by sectors

Sector/Categories	Historical emissions/ Removals [$MtCO_2e$]	GHG emissions projections [$MtCO_2e$]			Change [%]
	2019	2020	2025	2030	2019-2030
Fossil power plants	6.20	6.69	9.77	13.18	113
Direct combustion	4.01	4.75	8.50	12.40	209
Transport	9.22	9.85	13.00	16.17	75
Fugitive emissions	8.05	8.45	12.47	16.57	106
Industrial processes	1.73	2.07	2.39	2.93	69
Agriculture	10.89	11.25	13.21	15.50	42
Land	14.52	14.73	15.86	17.07	18
Waste	4.12	4.26	4.99	5.89	43
Total with Land	*58.75*	*62.05*	*80.19*	*99.73*	*70*
Total without Land	*44.23*	*47.32*	*64.33*	*82.65*	*87*

5.1.3 National greenhouse mitigation goal

Ghana has a greenhouse gas mitigation potential of 68.1 $MtCO_2e$ associated with the full and effective implementation of thirty-three mitigation actions in the Energy, Transport, Industry, Oil and gas, IPPU, FOLU and Waste sectors (Table 12).

Table 12: Mitigation measures, emission reduction potential, and investment requirements

Mitigation measures	US$/$tCO_2$	Emission reduction by 2030 per option kt/year	Investment required by 2030 (million $)
Shifting freight transport from road to rail	-1717.05	10.79	1000
Efficient wood stoves	-998.41	8278.53	783.92
Switch from fuel oil to natural gas	-714.17	4174.84	1.10788612
Restriction on import of used cars	-391.67	25.15	1
More efficient diesel cars	-340.75	0.22	3
New bicycle lanes	-284.81	54.93	4
Solar LED lamps	-236.23	175.14	35.712766
Efficient lighting with LEDs	-175.23	243.97	14.589695
Efficient residential air-conditioning	-117.84	11.36	1.76033
Efficient water pumping	-112.44	0.68	0.165
Wind turbines, on-shore	-110.32	431.25	243.75
Efficient room air conditioner	-99.49	37.95	3

Hydropower connected to main grid	-94.22	314.90	170.715
Efficient office lighting with LEDs	-70.65	19.11	6.85630809
REDD: Avoided Deforestation	-18.55	1505.90	165.649
Landfill gas plant with power production	-11.59	3288.12	108.373229
Reforestation with agroforestry	-1.32	14996.67	5521.5
Wildfire Management	0.00	11.70	2
Forest Conservation	0.00	634.07	20
ODS phaseout	0.00	3874.16	7.4
Composting of Municipal Solid Waste	0.07	18020.51	30.885549
Biogas from Municipal Solid Waste	0.29	4.35	2.04
Energy efficiency in industry	1.69	1480.69	14.8069163
Charcoal production	2.70	1542.99	24.72
Efficient refrigerators	10.97	1586.22	336.634241
Reforestation	27.60	6416.67	1050
Reduced flaring at the oil field	45.35	12.24	5.88069108
Single-cycle to combined cycle	90.10	264.58	141.32672
Solar PVs, large grid	105.11	348.39	622.5
Solar house PVs	140.58	226.65	449.964
Solar/diesel mini-grid	155.94	17.23	17.7
LPG stoves replacing wood stoves	493.47	159.81	2.484
Electric 12m buses	1448.71	18.81	187.5

5.1.4 Policies supporting the achievement of mitigation goals

Ghana has adopted national and sector policies that support the achievement of sustainable development and climate mitigation outcomes at the same time. Section 5.1.5 lists some of the policy achievements since the submission of the BUR 2. These are in reducing deforestation, scaling-up adoption of renewable energy, promoting low carbon electricity supply, stepping up energy efficiency in residential and commercial areas, promoting clean cooking stoves, improving waste management practices, phasing down HFCs, as well as other cross-cutting policy changes.

5.1.5 Overall Progress and achievement of mitigation actions

5.1.5.1 Cross-cutting policies and measures

- Update of Ghana's Nationally Determined Contribution to align it with emerging policies to ensure effective implementation and with the view to increase mitigation ambition.

- A comprehensive review of the National Energy Policy to respond to the Government's sustainable energy programme and address emerging energy issues.

- **Scaling-up renewable energy deployment** - The parliament passed the Renewable Energy Act 1045, 2020, which establishes a competitive procurement scheme and a net metering scheme regarding electricity generated from renewable energy sources. The amended act also makes it mandatory for fossil-based whole electricity suppliers, producers of fossil fuels and any company that contribute to greenhouse gas emission to invest in non-utility renewable energy to offset greenhouse emissions.

- Adoption of the Renewable Energy Master Plan in 2019 to step up the efforts to accelerate renewable energy deployment.

- **Promoting E-mobility** - Implementing a two-prong approach to promote electric mobility by setting up the regulatory and market standard.

    - Launched the "drive electric initiative" in 2019 to promote electric vehicles on roads to create demand and drive the productive utilisation of electricity in the system. The Energy Commission is conducting a baseline study to inform the country's drafting of standards and regulations on e-mobility. There are plans to host "Drive Electric Fair in 2021, develop a national policy and standards for regulating the e-mobility market.

    - Ministry of Transport is aiming at introducing electric buses into the public transport system. As a result, the Ministry is working with CTCN to undertake the following: (a) develop a national policy on e-mobility; (b) assess the market readiness to deploy electric vehicles; and (c) conduct a detailed feasibility study, capacity building and awareness of relevant stakeholders.

- **Strengthening vehicle inspections and standards** - Ministry of Transport has authorised the twenty-seven Private Vehicle Test Stations (PVTS) to conduct the roadworthiness inspection tests using state-of-the-art equipment, and results automatically recorded, transferred and printed. In addition, Ghana has adopted motor vehicle emission standards, and EPA has developed a regulation to back the implementation, which is currently undergoing administrative reviews.

- **Legislation on restricted gas flaring** - Ghana enacted Petroleum Exploration and Development Act, 2016 (Act 919) to restrict gas flaring in petroleum exploration and development unless the regulator grants permission to the producers to flare. In addition, the Ghana National Gas Company was established to uptake and process gas for the Ghanaian downstream market.

- **Enhanced landscape restoration** - Achieving Forest mitigation outcomes by implementing the Forest Plantation Development Strategy and the REDD+ strategy. The Forest Plantation Strategy aims to increase forest cover and restore degraded lands. REDD+ strategy seeks to address the key drivers of deforestation and forest degradation in the cocoa, shea, and sub-national mangrove landscapes. Ghana also introduces the Green Ghana Initiative to institutionalise the culture tree growing.

5.1.5.2 Aggregate effects of sectoral mitigation actions

Ghana continues to implement mitigation actions as part of the overall low emission development strategy. In this BUR3, Ghana has presented information on implementing 14 mitigation actions across the energy, forestry, waste, transport and RAC sectors. It covers technology, fiscal and regulatory instruments, capacity development and awareness measures. The implementation of the fourteen actions is leading to GHG emission reduction outcomes and other mitigation co-benefits. Of the 14 measures, 12 has led to 25.33 Mt/year GHG mitigation outcomes representing a 43% reduction compared to the 2019 GHG emissions. When the emission reductions from FOLU and large hydro-dam are excluded, the total mitigation outcomes stood at 24.63 Mt/year and 20.84 Mt/year, respectively (Table 13). The remaining two REDD+ measures have the potential to generate 2,429.17 Mt/year emission reductions.

Table 13 Breakdown of the mitigation effect and co-benefits of climate actions

Mitigation variables	Value	Unit
Total mitigation measures being reported	14	No
of which being implemented	12	No
of which are planned	2	No
GHG savings	25.33	Mt/yr.
GHG savings without large hydro-dam	20.84	Mt/yr.
GHG savings without FOLU	24.63	Mt/yr.
GHG emissions reduction potential in REDD+	2,429.17	Mt/yr.
Fuel cost saving	94-109	US$ million
Investments	1,317.26	US$ million
Jobs created	588,906	No of people
Renewable energy produced	82.2	GWh/per year

Furthermore, the 12 mitigation measures have delivered significant sustainable development co-benefits in terms of jobs, investment, increase renewable energy generation and cost-savings (Table 3). The energy sector has seven measures with the corresponding 11.9 Mt/year emission savings, 46.9% of the total reductions. Without the emission reductions from the large hydro dam, the mitigation outcomes achieved in the energy sector amounted to 7.4 Mt/year. The large hydro dam generated the highest emission reductions within the energy sector, followed by improved biomass stoves with 4.0 Mt/year savings. Besides the energy sector, the measures in the environment, which consisted of restricted flaring and HFC phase-out, recorded the second-highest emission reductions in Ghana in the reporting period. It generated a total of 8.8 Mt/year emission savings, making 35% of the total GHG mitigation outcomes.

Table 14: Mitigation action per category

Sector	Mitigation Theme	Mitigation actions	Code	GHG (ktC/yr)
Energy	Low carbon electricity	Open-cycle to combine cycle	OC-CC	700.3
		Fuel oil to natural gas	FO-NG	945.5
	Renewable energy	Renewable energy	RE	77.5
		Large hydro-dam	LHD	4,494.4
	Energy Efficiency in homes and businesses	Energy Efficiency	EE	1,367.5
	Clean cooking solutions	LPG Stoves	LCS	256.3
		Improved Cookstove	ICS	4,036.4
Water and Sanitation	Alternative waste management	Compost	CP	3983.5
Environment	Green cooling	HFC reduction	HFC	80
	Decarbonisation of oil and gas production	Restricted Flaring	RF	8,683.6
Transport	Urban transit	Fleet renewal and BRT	BRT	2.1
Forestry	Plantation development	Tree plantation	FPS	704.7
	Result-based REDD+	Cocoa Forest REDD+	CFR	1,666.7
	Shea landscape emission reduction	Shea Landscape REDD+	SLR	762.5

Regarding the attainment mitigation outcomes by the individual actions, restricted gas flaring recorded the largest GHG emission savings. In the period under review, restricted gas flaring measures generated 8.7 Mt/year, followed by hydro dams (4.5Mt/year) and improved cookstove (4Mt/year) (Figure 8). The rest are compost (3.9Mt/year), energy efficiency (1.4Mt/year) and switch from fuel oil to natural gas in thermal plants (0.9Mt/year).

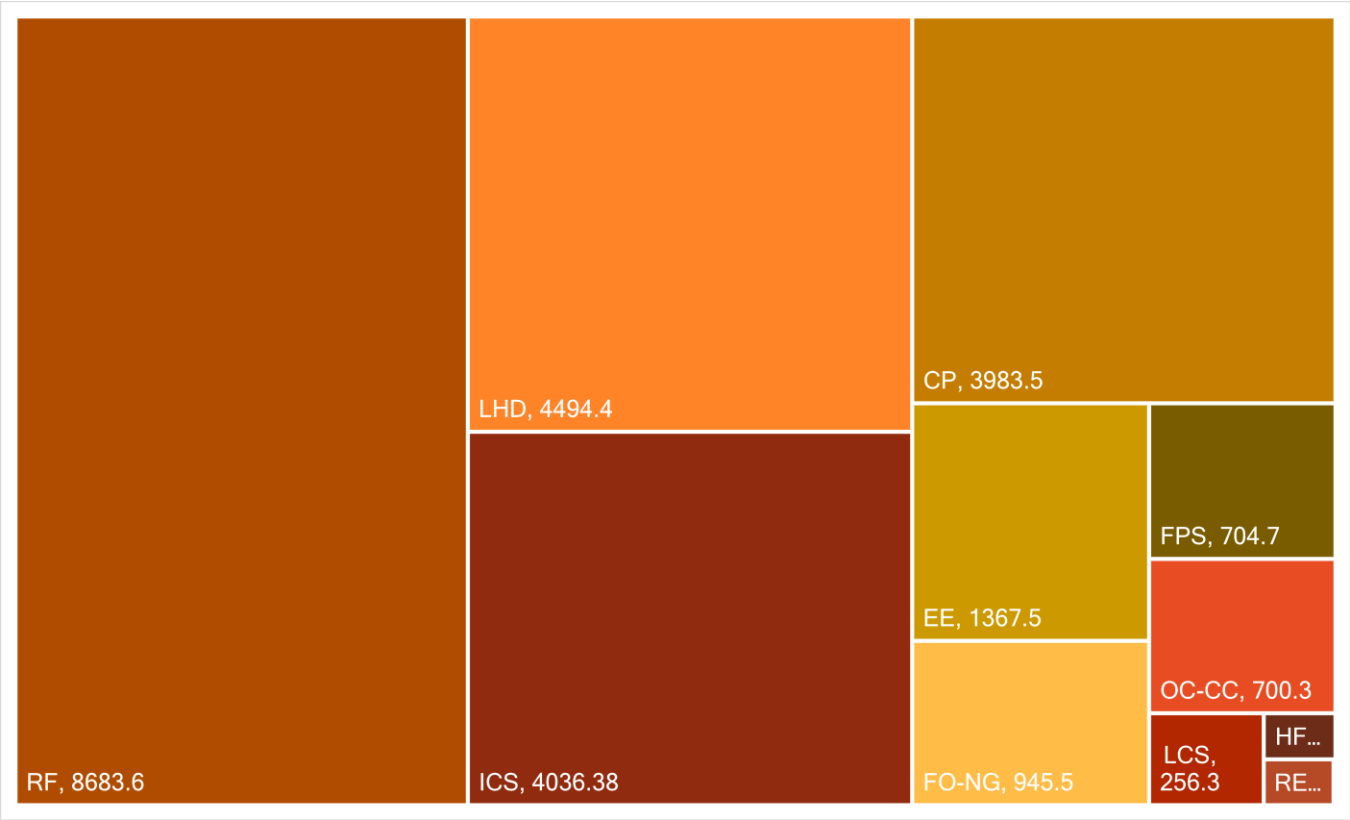

Figure 8: Summary of individual mitigation actions and their GHG effects

The breakdown of the GHG effects of the remaining mitigation actions are forest plantation (0.7 Mt/year); (b) conversion of open-cycle to combined cycle in thermal plants (0.7 Mt/year); LPG stoves (0.3 Mt/year); HFC phase-out (0.08 Mt/year) and renewable energy (0.07 Mt/year).

5.1.6 Sector-specific progress and achievement of mitigation actions

5.1.6.1 Energy sector

The global race to achieve a sustainable energy transition is on Ghana's policy radar. Ghana continues to work at its aspiration to become energy-sufficient by developing and utilising its domestic energy resources (natural gas, renewables) and promoting bio and nuclear energy. While at it, Ghana is mindful of the urgent need for energy diversification, promotion of renewables, energy efficiency improvements, decarbonising the electricity supply and clean cooking to deliver reliable, cost-effective and clean energy for all. That is why Ghana’s energy mitigation policy aims to make energy services universally accessible and readily available in an environmentally sustainable manner. National Energy Policy, adopted in 2010, is the primary document driving the mitigation efforts in the sector. It has specific strategies for achieving universal access to electricity, renewable energy penetration, natural gas commercialisation, infrastructure and LPG use and recently, nuclear energy development. The following document outlines strategies to policy objectives and interventions toward achieving the broad clean energy goals in the national energy policy:

- National Gas Master Plan (2016)
- Renewable Energy Master Plan (2019)
- Sustainable Energy for All Country Action Plan (2012)
- Mini-grid Electrification Policy (2015, revised in 2017)
- Integrated Power System Master Plan
- National LPG Promotion Policy (2017) and the
- Ghana Nuclear Power Programme (NPP)

In 2017, the Ministry of Energy started a comprehensive review of the National Energy Policy, still ongoing. The review makes the policy consistent with the Government's sustainable energy programme and responds to the country's emerging energy issues. Thus, the Ministry of Energy is leading in the implementation of specific programmes in the following areas that deliver mitigation outcomes:

- Low carbon electricity supply
- Scaling-up renewable energy
- Energy efficiency in households, commerce, and industry
- Clean cooking solutions

5.1.6.1.1 Low carbon electricity supply

Table 15: Single cycle to combined cycle in thermal power plant

Name	Conversion from an open-cycle gas power plant to a combined-cycle power plant.
Type of action	Fuel savings through energy efficiency improvement in power plants (Technology)
Sector	Energy
Implementors	Volta River Authority and Independent Power Producers
GHGs	CO_2, CH_4 and N_2O
Objectives	Increase the installed capacities of the thermal plant by converting open-cycle gas power plant to a combined-cycle to utilise steam as fuel instead of fossil fuel to reduce greenhouse gas emissions. Upgrade the installed capacity of each of three open-cycle thermal power plants to 330 MW through retrofits to use steam.
Description	Electricity generation capacity had more than doubled from 2,165 MW in 2010 to 5,172MW in 2020. The share of fossil-fuel thermal power is on averagely 52%. Ghana has adopted a policy to retrofit existing and new thermal plants to combined cycle power plants to reduce reliance on fossil fuels.
Period	2014 till date (ongoing)
Steps taken or envisaged to achieve the action	Completed upgrade of steam capacity of the following thermal power plants: • 120 MW by TICO • 110MW by Takoradi Thermal 2 (T2) Power Plant • 110MW by Tema Thermal 1 Power Station (TT1PS) • 110 MW by CENIT • 110 MW by Kpone Thermal Power • 247MW by Karpowership • 40MW Takoradi 3 Thermal Plant Additional planned steam capacity include: • 110M by KTTP • 110 by TT1PP
Results Achieved	• Upgraded 847 MW steam capacity in existing seven existing thermal power plants. • Seven existing thermal power plants expanded steam capacity.
Impacts	GHG impacts • 700.3 kt/CO_2e/year since 2016 to date. Non-GHG impacts • Fuel cost savings over the lifetime of the project are expected to be between US$94 million and US$109 million, based on the mid-level gas demand projection. • Increase electricity supply to meet the annual 10% growth in electricity demand. • 1,321 GWh of total electricity saved through the efficient use of steam to generate electricity.
Progress indicators	• Steam capacity increase in MW • Share of steam electricity generation (MWh)
Methodology/ Assumptions	• Calculation based on approved CDM methodology (CDM ACM0007) • Fossil fuel consumption to operate the project power in combined cycle mode. • Plant utilisation time is 6000 hours per year. • Power plant efficiency is estimated at 51%

Table 16: Fuel switch from heavy fuel to natural gas in thermal power plants

Name	Fuel switch from heavy fuel oil to natural gas thermal power plants
Type of action	Replacement of high carbon-intensive fuel oil with natural gas
Sector	Energy
Implementors	Ministry of Energy, Volta River Authority and Independent Power Producers
GHGs	CO_2, CH_4 and N_2O
Objectives	The objective is to replace the utilisation of heavy fuel oil (LCO or HFO) with gas to reduce the cost of electricity generation and emissions. It also involves developing gas infrastructure to facilitate production, transportation, and natural gas processing as primary fuel inputs to generate thermal electricity.
Description	It involves investing in gas infrastructure development to facilitate natural gas production, transportation, and processing as primary fuel inputs for thermal electricity generation. To this end, Karpower, AKSA, CENIT, TAPCO, TICO, TT1PP, TT2PP should utilise gas for power generation.
Period	2010 till date (ongoing)
Steps taken or envisaged to achieve the action	• Invested nearly $13.2 billion (Tweneboa-Enyenra-Ntomme (TEN) and ENI/Vitol, (Sankofa) fields (ENI/Vitol - $7.28 billion, TEN - $5.9billion) in natural gas production and infrastructure development. • Commissioned a natural gas processing facility in 2012. • Adopted the Ghana national gas master plan to guide the development of the natural gas market in Ghana • Relocation of Karpower from the Eastern Power enclave to the Western Power enclave of the country.
Results Achieved	• Commissioned three gas production fields (Tweneboa-Enyenra-Ntomme (TEN) and ENI/Vitol (Sankofa)and (NI/Vitol) with an initial production capacity of 300 MMscf daily. • Commissioned and operating a first-ever natural gas processing plant with a capacity of 150m standard cubic feet a day (MMscfd). • Ghana Gas Company, since 2011 processed and supplied to VRA thermal plants a total of 3,343.19 ktoe of natural gas for electricity generation. Specifically, TAPCO, TICO, TT1PP, TT2PP and Karpower now utilise natural gas for power generation. • In 2019, TAPCO generated 1,067 GWh, TICO generated 1,616 GWh, TT1PP generated 377 GWh, TT2PP generated 138 GWh, and Karpower generated 1,510 GWh with natural gas as input fuel.
Impacts	GHG impacts • 945.5 kt/CO_2e/year since 2010 to date. Non-GHG impacts • Reliance on competitively priced domestic natural gas is the most cost-effective means of providing the primary energy needed to fuel power stations and satisfy the growing demand for electric power in Ghana.
Progress indicators	• Thermal capacity switch from fuel oil to natural gas (MW) • Natural gas-based electricity generated (GWh) • Quantity of natural gas consumed instead of crude oil (tonnes)
Methodology/ Assumptions	• Calculation based on approved CDM methodology (CDM ACM0011) • Power plant efficiency estimated at 42% for using natural gas • Capacity factor estimated 6000 operating hours

5.1.6.1.2 Scaling up deployment of renewable energy

Table 17: Scaling up renewable energy technology

Name	Scaling up deployment of renewable energy
Type of action	Renewable energy technology deployment backed by fiscal and regulatory instruments (Technology and regulation)
Sector	Energy
Implementors	Ministry of Energy, Energy Commission, Volta River Authority, Bui Power Authority, IPP, Individuals, Hotels, Hospitals, Banks, etc.
GHG	CO_2
Objectives	Increase the contribution of renewable energy share in the overall energy mix while ensuring efficient production and utilisation of biomass energy resources to reduce greenhouse gas emissions and achieve the scaling-up of renewable energy penetration to 10% by 2030.
Description	A government-wide cum private-sector initiative led by the Ministry of Energy promotes renewable energy technologies at all economic levels. The action has the following components: • Utility-scale renewables • Distributed solar PV • Mini Hydropower • Off-grid renewables • Replacement of kerosene lamps with solar lamps'
Period	2012 to 2030
Steps taken or envisaged to achieve the action	• Renewable Energy (Amendment) Act, Act 1045 establishes a competitive procurement scheme and a net metering scheme regarding electricity generated from renewable energy sources. The amended act also makes it mandatory for fossil-based whole electricity suppliers, producers of fossil fuels and any company that contribute to greenhouse gas emission to invest in non-utility renewable energy to offset greenhouse emissions. The Amended Act also removed the 100MW threshold for hydro dam qualify as a renewable source and allowed all existing large hydro to qualify as renewables. • Implementing the following sub-measures: ▪ RE licensing framework and ▪ Mini-grid electrification policy. ▪ Scaling-up RE programme Investment Plan. Plans to establish the following by 2030 • Install 300 MW distributed solar PV • solar 300 mini-grids translating into 14.22MW • Attain utility-scale solar electricity installed capacity to 527.1MW

	• Increase utility-scale wind power capacity up to 375MW Increase install hydro capacity from 1580.045 MW to 1730.45MW. • Increase kerosene lamp replacement with solar lanterns in rural non-electrified households to 2 million.
Results Achieved	Utility-scale renewables • Installed 42.5MW utility-scale solar system. • Construction of VRA 17MW utility-scale connected solar Power Project located in the Upper West Region. • Bui Power Authority utility-scale connected solar Power Project Distributed solar PV • Installed individual solar PV system adding up to 2,751 kW composing: • 534 kW individual distributed solar PV system. • Installation of 1,109kW solar PV system to supply 1.6M kWh of clean electricity each for Coca-Cola Bottling Company of Ghana by Cross Boundary Energy. This project is completed and operational. • Installation of 400.4kWp solar-connected plant located at Kasapreko's to supply 570,570kWh. • Installation of 704kW solar-connected Miniplast. Mini Hydropower • Installation & completion of 45kW Mirco hydropower project at Tsatsadu Falls located in the Volta Region. • 1580MW large hydropower connected to the grid. Mini-grid • Installation of five mini-grid translating into 4kW off-grid solar PV systems. • Additional twenty mini-grid sites have been commissioned. It translates into 0.36MW of mini-grid installed, which serves communities of 6,350 people. Replacement of kerosene lamps with solar lamps • Distributed 135,000 solar lanterns distributed nationwide
Impacts	GHG impacts • 77.5 kt/CO_2e/year since 2012. • 3394.4 kt/CO_2e with large hydro from 2019 Non-GHG impacts • The increased renewable share of the national energy mix by 50MW • Jobs creation in the solar value chain conservatively estimated 343 jobs • 1,068 households have installed SPV corresponding to 0.107 MW of installed capacity. • All installed capacity of 50MW to generate 82.2 GWh of renewable energy per year
Progress indicators	• Capacity of renewable energy installed (MW) • Share of the renewable energy capacity of national installed capacity (%) • Quantity of renewable energy generated and consumed (GWh) • Number of renewable energy installations (No).

Methodology/ Assumptions	• Calculation based on approved CDM methodology (CDM AM0019, AMS-I.A, AMS-I.L) • Grid Emission Factor (combined Margin (CM) solar & wind) – 0.43tCO_2/MWh) • Hourly consumption of kerosene (0.05 litres) • Hours of lantern use (4 hours per day) • Efficiency factors of solar home PV (80%), • Daily insolation (5 hours).

5.1.6.1.3 Energy Efficiency in homes and businesses

Table 18: Scaling up renewable energy technology

Name	Energy Efficiency Improvements in homes and businesses
Type of action	Technology backed regulation and awareness creation
Sector	Energy
Implementors	Ministry of Energy, Energy Commission, Ghana Standards Authority and Millennium Development Authority (MiDA).
GHG	CO_2
Objectives	• Promote energy-efficient appliances and transform the electrical appliance market into an energy-efficient one. • Distribute 12 million LED Bulbs (6 watts, 9 watts and 13 watts) to households, schools, institutions and businesses. • Install 500,000 LED street lights to replace existing high energy-consuming street lights. • Replace inefficient refrigerators, ACs, Light bulbs and fans in selected twenty public buildings to save a total of 2,201,930 kWh/yr • Develop and enforce energy efficiency standards and regulations for twenty more electrical appliances. Revise and upgrade three existing standards for refrigerators, light bulbs and air conditioners. • Creation awareness nationwide and train all security agencies (Military, Police, Fire Service, Prisons, Immigration and Customs) in energy efficiency and conservation. • Distribute at least 4,000 energy efficiency and conservation educational materials yearly. • Training of Energy Managers in Government institutions and agencies • Prohibit through regulations the importation and sale of used refrigerators, air conditioners and incandescent bulbs
Description	The key components of the energy efficiency and conservation action are: • **Distribution of LED bulbs to consumers** - under a nationwide Government free LED bulb distribution programme. • **Installation of LED street lights** - under an ongoing Government and Millennium Development Authority (MiDA) Energy Efficiency and Demand Side Management Project (Ghana Power Compact) LED street lighting programme. • **Replacement of inefficient appliances with efficient ones in selected public buildings/institutions** – Under a MiDA Energy Efficiency and Demand-side Management Project (Ghana Power project), which involves retrofitting of

	inefficient systems, particularly, lighting, air-conditioning, refrigeration, fans and installation of Real-Time Energy Monitoring System (RTEMS) for monitoring in selected government and (PSU) buildings (Hospitals, Polyclinics Ministries, Universities). • **Expand and update the energy efficiency appliance application (APP) and database** with data on efficient refrigerators, air conditioners and lighting bulbs to enable consumers to verify certified energy-efficient appliances and identify retail shops for energy-efficient appliances. • **Development of Energy Efficiency Standards and Regulations** – Development of standards and regulations for Twenty (20) more commonly used electrical appliances (TV sets, ceiling fans etc.) to improve energy use efficiencies. • **Consumer awareness creation and training in energy efficiency and conservation** through TV adverts, jingles, radio interviews/discussions, posters and flyers. In addition to this public awareness and campaigns, the Commission also holds energy efficiency and conservation training workshops for identifiable consumer groups. The training workshops are held to equip consumers with energy efficiency and conservation benefits and adopt measures to improve their energy use efficiency.
Period	2016 to date (ongoing)
Steps taken or envisaged to achieve the action	• **Distribution of LED bulbs to consumers** - 12 million LED bulbs imported for free distribution by the Government. The government officially launched the programme in March 2020 and a distribution mechanism by the Ministry of Energy. Consignments of the LED bulbs are being dispatched to all the target beneficiaries, including the security agencies, communities and institutions. The community distribution of the bulbs is being spearheaded by Municipal and District Chief Executives (MCEs and DCEs). It is envisaged that the quantities to be given for community distribution will be 50,000 pieces for the Metropolitan area, 40,000 for the Municipal area and 30,000 for districts. In collaboration with the Ministry of Energy, Energy Commission monitors and compiles data on the free distribution of the bulbs to estimate the impacts in terms of energy and emission savings. • **Installation of LED Street lights** – Ministry of Energy and the MiDA have initiated measures to install several thousands of LED street lights in towns, cities and communities. Feasibility studies have been undertaken, and MIDA has placed an order to supply the bulbs for installation. A Government-led initiative involves the free distribution of LED streetlights to communities and replacing high consuming streetlights with energy-efficient LEDs. • **Replacement of inefficient appliances with efficient ones in selected public buildings/institutions** – Investment grade energy audits undertaken in thirteen Government and PSU buildings. Implement measures like retrofitting lighting systems, air conditioning systems, refrigerators, fans, etc., and installing a real-time energy monitoring system in twelve buildings.

	• **Expand and update the energy efficiency appliance application (APP)** and database – Systems for market surveillance and data collection, analysis and archiving put in place. A dedicated team has also been established to undertake these activities to ensure the system's effective functioning. Awareness creation and sensitisation on the database and APP ongoing. Measures are being put in place to expand the database and the APP to include more regulated appliances. An IOS version of the Certified Appliance APP is being developed to expand access. • **Development and enforcement of Energy Efficiency Standards and Regulations** – Over twenty new electrical appliances were identified to develop new energy efficiency standards and regulations. Technical committee consisting of experts from the Energy Commission, Ghana Standards Authority and key stakeholders put in place and developed new standards and regulations for the selected appliances ongoing and far advanced. Revision and upgrade of two existing standards for refrigerators and air conditioners have been undertaken to increase the energy efficiency thresholds. Work ongoing to install the air condition test facility at Ghana Standards Authority (GSA) in addition to the existing test facilities for refrigerators and lighting bulbs. The test facility will ensure that appliances meet a Minimum Efficiency Performance Standard (MEPS) and contribute to the efficient use of electricity. The Law banning the importation and sale of used appliances is also being revised and upgraded to include more appliances and accessories apart from refrigerators, air conditioners and incandescent bulbs. Enforcement of the regulations on lighting bulbs, refrigerators and air conditioners are being undertaken at the country's ports of entry. Importers of these regulated appliances must submit a test report for verification and approval before importation can go ahead. • **Consumer awareness creation and energy efficiency and conservation training** – Public awareness creation and training systems and dedicated team established for energy efficiency and conservation. Awareness creation and training in energy efficiency and conservation are now yearly activities undertaken by the Energy Commission. Thousands of educational materials were developed and printed for free distribution to consumers. Documentaries and jingles on energy efficiency and conservation developed for airing on radio and TV.
Results Achieved	• **Distribution of LED bulbs to consumers** - So far, a total of 12 million consisting of 6 watts (6 million), 9 watts (3 million) and 13 watts (3 million) has been distributed to security agencies, institutions and communities. • **Installation of LED Street lights** – A total of 367,348 LED streetlights have been installed in cities, towns and communities to give better illumination at night and reduce the power consumption and cost of street lighting.

	• **Replacement of inefficient appliances with efficient ones in selected public buildings/institutions** – energy-efficient appliances (air conditioners, refrigerators, ceiling fans and LED bulbs installed in six (6) public buildings to save 30% of total energy cost. • **Expand and update the energy efficiency appliance application (APP) and database –** Database on energy-efficient refrigerators, air conditioners and lighting bulbs established and updated. The associated certified appliance application (App) expanded to include data on lighting bulbs (LEDs and CFLs) and is available for free downloads by consumers. The App has so far recorded over 10,000 downloads. • **Development of Energy Efficiency Standards and Regulations** – Completed the development of standards for 20 for Electrical Appliances (i.e. Microwave Washing Machine, Computer, Electric Motor and Standing Fan). Legislative Instruments are being developed to give legal backing to the 20 standards to make them enforceable. Secured funds for the US$1.5 million air conditioner test containment building and the testing laboratory at the Ghana Standards Authority. • **Consumer awareness creation and training in energy efficiency and conservation** – A total of 2,785 military officers were trained in energy efficiency and conservation during the first phase of this exercise in 2018. In 2019 and the early part of 2020, the second phase of the training focused on the officers of the Ghana Police Service and successfully trained 1,800 officers nationwide. • **In addition, 102 trainee nurses were also trained in early 2020**. During 2018 - 2020, over 4,000 leaflets/brochures were distributed, 180 jingles and eight (8) adverts were aired on energy efficiency and the certified appliance App. • Furthermore, under a GIZ Energy Efficiency for Households and SMEs project, a total of 280 Energy Efficiency Advisors (EEAs) (43% female), mainly from the Universities and Polytechnics, were recruited and trained in energy efficiency conservation measures from 2017-2019. Under the same project, 16,142 beneficiaries (8,500 households and 7,642 SMEs) were introduced to household energy efficiency best practices in three selected cities in Ghana.
Impacts	GHG impacts • 1,367.5/ktCO_2e/year since 2016 to date. Non-GHG impacts • Increased investment: investing US$ 49.41 million in energy efficiency measures. • **Reduced energy cost**: reduced power consumption means lower households expenditure and running costs of businesses. Products and services of businesses such as MSMEs become more competitive on the

	market and profitable. Household's experience reduced financial burden, especially in low-income households with high energy bills • **Improvement of energy security**: reducing energy consumption and, consequently, demand reduces the strong reliance on imported energy.
Progress indicators	• Number of inefficient appliances replaced (No) • Energy and cost savings achieved (US$/kWH) • Number of buildings retrofitted (No) • Number of people trained (No)
Methodology/ Assumptions	• Methodology as based on WRI GHG project protocol • The assumption in the methodological calculation included the following: Distribution of LED bulbs ▪ All 12 million bulbs are being since it is a lighting retrofit programme. ▪ 6-Watts LED will replace 9 Watts CFL for indoor lighting usage: 6 hours per day ▪ 9 Watts LED will replace 13 Watts CFL for indoor lighting (usage: 6 hours per day) ▪ 13 Watts will replace 15 Watts CFL for outdoor lighting (usage: 12 hours per day) Installation of LED Street lights ▪ Hours of usage of streetlights (6 pm - 6 am each day) is equivalent to 12hrs ▪ 150W LED will replace the 250W sodium bulbs The grid emission factor of 0.47 tCO_2/MWh.

5.1.6.1.4 Promotion of clean cooking solutions

Table 19: Clean cooking solutions

Name	Promotion of clean cooking solutions
Type of action	Improved cookstoves and clean cooking fuels, regulation and capacity development
Sector	Energy
Implementors	• **Ministry of Energy** - Sets the policy direction for the clean cooking sector. • **Energy Commission** – Develops regulations for biomass cookstoves and woodfuel sector; promoting efficient end-use devices and sustainable use of woodfuel resources. • **National Petroleum Authority** - Implementation of the National LPG Promotion Policy.
GHG	CO_2, CH_4 and N_2O
Objectives	• Improve access to LPG for cooking • Improve access to energy-efficient and improved cookstoves by woodfuel users Translating into 50% of residential, commercial and industrial users adopts LPG as the primary fuel for cooking and heating by 2030; 1,000 institutional stoves distributed in public and commercial institutions by 2020 and 23,000,000 improved biomass stoves adopted by households 2030.
Description	The mitigation action aims to promote and adopt clean cooking solutions in households, commerce, and service sectors. It has two main components, and these are: LPG promotion programme, and access to energy-efficient and improved cookstoves by wood-fuel users. **Component 1 (LPG Promotion Programme)** • Rural LPG Promotion Programme (RLPGPP) • Migration to cylinder recirculation model of distribution (CRM) **Component 2 (Access to energy-efficient and improve cookstove for wood fuel users)** • Development of standards and regulations • Promotion of energy efficiency biomass cookstoves
Period	2013 to 2030 (ongoing)
Steps taken or envisaged to achieve the action	**Component 1** • Public education on the safe use of LPG and the Cylinder Recirculation Model (CRM) of LPG distribution. • Implementation of a National LPG Promotion Policy. • Redirected subsidy on LPG to finance LPG access by rural communities. • Pilot implementation of the CRM in selected districts in 2020. • National roll-out of the CRM based on learnings from the pilot.

	• Implement a price build-up to cover the CRM investment cost. • Four districts have been identified for Phase 1 of the pilot of the CRM of LPG distribution. **Component 2** • Increased public awareness on the benefit of improved biomass cookstoves. • Institutionalised the collection of data on the adoption of improved cookstoves • Conducted baseline studies on the technical performance of biomass stoves on the Ghana market. • Facilitated partnerships between development partners, non-governmental organisations and stove producers to implement subsidy schemes to drive the adoption of improved institutional biomass stoves for agro-processing activities. • Developed and published national standards for biomass cookstoves. • Developed a labelling scheme for improved biomass cookstoves. • Established two test centres at the Technology Consultancy Centre of KNUST and CSIR Institute of Industrial Research to test the technical performance (thermal efficiency and emissions levels) of stoves. • Facilitated access to financing to enable manufacturers to increase their production capacity. • Promoting the establishment of woodlots in Senior High Schools as a sustainable source of cooking energy. • Enact and implement a performance labelling scheme for improved biomass cookstoves. • Implement Ghana-Korea CDM project to increase adoption of improved biomass cookstoves by 500,000 households. • Develop and implement a National Clean Cooking Strategy document. • Mobilise more investments to drive the adoption of clean cooking solutions.
Results Achieved	**Component 1 (LPG Promotion Programme)** • Under the Rural LPG Promotion Programme, 151,500 households have been reached with 151,500 cylinders and 132,800 stoves and accessories at the end of 2019. • Increased awareness on the benefits of LPG use and the negative impacts of using wood fuel in inefficient stoves. • Extensive regional and national stakeholder consultations were held on the CRM. • Under the CRM, three companies have been issued a license to build and operate an LPG bottle plant. • No new cylinder exchange points have been established as a result of the CRM pilot. Existing outlets are doubling as filling and exchange points for the CRM pilot. **Component 2 (Access to energy-efficient and improved cookstove for wood fuel users)** • About 14,432 improved institutional biomass (charcoal, firewood, palm kernel and pellet) stoves for general cooking, agro-processing and fish smoking have

	been disseminated under different donor and private sector-led interventions from 2012-2019. • About 1,910,417 million domestic biomass (charcoal, firewood, and pellet) stoves have been disseminated from 2012-2019. • ISO standards for clean cookstoves and clean cooking solutions were adopted as national standards for Ghana in 2019. • Labelling scheme for improved biomass cookstoves developed, draft regulations have undergone stakeholder engagements awaiting final validation. • Regulations for the woodfuel sector has been developed. Several district level engagements have been held on the draft regulations to educate key actors in the woodfuel value chain, get their inputs and mobilise support for the proposed regulations. • Over 120 hectares of acacia woodlot have been established in Senior High Schools nationwide from 2014 to 2019. • Data collection on the use of improved biomass cookstoves by households has been institutionalised and captured in the Ghana Living Standard Survey 7 report.
Impacts	GHG impacts • Component 1: 256.3 $ktCO_2e$/year • Component 2: 4036.4 $ktCO_2e$/year • Total: 4 292.7 $ktCO_2e$/year Non-GHG impacts • Created 3,836 jobs (permanent and casual) across the LPG and biomass cookstove supply chain • Require US$ 57.5 million to achieve the mitigation outcomes
Progress indicators	• The number of types of improved cookstoves sold or distributed and in use (No). • Percentage of households using LPG fuel for cooking.
Methodology/ Assumptions	• Methodology as based on Methodology AMS-II G • The assumption in the methodological calculation included the following: ▪ Fraction of non-renewable biomass (ranged 25.2% to 31.1%) ▪ Efficiency of improved cookstove (20%) ▪ Carbon content of wood (2.6 tC/yr)

5.1.6.1.5 Recovery of natural gas from three oil and gas fields

Table 20: Natural gas recovery from three oil and gas fields

Name	Recovery of associated and non-associated gas from three oil and gas fields
Type of action	Recovery of associated and non-associated natural gas from oil fields that would otherwise be flared or vented
Sector	Energy and Environment
Implementing entities	Petroleum Commission, Ghana National Gas Company, Environmental Protection Agency, Jubilee Partners, ENI
GHG	CH_4
Objectives	Recover associated and non-associated gas from the three oil fields for Ghana National Gas Company to produce downstream products (Lean Natural Gas thermal power generation, LPG and Condensate).
Description	The mitigation action resulted from Government policy to expand the domestic gas market and led to the investment in national gas infrastructure to facilitate the harnessing and processing of natural gas. The measure is part of the restricted flaring policy outlined in Section 33 of the Petroleum (Exploration and Production) Act 919, 2016.
Period	2014 to date
Steps taken or envisaged to achieve the action	• Commissioned ENI's integrated Oil and non-Associated Gas (NAG) Offshore Cape Three Points fields in 201713. • Ghana plans to establish a second gas processing plant north of the Atuabo Gas plant by 2024 to uptake and process more gas. • Enacted the Petroleum (Exploration and Production) Act 919, 2016. • Ghana is set to establish sub-Saharan Africa's first liquefied natural gas-to-power project as it moves to position itself as a hub for the cleaner and cheaper fuel in the region.
Results Achieved	• Investment of $1billion in Gas Processing Plant managed by the Ghana National Gas Company (GNGC). • Adopted national legislation (Act 919, 2016) to restrict normal and emergency flaring. • The share of natural gas flared of the total gas production in all three fields has decreased from 44% to 4% in 2011-2019. • Gas lift to GNGC processing has increased by 27% from 1,910.1 MMscf from 2014 to 53,932.6 MMscf in 2019
Impacts	GHG impacts • 8,683.58 kt C/yr. since 2014 Non-GHG impacts • Avoided 384 MMscf per day of natural gas flare • Invested over US$ 1 billion in the downstream gas market
Progress indicators	• Amount of natural gas recovered for utilisation (MMscf) • Share of natural recovered of the total gas production (%)
Methodology/ Assumption	• Methodology as based on approved CDM Methodology AM0009 version 4

[13] https://www.eni.com/assets/documents/eni-ghana2017.pdf

5.1.6.2 Forestry sector

The National Forest and Wildlife policy includes the forest sector's GHG mitigation strategy and aims to conserve and sustain forest and wildlife resources. The policy is operationalised through Forest Plantation Development Strategy (FPDS), REDD+ Strategy (RS) and the Forest Development Masterplan. Generally, the FPD seeks to increase forest cover and restore degraded lands, whereas the REDD+ strategy addresses the key drivers of deforestation and forest degradation in cocoa, shea, and mangrove landscapes. Some of the specific collaborative initiatives underway nation-wide include:

- Ghana Forest Investment Programme (GFIP)[14]
- Ghana Cocoa Forest REDD+ Programme (GCFRP)[15]
- Ghana Shea Landscape Emission Reduction Project[16]
- Dedicated Grant Mechanism (DGM)[17]
- Cocoa Forest Initiative (CFI)[18]
- Green Ghana initiative

Ghana submitted its second National Forest Reference Level (FREL) in 2021. After the submission, the UNFCCC secretariat undertook Technical Assessment (TA) on the FREL. In this BUR3, Ghana has presented information on mitigation action related to Forest Plantation Development and REDD+.

5.1.6.2.1 National Forest Plantation Strategy

Table 21 Forest Plantation Development

Name	Ghana Forest Plantation Programme
Type of action	Restoration of degraded forest lands
Sector	Forestry
Implementing entities	Forestry Commission and Private Companies
GHG	CO_2
Objectives	Develop a sustainable timber resource base that will satisfy the future demand for industrial timber and enhance environmental quality, thereby relieving the pressure on the natural forest and increasing forest cover.
Description	The GFPS is a public-private joint initiative that targets restoration of degraded landscape (on and off reserves) and covers the following activities: • Forest Plantation development • Enrichment Planting and • Trees on Farm

[14] http://mlnr.gov.gh/index.php/programs-projects/ghana-forest-investment-program-fip/
[15] http://www.ghanaredddatahub.org/ecozone/details/1/
[16] https://www.greenclimate.fund/project/fp137
[17] https://www.dgmglobal.org/ghana
[18] https://www.worldcocoafoundation.org/initiative/cocoa-forests-initiative/

	The establishment and management of planted forests are implemented through the following models: • Modified Taungya system (MTS) • Community Forest Management Project (CFMP) • Government Plantation Development Programme (GPDP) • Private developers on-reserve • FSD Plantation • Forest investment programme • Expanded plantation programme • FC/Industry plantations • Large scale off-reserve plantations. GFPS has the following quantitative target: • Establish and manage 625,000 ha of forest plantations. • Enrichment planting of 100,000 ha of poorly-stocked and degraded forest reserve compartments. • Facilitate tree incorporation within farming systems (trees-on-farm), covering 3.75 million (ha) agricultural landscapes.
Period	2002 to date (on-going)
Steps taken or envisaged to achieve the action	• Signed land lease agreement and benefit sharing agreement for commercial plantations and community groups. • Establishment of seed Orchard to provide quality seeds • Seed supplied to selected fringe communities and farmers. • The launched Greening Ghana Initiative in 2021 to continue. • Provision of incentives for private sector investments
Results Achieved	• **Plantation** - Area restored between 2016 and 2019 is 60, 604.7 ha • **Enrichment planting** - Planted 2.15 million forest trees translating into 18,120.3 ha over the period 2016-2019 • **Tree on the farm** – Maintained trees on 351,538.6 ha of farmland for 2016-2019.
Impacts	GHG impacts • 704.7 ktC/yr. since 2002 Non-GHG impacts • 252,857.9 ha tree plantation established under GFPS for the period 2002-2019 • Estimated 2.7 million metric tonnes of food produced from the plantations for 2002-to-date. Between 2017 and 2019, 65, 019.1 metric tonnes of food were produced from the productions • Created 585,706 direct jobs since 2002 to date. For the period 2017-2019, GFPS created 215,706 direct jobs. • Plantation timber production for export for 2017-2019 amounted to 471,535.3 m^3

	• Invested ~ US$ 113 million in Forest Plantation Development between 2017 and 2019
Progress indicators	• Annual area planted (Ha) • Jobs created (No), • Amount of food produced (Mt) • Volume of plantation wood harvested (M^3)
Methodology/ Assumption	• Methodology as based on 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 4 Agriculture, Forestry and Other Land Use. • The assumption in the methodological calculation included the following: ▪ 25-year rotation cycle after first year planting ▪ Annual increment in biomass is unchanged in the 25-year rotation cycle. ▪ The annual biomass increment depends on the degree of permanence determined by the risk posed by pests, fire and intermittent unplanned harvesting. ▪ Biomass stock before plantation (8.7 tonnes dm/ha) and biomass stocks after plantation (92.2 tonnes dm/ha)

5.1.6.2.2 REDD+ in Cocoa and Savannah Landscape

Table 22: Cocoa Forest REDD+

Name	Ghana Cocoa Forest REDD+ Programme
Type of action	Result-based REDD+
Sector	Forestry
Implementing entities	Forestry Commission (FC) and Ghana Cocoa Board (COCOBOD)
GHG	CO_2
Objectives	To significantly reduce carbon emissions resulting from cocoa expansion through forest conversion by promoting appropriate climate-smart cocoa production approaches, including intensification and yield enhancement.
Description	The GCFRP is a government flagship initiative in the promotion of sustainable and climate-smart cocoa production. It seeks to generation 10 million tonnes of carbon emission reduction in six years under World Bank's Forest Carbon Facility Programme. The GCFRP has six pillars around which the interventions and activities are being implemented as follows: • Forest Reserve Restoration and Rehabilitation • Strengthen institutional coordination and MRV • Facilitate landscape planning within Hotpot Intervention Areas • Ensure the implementation of Climate Smart Cocoa • Ensure reduction of Risk and management of Finance • Advocate for Legislative and Policy Reform
Period	2019-2024 (ongoing)
Steps taken or envisaged to achieve the action	Meeting of three conditions precedent for the emission reduction payment agreement with the World Bank as follows: • Benefit-sharing plan finalised and approved by the World Bank; • Signing of a framework agreement with at least 1 Hotspot Intervention Area; • Transfer of title to carbon emission reduction. Additionally, • Hotspot intervention consortium formed. All governance structures within 4 out of the 6 HIAS are in place. • Developed safeguard action plans for the various sub-projects. • Received upfront advance payment of US$ 1.3 million. • Developed a benefit-sharing framework. • Draft manual developed for tree and farmer registration. • 2019-2020 Land use/Landcover map developed. • Preparing first GCFRP's performance monitoring report
Results Achieved	• The signing of the Emission Reduction Payment Agreement • Developed and finalised Benefit Sharing Plan • Received upfront advance payment • Completed the declaration of emission reduction transfer title • Governance Structures developed for 4 of the 6 HIAs
Potential Impacts	GHG potential Impacts • 2.250 million tonnes per year, leading to 10 million tonnes by 2025

	Non-GHG potential impacts • 20,000Ha Trees on Farm annually • 700Ha Enrichment Planting annually • 1,000Ha Modified Taungya Agroforestry System annually • 4,000Ha Avoided deforestation • 6,000Ha Avoided degradation • Double incomes of 126,000 farmers from $6.52/ha to $13.04ha • Invested US$ 234 Million to support climate-smart cocoa production
Progress indicators	• Avoided deforestation area (ha) • Fam yield (kg/ha) • Income levels of farmers ($)
Methodology/ Assumption	The methodology is based on the Methods and Guidance Document (MDG) developed by the Global Forest Observation Initiative (GFOI) as the FCPF methodological framework. The methodological calculation assumes a conservative estimate of successfully reducing the rate of deforestation over the programme's lifetime, less a 15% risk buffer.

Table 23: Shea Landscape REDD+

Name	Ghana shea landscape emission reduction project
Type of action	Climate finance for Avoided deforestation
Sector	Forestry
Implementing entities	Forestry Commission (FC)
GHG	CO_2
Objectives	Implement landscape measures to reduce and /remove greenhouse emissions in the shea landscape of the Northern Savannah Zone. Funding comes from the Green Climate Fund and other streams of funds from the private sector and the government of Ghana. The aim is to mitigate GHG emissions of 6.1 $MtCO_2e$ over seven-year of the project and further to 25.2 $MtCO_2e$ in a 20-year timeframe through reduced emissions and enhanced removals from productive, sustainable management of savannah forests, shea parklands and forest plantations.
Description	The GSLERP is Ghana's leading effort to stem the increasing threats of deforestation and desertification targeting the Northern Savannah Zone (NSZ). It has four interrelated components implemented through a cross-sectoral, comprehensive and comprehensive approach, driven by communities and women's groups. It will serve as the basis for long term community resource management, sectoral investments, capacity building, training, knowledge sharing, community monitoring and public-private partnerships at the landscape level. The expected results will come from the following: • Restore 200,000ha of off-reserve savannah forests/woodlands and place them under self-financing CREMA. • Restore 100,000 hectares of degraded shea parklands. • Establish 25,500 hectares of modified Taungya system/forest plantation in severely degraded forest reserves. • Implement an integrated monitoring system and strengthen the national REDD+ safeguards and forest monitoring and reporting systems.
Period	2021 – 2028 (On-going)
Steps taken or envisaged to achieve the action	• Green Climate Fund approval of the Ghana shea landscape emission reduction project in August 2020. • Project implementation planning
Results Achieved	• GCF Board fund approved Ghana shea landscape emission reduction project in 2020
Potential Impacts	GHG potential Impacts • 6.135 million tonnes in emission reductions and removals over the first seven years of the project's lifetime • 25.24 million tonnes over 20 years • Non-GHG potential impacts • Expected to introduce US$ 54.5 Million worth of fresh investments in Shea Landscape • Restore 200,000ha of off-reserve savannah forests/woodlands • Restore 100,000 hectares of degraded shea parklands.

	• Establish 25,500 hectares of modified Taungya system/forest plantation in severely degraded forest reserves. • Strengthen the livelihoods and climate resilience of 100,200 people (78,850 women and 21,350 men)
Progress indicators	• Area planted (Ha) • Deforestation rate (%) • People whose livelihood are supported (No)
Methodology/ Assumption	The methodology is based on the 2006 IPCC Guidelines Vol 4 AFOLU Sector.

5.1.6.3 Waste sector

Most city managers in Ghana face major waste management challenges owing to the high population and associated consumption patterns. New sprawling suburbs with no access to roads, social infrastructure, and waste collection services worsen the waste management situation.

In 2019, Ghana produced 5.2 million tonnes of municipal solid waste, representing 7% higher than the 2016 level. The 1999 Environmental Sanitation Policy allowed private sector involvement in waste management to bring efficiency in waste collection, transportation and disposal. Since then, the contributions of Environmental Services Providers have led to increasing the waste collection and disposal rate to 80%. Through various PPP models, the private sector is expanding compost capacity and venturing in the waste to the energy and recycling market. The government has introduced a Sanitation and Pollution Levy on the policy side to help address sanitation in the country. Table 22 present the overview of compost as a mitigation action in Ghana.

Table 24: Compost as a biological treatment system of municipal solid waste

Name	Compost and recycling plants
Type of action	Avoided methane emissions through composting of Municipal Solid Waste (MSW)
Sector	Waste
Implementors	Ministry of Sanitation and Water Resources District Assemblies Zoomlion Ghana Limited Ministry of Environment, Science, Technology and Innovation, Environmental Protection Agency
GHG	CH_4
Objectives	• Install compost recycling plants in all 16 regions of the country with various capacities depending on the MSW generated in the region (capacities various from 1,200 tonnes to 300 tonnes). • Divert the 40- 60% organic component/ stream of MSW from the landfill sites to the various compost plants. • Produce and encourage the use of pure organic compost fertiliser for agricultural use.
Description	The mitigation action is a joint effort between the District Assemblies and private businesses. The businesses have established compost facilities that receive municipal solid waste from the waste operators at an agreed tipping fee. The compost produced is sold as fertiliser mainly in the agricultural business. Ministry of Sanitation and Water Resources provides policy incentives to drive compost market development. Drive down the operating cost of compost plants by streamlining the tipping fee regime, promoting sorting at source and promoting local manufacture of compost machinery.
Period	2013 to date (ongoing)
Steps taken or envisaged to	• Introduced Sanitation and Pollution Levy. • Three compost plants have been built in Accra and Kumasi.

achieve the action	▪ Zoomlion Ghana Limited's Integrated Recycling and Compost Plant (IRECOP) Accra Composting and Recycling plant Design capacity: 600 tons per day of municipal solid waste Cost: $ 20 million Start of Operations: 2012 ▪ Integrated Recycling and Compost Plant Limited (IRECoP) Expansion and retrofitting: $75 million Design Capacity: 400 tons of Municipal solid waste per day Cost: $20 million Start of operations: 2019 ▪ Kumasi Compost and Recycling Plant (KCARP) Capacity: 1200 tons per day of municipal solid waste per day Cost: $ 95 million Start of operations: 2020 There are plans to have one of such facilities in the rest of the regions beginning in 2022. The capacity will depend on the waste availability and may range from about 200-400 tons per day, depending on the area.
Results Achieved	• Introduced a sanitation levy to address sanitation challenges in Ghana. • Established three compost recycling plants with a total capacity of 2,200 tonnes of MSW per day.
Potential Impacts	GHG Impacts • 3,983.5 ktC/yr. since 2012 Non-GHG Impacts • Produce 45,625 tonnes of compost per year • Created some 800 direct and 1,500 indirect jobs • Promotes high crop yields • Invested US$ 135 million in three compost facilities
Progress indicators	• Quantity of MSW processed in compost facilities (Mt/day) • Compost installation capacity (Mt/day) • Quantity of compost produced (tonnes) • Number of jobs created (No)
Methodology/ Assumption	The methodology is based on approved CDM methodology AM0025 ver. 12 - Avoided emissions from organic waste through alternative waste treatment processes. The assumption in the methodological calculation includes • All compost plants operate at full capacity. • All organic components of MSW collected are composted.

5.1.6.4 HFCs Phase-Down in the Refrigeration and Air-Condition sector

Ghana is fulfilling its commitments under the Montreal Protocol on substances that deplete the ozone layer to completely phase-out HCFCs by 2030 by implementing the national ODS phase-out programme and Management of ODS and product regulation, 2005 (LI. 1812) (Government of Ghana 2005a). After ratifying the Kigali Amendment in August 2019, the focus is on phasing out HFCs by introducing an alternative technology. In terms of institutional arrangement, EPA's National Ozone Unit Carries out GHG inventories for the RAC Sector while Energy Commission (EC) operate a Mandatory Appliance Standards and Labelling regime designed to ensure that only appliances that meet MEPS enter the market.

Act 917 (which is implemented by the LI 2250 (Government of Ghana 2016) includes extended producer responsibility (for instance, the levy on appliances to be used for their proper dismantling and disposal of equipment). The Act includes both ACs and domestic refrigerators. The EPA hosts the National Ozone Unit and implements the HFC Phase-out Management Plan (HPMP). Under the HPMP, the EPA started training technicians from well-established air-conditioning installation workshops to convert existing R22 based air-conditioning units to run on Hydrocarbon R290. In 2019, the EPA hosted a week-long sub-regional training workshop of national ozone officers from the Western, Eastern, Northern and Southern regions of the Africa Anglophone Network in Accra. The implementation of the HPMP could save 80 kilotonnes of GHG emissions every year.

5.1.6.5 Transport sector

The transport sector mitigation strategy aims to promote low carbon mass transport mobility in the long term. This strategy is anchored on the national transport policy. It focuses on electric mobility (e-mobility), fleet renewal, efficient vehicle inspections, and rail-based transit to realise GHG mitigation outcomes. As part of the fleet renewal efforts, the Ministry of Transport has introduced a facility to put 400 euro-3 high occupancy buses to service to increase mass transport in cities. One hundred buses are in operation, whereas the remaining three hundred buses will start in 2020. The Ministry of Transport also has the policy to improve the vehicle inspection regime to allow private sector participation to bring innovation and efficiency. Table 23 presents the mitigation outcomes of the urban transit mitigation made of Bus Rapid Transit (BRT), fleet, and better inspection measures.

Table 25: Urban transit measures

Name	Urban road transit measures
Type of action	Promote better urban transit through BRT, Fleet Renewal and Inspections
Sector	Transport
Implementors	Ministry of Transport Greater Accra Passenger Transport Executive (GAPTE) Private Vehicle Test Stations (PVTS) Private businesses
Gas	CO_2,CH_4,N_2O
Objectives	• Promote road-based mass transportation system, including extending BRT corridors. • Review and strengthen institutional arrangements governing the mass transit system. • BRT piloting in four corridors: Amasaman-Tudu, Adentan to Accra, Kasoa. • Introduce high occupancy buses and a better vehicle inspection regime.
Description	The National Urban Transport Policy lays a broad policy framework to guide the sector's development. The goal of this action is to: provide high occupancy mass transit buses which will alleviate the acute transportation difficulties facing Ghanaian workers and school children in the metropolis, municipalities, and districts in Accra/Tema Metropolitan area and Kumasi Metropolitan Area; provide safe and reliable public transportation to Ghanaians in the metropolis and municipalities and reduce the rate of avoidable accidents, and promote a shift to an environmentally safe mode of transport and clean technology.
Steps taken or envisaged to achieve the action	• 200 buses provided for the MMTA and STC coaches • Overall, 445 buses were supplied between 2016-2020 (Accra services commenced in 2016 with 145 buses; Kumasi services commenced in 2018 with 60 buses; Takoradi services commenced in 2020 with 20 buses). • Two states of the Art multipurpose BRT terminals were completed at Adentan and Tudu in Accra; 3 standard BRT terminals were completed at Amasaman, Pokuase, Achimota and one bus depot at Achimota; • 1km Dedicated BRT Lane created and gazetted. • Quality Bus Services coordinating bodies/ Operator companies operational in Accra, Kumasi and Takoradi.

	• Feasibility Studies for the introduction of Compressed Natural Gas Buses completed.
Results Achieved	• Develop Regulatory framework for urban transport • Equipped transport Departments in 3 District Assemblies to operate; • Some infrastructure such as bus lanes developed lanes, terminals, depot and buses. • Services - operating companies three established to run a pilot at Anamsaman and KMA for a pilot programme of 60 buses. • 200 buses provided for the MMTA and STC coaches • 445 buses supplied between 2016-2020 (Accra services commenced in 2016 with a total of 145 buses
Potential Impacts	GHG Impacts • 2.1 $ktCO_2e/yr$.
Progress indicators	• Length BRT route (km) • Number high occupancy buses introduced (No)
Methodology/ Assumption	The methodology is based on approved on ACM0016 ver. 2 - Baseline Methodology for Mass Rapid Transit Projects

5.2 Information on International Market Mechanism

5.2.1 CDM and POA Projects

Four projects on composting, oil field flaring reduction, single cycle to combined cycle plant and landfill gas flaring have been approved and registered by the CDM Executive Board (EB). The four CDM projects are expected to generate 3,026 kCER per year in the first crediting period. Project development of additional four CDM projects with potential CERs of 2,541 $ktCO_2e$ has commenced, but the validations have been terminated. Furthermore, Ghana is involved in 43 registered POA CDM projects that have generated 4,973.9 $ktCO_2$/year of CERs in 1st crediting period. Tables 26 and 27 give an overview of CDM Projects and POA in Ghana.

Table 26: List of CDM Projects in Ghana

Project Name	Category	Status	Crediting starts	CERs ($ktCO_2e$/yr) (1st period)	Status
Zoomlion Ghana Ltd Composting of Municipal Solid Waste in Accra area	Composting	Registered	March 2012	69	
Jubilee Oil Field Associated Gas Recovery & Utilisation Project	Oil field flaring reduction	Registered	December, 2014	2,603	10
Project Asona - CCGT – Takoradi - Ghana	Single cycle to combined cycle	Registered	May, 2015	367	10
Oblogo 1 Landfill Gas Recovery and Flaring Project	Landfill flaring	Registered	June 2017	7	10
Large scale oilseed crop cultivation at Yeji in the Pru district, Ghana	Reforestation	Validation terminated	January 2009	2036	20
Saltpond Oil Field Associated Gas Recovery and Utilisation Project	Oil field flaring reduction	Validation terminated	January 2014	84	10
Kpone Thermal Power Project of Volta River Authority, Ghana	New natural gas plant	Validation terminated	January 2014	399	10
Oblogo 1 Landfill Gas Recovery and Flaring Project	Landfill flaring	Replaced validation terminated	January 2014	22	10

Table 27: List of POA in Ghana

Title	Coordinating Entity	Status	PoA-Type	1st period ktCO2/yr
CPA- GA-001-Ghana	Green Development AS	Registered	EE households	111.4
African Improved Cooking Stoves Programme of Activities	Envirofit International	Registered	EE households	649.1
African Improved Cooking Stoves Programme of Activities – CPA No. 00001 (Ghana)	Envirofit International	Registered	EE households	15.5
African Improved Cooking Stoves Programme of Activities – CPA No. 00002 (Ghana)	Envirofit International	Registered	EE households	47.0
African Improved Cooking Stoves Programme of Activities CPA 00003 (Ghana)	Envirofit International	Registered	EE households	47.0
African Improved Cooking Stoves Programme of Activities CPA 00007 (Ghana)	Envirofit International	Registered	EE households	46.6
African Improved Cooking Stoves Programme of Activities CPA 00008 (Ghana)	Envirofit International	Registered	EE households	46.6
African Improved Cooking Stoves Programme of Activities CPA 00009 (Ghana)	Envirofit International	Registered	EE households	46.6
Standard Bank Renewable Energy Programme	Standard Bank	Registered	Hybrid renewables	1.1
Standard Bank Renewable Energy Programme –Solar Bundled CPA in SADA zone	Standard Bank	Registered	Solar	1.1
Standard Bank MSW Composting Programme	Standard Bank	Registered	Methane avoidance	27.9
CPA001 Kumasi Composting Plant at Adagya	Standard Bank	Registered	Methane avoidance	27.9
Landfill gas capture, flaring and utilization program in Africa	Puresphere Limited	Registered	Landfill gas	103.2
CPA-1: Oti Landfill gas capture, flaring and utilization at Kumasi (Ghana)	Puresphere Limited	Registered	Landfill gas	103.2
Clean Cook Stoves in Sub-Saharan Africa by ClimateCare Limited	ClimateCare Limited	Registered	EE households	610.9
CookClean Ghana Limited —CPA01	ClimateCare Limited	Registered	EE households	136.7
CookClean Ghana Limited - CPA02	ClimateCare Limited	Registered	EE households	145.5
20MW Ningo PV Power Generation Project in Ghana	Scatec Solar ASA	Registered	Solar	31.7
Man and Man Enterprise Improved Cooking Stoves CDM Programme in Ghana supported by the Republic of Korea	AERA GROUP	Registered	EE households	165.6

Man and Man Enterprise Improved Cooking Stoves CDM Programme in Ghana supported by Republic of Korea – CPA001	AERA GROUP	Registered	EE households	10.0
Man and Man Enterprise Improved Cooking Stoves CDM Programme in Ghana supported by the Republic of Korea – CPA002	AERA GROUP	Registered	EE households	155.6
Ghana Improved Cookstove Project by EWP in the Republic of Korea	Climate Change Center	Registered	EE households	1221.8
Ghana Improved Cookstove Project by EWP in Republic of Korea – CPA 001	Climate Change Center	Registered	EE households	75.8
Ghana Improved Cookstove Project by EWP in Republic of Korea – CPA 002	Climate Change Center	Registered	EE households	67.4
Ghana Improved Cookstove Project by EWP in Republic of Korea – CPA 003	Climate Change Center	Registered	EE households	68.1
Ghana Improved Cookstove Project by EWP in Republic of Korea – CPA 004	Climate Change Center	Registered	EE households	70.8
Ghana Improved Cookstove Project by EWP in Republic of Korea – CPA 005	Climate Change Center	Registered	EE households	75.8
Ghana Improved Cookstove Project by EWP in Republic of Korea – CPA 006	Climate Change Center	Registered	EE households	71.6
Ghana Improved Cookstove Project by EWP in Republic of Korea – CPA 007	Climate Change Center	Registered	EE households	70.9
Ghana Improved Cookstove Project by EWP in Republic of Korea – CPA 008	Climate Change Center	Registered	EE households	59.2
Ghana Improved Cookstove Project by EWP in Republic of Korea – CPA 009	Climate Change Center	Registered	EE households	68.8
Ghana Improved Cookstove Project by EWP in Republic of Korea – CPA 010	Climate Change Center	Registered	EE households	68.8
Ghana Improved Cookstove Project by EWP in Republic of Korea – CPA 011	Climate Change Center	Registered	EE households	68.8
Ghana Improved Cookstove Project by EWP in Republic of Korea – CPA 012	Climate Change Center	Registered	EE households	79.0
Ghana Improved Cookstove Project by EWP in Republic of Korea – CPA 013	Climate Change Center	Registered	EE households	88.4
Ghana Improved Cookstove Project by EWP in Republic of Korea – CPA 014	Climate Change Center	Registered	EE households	86.5
Ghana Improved Cookstove Project by EWP in Republic of Korea – CPA 015	Climate Change Center	Registered	EE households	79.6
Ghana Improved Cookstove Project by EWP in Republic of Korea – CPA 016	Climate Change Center	Registered	EE households	39.1
Ghana Improved Cookstove Project by EWP in Republic of Korea – CPA 017	Climate Change Center	Registered	EE households	14.7
Ghana Improved Cookstove Project by EWP in Republic of Korea – CPA 018	Climate Change Center	Registered	EE households	36.7
Ghana Improved Cookstove Project by EWP in Republic of Korea – CPA 019	Climate Change Center	Registered	EE households	23.2
Ghana Improved Cookstove Project by EWP in Republic of Korea – CPA 020	Climate Change Center	Registered	EE households	8.6
Climate action with rural households by Climate Future Action Stitching, CPA No.XXX	Climate Future Action Stitching (CFAS)	Registered	EE households	

5.2.2 Participation in Korea Carbon Market

The Ghana Improved Cookstove Project is a Programme of Activity aiming to generate 832,608 CER under CDM standards for the Korea Carbon Market starting 2020. It has a seven-year crediting period renewable twice. The CERs would be achieved through the manufacturing, distribution and use of 500,000 locally made improved cookstoves. The project is at the validation stage[19].

5.2.3 Voluntary Carbon Market

Form Ghana Limited participates in the voluntary carbon market reforestation project under the Verified Carbon Standard (VCS) certification[20]. Form Ghana's reforestation project comprises CO_2 sequestration in tree plantations with various tree species and forest restoration in riparian buffer zones. The project has generated more than 200,000 tons of CO_2 credits by 2018 and will sequestrate over 850,000 tons of CO_2 by the end of 2025.

5.2.2 NAMA Projects

Ghana has developed four NAMA projects in the energy, transport and forestry sectors. The energy project was on "Access to clean energy through the establishment of market-based solution" was prepared under the UNDP Low Emission Capacity Building Project, awaiting funding. Under the FIRM project implemented by UNEP-DTU, Ghana prepared two NAMA projects on BRT and Capacitor Banks for Industry. Additional work on the BRT NAMA is underway before submitting to the Green Climate Fund (GCF). The World Bank has also supported Ghana to prepare sustainable charcoal NAMA. The charcoal NAMA project needs additional funding for technical and financial feasibility assessment.

5.2.3 Carbon Offsetting and Reduction Scheme for International Aviation

Ghana has signed on as a volunteer of the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) in 2018. After signing up to CORSIA, Ghana initiated the following country-level actions:

- Developed Standard and Recommended Practices (SARPs) for CORSIA.
- Ghana Civil Aviation Authority (GCAA) serves as CORSIA's focal point.
- Established internal and external committees involving airlines and fuel agents.
- Reported its first unverified CO_2 emissions for 2019 through the ICAO CORSIA Central Registry (CCR).
- Implemented the following measures:
    - Replaced runway lights from halogen to Light Emitting Diode (LED) to save energy.
    - Shifted from the previous zig-zag type of aircraft landing to the Continuous Climb Operation/Approach (CCOs) and Continuous Descent Operation (CDOs).
    - Constructed two rapid exits point at KIA. Most airlines use the first exit to reduce their taxing and parking time and fuel consumption.

[19] https://cdm.unfccc.int/ProgrammeOfActivities/Validation/DB/3X9KQGLR5Z805BUYQGDSTD55MTX9C4/view.html
[20] https://www.formghana.com/carbon-credits

Africa World Airlines and Air Ghana participate in the CORSIA scheme and are expected to submit an annual emission monitoring report.

5.2.4 Participation in Article 6.2 Pilots

Ghana has taken an early leap into the Article 6 market. It is cooperating under two Article 6.2 pilots involving the Governments of Switzerland and Sweden. Regarding the Article 6.2 pilot with Switzerland, in November 2020, both countries signed a bilateral agreement[21] to pave the way for developing and implementing the National Clean Energy Access Programme (NCEP) to generate Internationally Transferred Mitigation Outcomes (ITMOs). The NCEP may cover mitigation activities in decentralised renewable energy, clean cooking solutions, waste management and agriculture. The development of the pilot cooperation with Sweden is at a nascent stage. Both countries are formulating the rules of engagement for a formal dialogue leading to a bilateral agreement.

5.2.5 Result-based REDD+

In 2019, Ghana signed a landmark deal with World Bank to cut carbon emissions and reduce deforestation. Under the World Bank's Forest Carbon Partnership Facility (FCPF), Ghana is implementing a result-based payment Cocoa REDD+ project to generate 10 million emissions reduction over six years. Ghana's five-year Emission Reductions Payment Agreement (ERPA) with FCPF Carbon Fund, which the World Bank administers, unlocks performance-based payments of up to US$50 million for carbon emission reductions from the forest and land use. Refer to Table 22 for additional details.

5.3 Information on other financial instruments

5.3.1 Green credit line

Agence Française de Développement (AFD) and the Energy Commission (EC) have signed a Technical Assistance Facility (TAF) to support local banks and energy businesses in Ghana. The Sustainable Use of Natural Resources and Energy Finance (SUNREF) programme is one of the most significant green finance projects to be deployed in Ghana. SUNREF programme seeks to provide technical assistance and green credit loans to local financial institutions to finance Ghana's small and medium-scale renewable energy and energy efficiency projects. The SUNREF programme has three pillars: credit lines of up to €30m from AFD disbursed through local banks; Technical Assistance Facility (TAF) of €1.88 million from the European Union Africa Infrastructure Trust Fund (EU-AITF); and an investment grant scheme of €2.4m from the EU-AITF to provide additional incentives to green investments. Ghana officially launched the SUNREF in July 2021, with CAL Bank and Commercial Bank as the lead local bank.

[21] https://www.undp.org/press-releases/switzerland-and-ghana-sign-historic-agreement-climate-action

SUNREF will offer businesses, organisations and households the opportunity to access financing for sustainable energy projects and assistance in structuring green investments. The SUNREF Ghana Programme provides (a) special loan product with very competitive terms; (b) grant portion of up to 10%; and (c) free technical assistance for project implementation. KfW is collaborating with the Ministry of Finance and Economic Planning to establish a green credit line for refinancing Renewable Energy and Energy-Efficient (RE/EE) investments for MSMEs and households in Ghana[22]. On behalf of KfW, IPC designed a potential green credit line structure based on Ghanaian green lending market demand and supply. With seven potential Ghanaian partner financial institutions identified, the Ministry of Finance and KfW again contracted IPC to select three institutions as potential implementing partners for the RE/EE credit line and conduct their detailed institutional assessments.

5.3.2 Green and social bonds

Ghana has initiated a programme to explore green bonds' potential for SDGs and NDC financing in 2019. As part of the programme, the Ministry of Finance began tapping into green and SDG related bonds. MOFEP is planning to issue a US$ 2 billion green and social bond in November 2021. Adaptation and mitigation activities in Ghana's nationally determined contribution maybe be eligible for investment from the share of proceeds from the green and social bonds.

[22] https://www.ipcgmbh.com/projects/due-diligence-ghanaian-financial-institutions-green-credit-line

Chapter 6

Domestic Monitoring Reporting Verification System

6.1 Status of the Domestic Monitoring Reporting and Verification System

6.1 Progress in implementing the Domestic MRV system

Ghana formally commissioned the Climate Ambitious Reporting Program (GCARP) in 2013 to respond to decision 1/CP.16 on the call to establish and operate a domestic MRV system for climate action and support. Ghana's strategy is to use the GCARP effectively to compile, communicate reliable, transparent and comprehensive information on GHG emissions, climate actions (NDC and adaptation) and support under the existing international MRV arrangement and beyond (respond to Decision 18/CMA.1 (MPG for Article 13). Over the years, proper data management and institutional reforms have strengthened the GCARP. Some of the key reforms resulting from the GCARP since its establishment in 2013 are:

- The initial ad-hoc institutional arrangement was decentralised to selected line ministries and agencies[23]. EPA signed a Memorandum of Understanding (MOU) with lead government institutions to govern the smooth workflow of climate reporting among the actors.
- Establishment of an online database to host and facilitate data harmonisation, sharing and archiving. The database has four portals; GHG inventory, climate policies and measures, mitigation project registry, the NDCs and GCF project. The database's current challenges are irregular content updates, high license and maintenance fees, and low visits to the hub. As a result, the database is not active online. The CBIT project will revive the database by re-designing the interface and run on an open-source application.
- Ghana has developed a mitigation action data template to collect data regularly to prepare the greenhouse gas inventory estimates and mitigation actions.
- The efforts on continuous training, skills improvements and development of tools and methods have also progressed relatively well
- The capacity development initiatives contributing to improving skills and knowledge in the MRV include training received from the UNFCCC, the Low Emission Capacity Building Project, Information Matters Project (IM Project), the CD-REDD project and CBIT Project.
- Development of a GHG manual, quality assurance/ Quality Control (QA/QC), and uncertainty management guidance.

Despite the reforms, the full implementation of the GCARP has not reached desirable levels. That is why Ghana's CBIT project seeks to address some of the persistent institutional and capacity challenges that impede the implementation.

[23] Including: Forestry Commission, Forestry Commission, Ministry of Food and Agriculture, EPA (Built Environment), EPA (Manufacturing Industry) and EPA (Petroleum)

6.2 Progress and achievements in the Domestic MRV since BUR2

Below are the highlights of the key achievements in the operationalisation of Ghana's domestic MRV system since 2016:

Tracking NDC progress

- The National Development Planning Commission and the EPA developed indicators to track the progress of NDC at the national and sectoral levels. Additionally, they have prepared an NDC indicator tracking template that the line ministries use for data collection and reporting progress (Annex 3).

- The EPA has developed an NDC accounting tool for anthropogenic GHG emission inconsistent with the Guidance for accounting for Parties' nationally determined contributions, referred to in decision 1/CP.21, paragraph 31. The tool will enable Ghana to regularly prepare, communicate and account for its nationally determined contributions under the Paris Agreement. EPA has tested the tool and is now revising it to address the changes in the revised NDC. The next step is to conduct extensive training on the tool and help the line ministries set up the system for regular data collection input. Ghana EPA manages the NDC accounting and will sectoral representatives as contact points (Annex 4)

Adaptation reporting

Ghana is preparing its National Adaptation Plan (NAP) with financial support from GCF through UN Environment. Under the NAP, Ghana is establishing an adaptation database to support and process data for effective communication.

Adaptation communication

Ghana is preparing an Adaptation Communication (ADCOM) to inform synthesis reporting for the Global Stocktake (GST) under the Paris Agreement ahead 26th UN Climate Change Conference of the Parties (COP26). The ADCOM will enhance the visibility and profile of adaptation in Ghana; provide input to the GST; strengthen adaptation action and support, and enhance learning and understanding of adaptation needs and actions.

Tracking of Climate Finance

The Ministry of Finance and Economic Planning leads Ghana climate finance tracking. The Ministry has developed three sets of climate change finance tools to track the country's financial resources generated for climate change actions or external sources.

- The first tool (Climate finance tracking tool) was designed to track climate relevance expenditure using the national budget codes to isolate climate-relevant public expenditure on climate change and international inflows.
- The second tool (MRV of finance guidance manual) was also developed to track Ghana's climate finance, verify completeness of data and help demonstrate transparency of support and climate action.

- The third tool (Climate Change Finance Tracking tool (CLIMFINTRACK) updates the existing tracking tools to reflect the new policy, programme areas and budget codes to help capture relevant end-of-year outturn climate-relevant expenditures. The manual is firmly based on the existing policy planning and public financial management system in Ghana. The CLIMFINTRACK is a tracking tool that offers users within the Public Sector domain to track finance on climate change-related activities in real-time, direct to their PCs, mobile phone or handheld device. It is a Microsoft Excel-based tool developed via Oracle Smart View for Office and provides a common Microsoft Office interface. With CLIMFINTRACK, users can view, import, manipulate, distribute and share data on Ghana Government's budget on climate change activities. The ability of CLIMFINTRACK to track the Ghana Government's budget is based on the codes used in the chart of accounts.

- Integrated MRV of Finance - The Finance tool is an integrated tool that seeks to provide a dashboard for tracking climate-specific funds, international financing inflows and national climate-relevant budget and expenditures.

GHG Inventory

- Foundational Platform for REDD+ FREL – To support the regular preparation of the REDD+ FREL, the Forestry Commission has developed a Foundational Platform. The Foundational Platform is a calculation spreadsheet based on the 2006 IPCC GHG inventory guidelines and the 2019 IPCC Refinements of the 2006 Guidelines. The platform includes all relevant national data and IPCC equations; also, displaying information by IPCC land-use classes (Forest land, Grasslands, etc.). This tool allows to explicitly show all steps in producing the final GHG inventory/ Forest Reference Level or MRV. The tool was used to compile Ghana's second FREL to the UNFCCC (Annex 5).

- The Forestry Commission has started work to establish a forest monitoring system to improve the forest monitoring capacities. As part of this initiative, the Forestry Commission has developed 12 standard operating procedures (SOPs) to guide the setting up of forest reference levels and FOLU GHG inventory. It has contracted a consultant to develop the national forest management system.

- Incorporated GHG inventory data requirement into the Annual Environmental Report Template for the industry

Chapter 7

Information on Support Received; Constraints and Gaps, and Related Financial, Technical and Capacity Needs

7.1 Information on Support Received

7.1.1 Tracking climate finance inflows

Accessing adequate and predictable climate finance is a catalyst for ambitious climate action. That is why despite its increasing fiscal constraints, even after COVID-19, Ghana continues to make strides to mobilise financial and technical resources across multiple sources (Government, International and private sector) to finance its climate change agenda. Therefore, it is important to know the levels of climate support inflows, the recipient sector and scope, and the needs. In BUR2, Ghana reported results from annual surveys for tracking climate finance and further indicated the Ministry of Finance (MOF) plans to use the Government Budget Database to track domestic and international climate finance inflows. Since then, MOF started tracking climate finance with its Climate Finance Tracking Tool (CLIMFINTRACK).

In the BUR3, data available from the OECD/DAC, EPA Annual Climate Finance Survey and Climate change finance tracking tool (CLIMFINTRACK) have been used to ensure completeness of climate finance information. The OECD/DAC and EPA Annual survey data were on international climate finance inflows, whereas the data from the CLIMFINTRACK was mainly for tracking domestic climate finance from the national budget. Information on international climate inflows in the CLIMFINTRACK was excluded from the analysis to avoid double-counting. The OECD/DAC and EPA dataset complemented each other because the data missing from the OECD/DAC database was filled with EPA surveys.

In this BUR, updates on funding and monetised inflows for the period 2015 to 2020 covering international and national climate flows. Financial inflows are reported in Ghana Cedi (GH₵) and US Dollar (US$) dominations. Non-US dollar-denominated flows have been converted to US$ using the December exchange rate for each year. Projects that started in 2011 and are still active have been included in the analysis. Those projects that began and ended before 2011 have been excluded from the list. Projects that may have a global or regional scope or are meant for several countries and the specific budget for Ghana are unknown are included for an anecdotal purpose.

We have reported information on "**committed funds**" for the active projects because information on expenditures and their corresponding outputs are unavailable and may take more time to collate. Note that there may be a significant variation on amounts "committed", "disbursed", and "released", depending on the reporting period. All the results are presented without the loans except unless stated. Financial flows are considered and reported as non-ODA.

The categorisation of projects in the OECD/DAC and the EPA dataset follows the Rio marker indicators (climate, adaptation and mitigation outcomes) as principal, significant, and not targets. A "significant" marker would indicate climate or adaptation and mitigation objectives are explicitly stated but not the fundamental driver or motivation for undertaking and designing the activity. Whereas a "principal" marker shows that the objectives are explicitly stated as fundamental in the design of, or the motivation for, the project. The EPA dataset was collected through a national survey and information published on the web pages of donor and recipient institutions. The information has been collected at the project level. All projects without adequate information and worth less than $10,000 are excluded because they do not meet basic analysis requirements and avoid double counting.

For the CLIMFINTRACK, the domestic climate finance budget or expenditure lines are based on the national budget code and the definition of keywords in the National Climate Change Policy. Climate change expenditure or budget can search according to the budget code and the corresponding keyword by policy theme in the database. The policy theme covers the following areas: Across sectors; Agriculture and Food Security; Infrastructure; Disaster Preparedness; Forests and Carbon sinks; Ecosystem Management; Climate Change and Health; Climate change and gender; Climate change and migration; energy and infrastructural development. Furthermore, the CLIMFINTRACK also incorporate climate relevance (High, Medium and Low) scores in the unique tracking codes.

7.1.2 Tracking climate finance results

7.1.2.1 International climate finance commitments

The OECD/DAC and the EPA annual survey capture information on climate financial commitments for six hundred projects (600) with a value of US$ 8.82 billion between 2015 and 2020. When ENI/Vitol's financial investments into the Natural Gas Field Development was excluded from the calculations, the total financial commitments for the period amounted to US$1.54 billion over the same period. It is important to highlight the contribution of this investment to decarbonising the electricity sector as it contributes to the achievement of the mitigation commitment in the nationally determined contribution of replacing crude oil with natural gas for thermal electricity generation. Henceforth, the results have been presented without ENI/Vitol investment in national gas field development.

The financial commitments were in the forms of grants, debt instruments, equity and a mix of loans, co-financing and grants or equity. Grants and debt instruments are the main types of financial tools used by financial providers. They respectively account for 56% and 38% of the total financial commitment for the reporting period. The mixed instruments have also been by the financial providers. About 4%(U$ 54.5 million) of the total financial commitment to climate-related projects were in the form of grant and co-financing. It is followed by a mix of loans, grants and co-financing, making up 2% (US$ 35 million) of the total financial commitments.

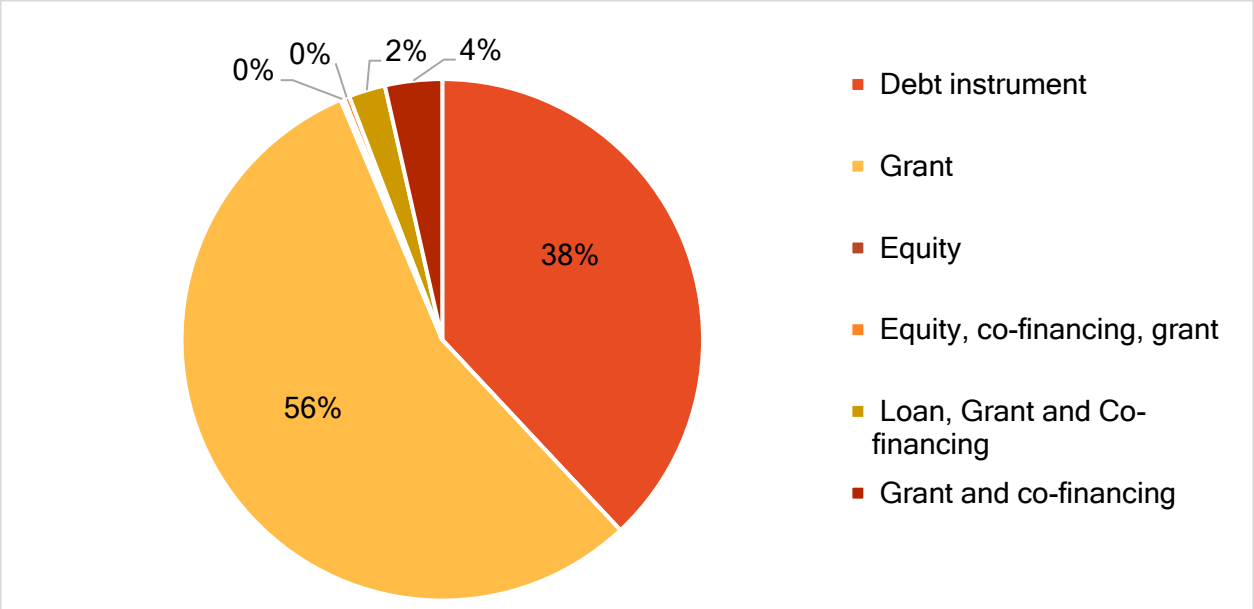

Figure 9: International financial commitment to climate change projects for 2015-2020

Table 28 further reports the financial instruments used by the financial providers per the climate objectives. The table highlights the predominance use of grant instruments for the projects with principal and significant climate objectives. Grant instrument accounted for 72% and 84% of the project under the principal and significant Rio marker indicators. Under the project with climate components, the financial providers mainly use debt instruments (99.5%).

Table 28: Breakdown of financial commitment by climate objectives and financial instruments

Climate objectives and financial instruments	Financial resources committed (US$ 000)			
	Adaptation	Adaptation/mitigation	Mitigation	Total
Climate components	323,670.5	-	117,225.3	440,895.9
Debt instrument	322,597.8	-	116,175.3	438,773.1
Grant	1,072.7	-	1,050.0	2,122.7
Principal	63,729.2	234,302.9	276,213.4	574,245.6
Debt instrument	-	10,422.6	51,927.0	62,349.6
Equity	-	-	3,571.4	3,571.4
Equity, co-financing, grant	5,200.0	-	-	5,200.0
Grant	23,529.2	223,880.3	166,214.9	413,624.5
Grant, Co-financing	-	-	54,500	54,500
Loan, Grant and Co-financing	35,000	-	-	35,000
Significant	143,806.4	71,477.9	309,872.9	525,157.3
Debt instrument	16,388.0	-	68,237.9	84,625.9
Grant	127,418.4	71,477.9	241,635.1	440,531.5
Grand Total	531,206.2	305,780.9	703,311.6	1,540,298.8

The breakdown of the US$ 1.54 billion financial commitments shows that 46% went into mitigation projects and while the rest were for adaptation (34%) and mitigation/adaptation (20%) projects. Table 29 shows a relatively even distribution of the development finance commitment to projects with three climate objectives. Out of the 599 projects, 191 with the financial commitment value of US$ 574 million were in the climate principal's marker category. There were 351 projects in the significant climate marker category with a financial commitment of US$ 525 and additional 57 projects with climate components amounting to US$ 440.

Table 29: International climate finance commitment (2015-2019)

Climate Objectives	Financial resources committed (US$ 000)				
	Climate components	Principal	Significant	Grand Total	Share(%)
Adaptation	323,670.5	63,729.2	143,806.4	531,206.2	34.5
Mitigation	117,225.3	276,213.4	309,872.9	703,311.6	45.7
Adaptation/mitigation		234,302.9	71,477.9	305,780.9	19.9
Grand total	440,895.8	574,245.6	525,157.3	1,540,298.8	100
Share (%)	28.6	37.3	34.1	100	

For the projects with principal climate objectives, the results showed that the financial commitment increased by 162% between 2015 and 2020 (Figure 10). The financial commitments rose from US$ 23.5 million in 2015, peaked in 2017 with US$ 183 million and declined to US$ 62 million in 2020. In the same vein, the breakdown of the projects with principal climate objectives further revealed a relatively even distribution of financial commitment between mitigation projects (48%) and adaptation/mitigation (41%) projects for 2015-2020. Adaptation projects received 11% of the financial commitments over the same period.

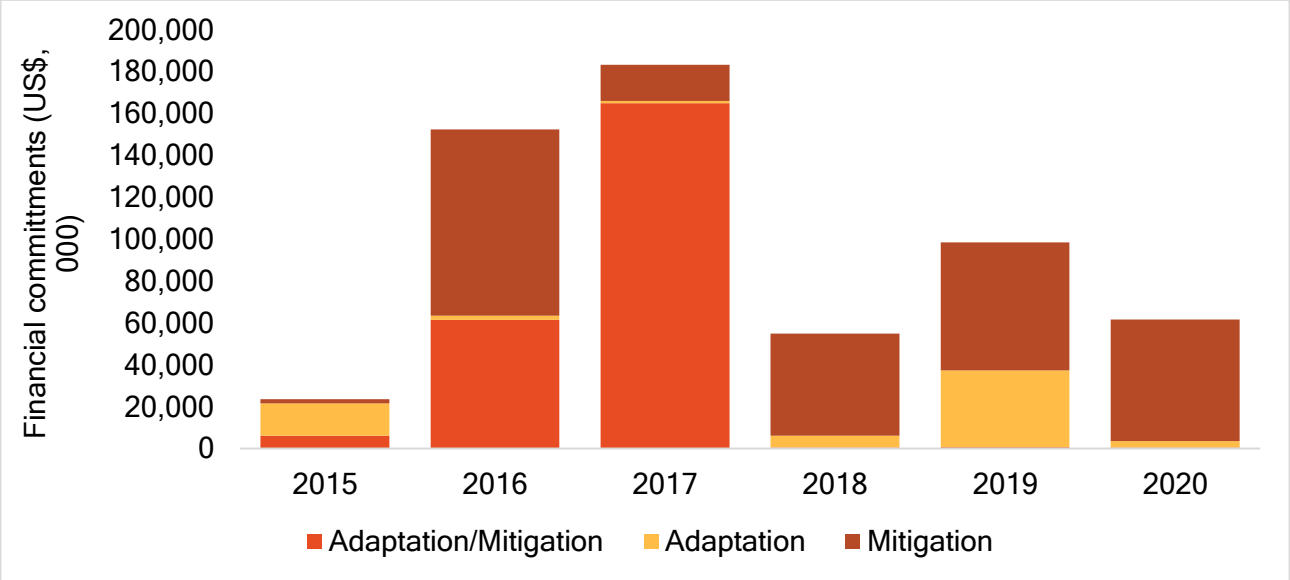

Figure 10: Trends financial commitment to project with principal climate objectives

In terms of sources of financial commitment, the bilateral and the multilateral continue to dominate, followed by vertical climate funds. About 41% of the total financial commitments for the 2015-2020 project in the principal marker category were from Bilateral[24] sources and followed by the multilateral[25] sources making 33%. The rest were from Climate Trust Funds[26] (20%), Multilateral Development Banks (MDB)[27] (6%) and Foundations[28] (less than 1%) (Figure 11).

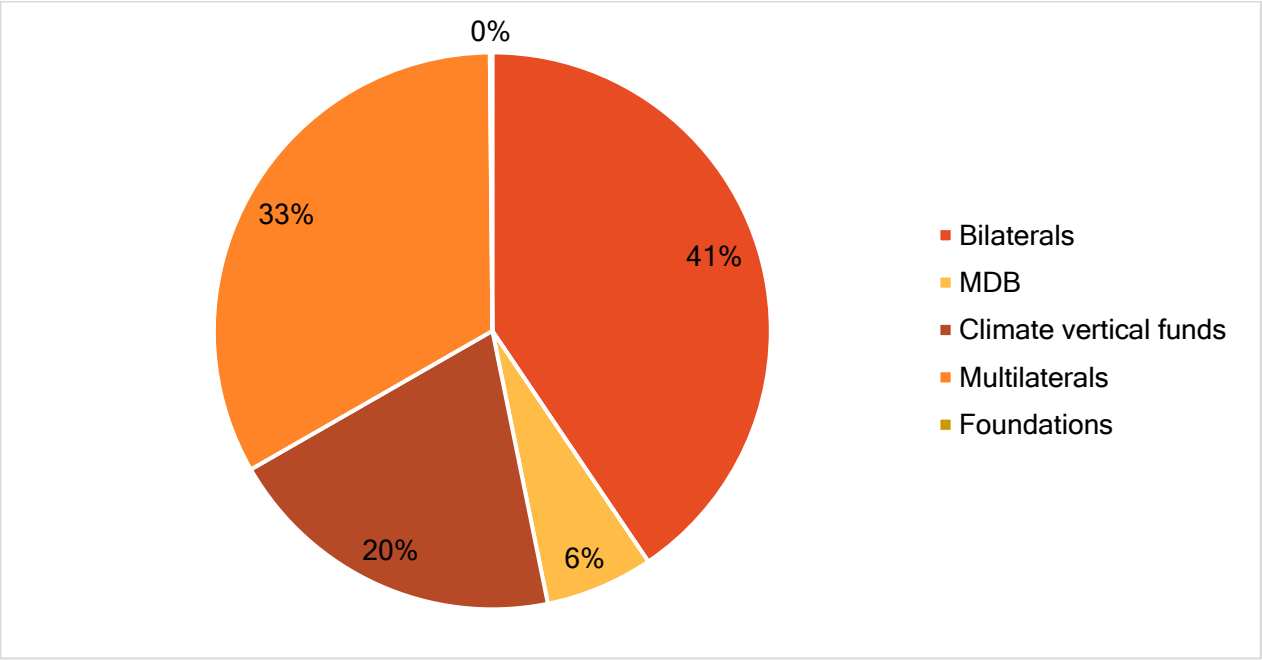

Figure 11: Distribution of the financial commitment to principal climate marker and projects with climate components by sources for the period 2015-2020

Figure 12 presents the breakdown of the financial commitments to projects with principal climate objectives. It also highlights the largest commitment to the Agriculture, Forestry and Fishing sector (64%) and followed by the Energy sector (23%)

[24] The Bilaterals sources in no particular order Belgium, Canada, Germany, United States, Japan, Czech Republic Austria, Italy, France, South Korea, Netherland, Norway, Switzerland
[25] Includes FAO, IFAD, DTU and Other EU Institutions
[26] Green Climate Funds, Global Environment Facility and Adaptation Funds
[27] World Bank, Africa Development Bank, European Investment Bank
[28] Bill and Melinda Gates Foundation, Mastercard Foundation, IKEA Foundation, William and Flora Hewlett Foundation

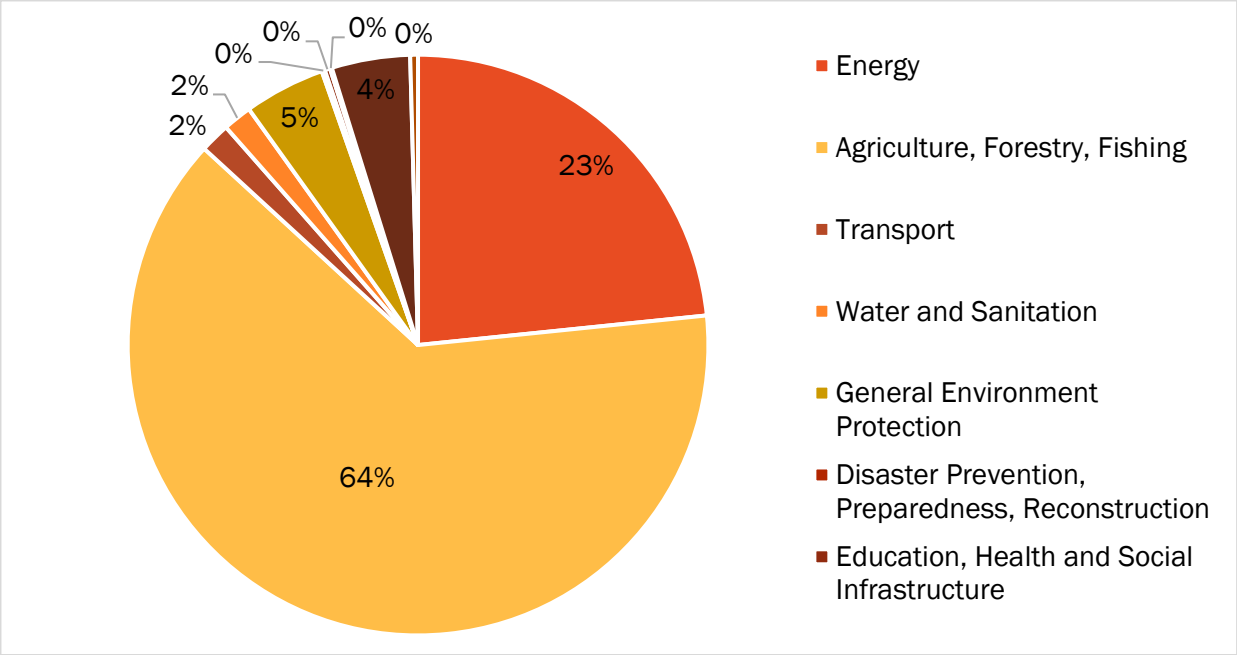

Figure 12: Financial commitments by sectors for the period 2015-2020

7.1.2.2 Climate flows from the National Budget

In the BUR2, Ghana's indicated its plans to begin reporting climate flows in the national budget. The domestic climate flows come from the CLIMFINTRACK system managed by the Budget Division of the Ministry of Finance. The CLIMFINTRACK has tracked the approved national budget of 48,707 projects with climate outcomes in MDAs and MMDAs between 2015-2020. The projects have an approved budget value of Gh¢ 12 billion for the same period at an annual average of Gh¢2 billion. The approved budgets were earmarked from the consolidated fund, statutory payment and internally generated funds. Within 2015-2020, the approved budget for the number of projects with climate outcomes increased 237% from 6,123 in 2015 to 20,642 in 2020. The majority (52%) of the projects fall in the category of low climate policy coherence. About 37% of the projects have high coherence, followed by 11% of projects with medium coherence. Figure 12 show a general rising trend of the national budget for projects with climate outcomes

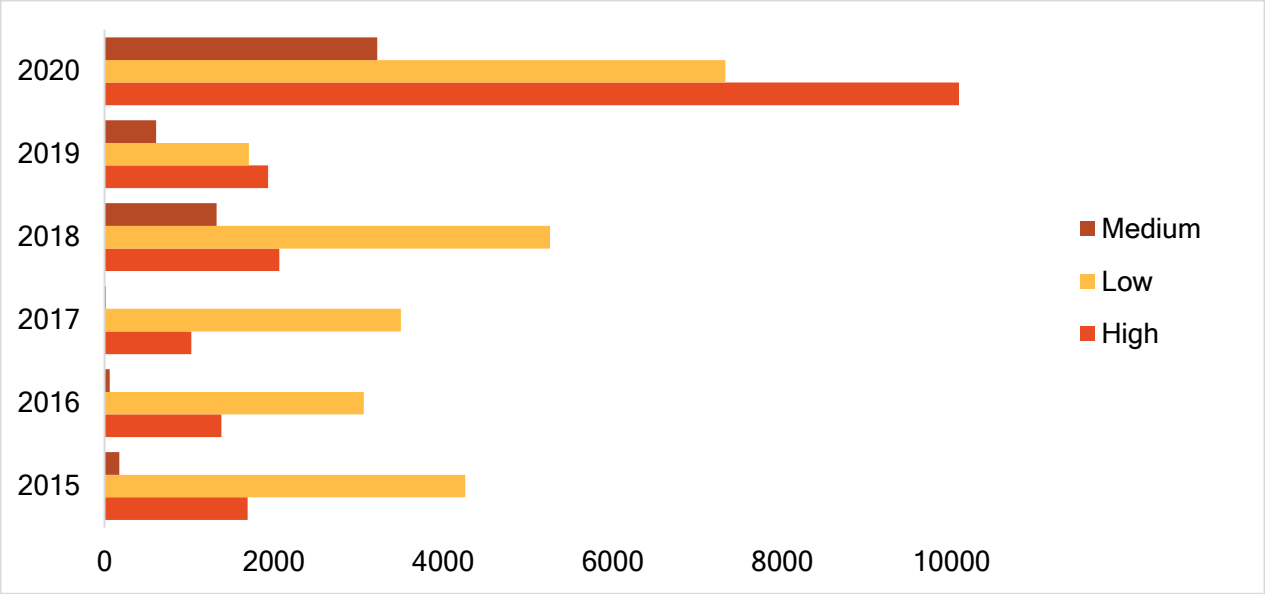

Figure 13: Trends of project tracked in the CLIMFINTRACK for the period 2015-2020

Table 29 present the approved budget of the projects with high policy coherence. Of the total estimated Gh¢6 billion approved national budget over the five years, Agriculture and Food Security recorded the highest of 27%, followed by Water and Sanitation of 21% and Disaster Preparedness (21%). Across the years, the national budget allocations for projects with high climate outcomes contributed 28% and 48% of the total budget allocation for the same period. The highest budget allocation for the high policy coherence project was recorded in 2020. In the 2020 approved budget, Agriculture and Food Security, Climate change and migration, Disaster Preparedness and Water and Sanitation policy received the high budget allocations (Table 29). The national budget trends are consistent with Ghana's priority of investment in climate change adaptation interventions.

Table 30: Approved National Budget for Projects with High climate policy coherence

National climate change policy themes	2015	2016	2017	2018	2019	2020	Total	Share (%)
Agriculture and Food Security	19.8	132.8	380.5	5.7	293.5	760.5	1,592.8	27
Climate change and gender	10.7	24.4	2.1	-	-	-	37.2	1
Climate Change and Health	-	-	-	171.3	43.4	4.0	218.8	4
Climate change and migration	-	-	-	1.3	173.4	749.5	924.1	15
Disaster Preparedness	77.7	47.6	50.9	106.8	14.2	679.6	976.8	16
Energy and Infrastructural development	146.9	40.9	0.7	0.0	41.4	20.2	250.0	4
Forests and Carbon sinks	132.9	74.3	214.7	-	0.1	4.3	426.3	7
Infrastructure	162.5	42.6	70.8	-	-	53.9	329.8	5
Water and Sanitation	100.3	46.6	65.8	50.6	388.0	594.3	1,245.6	21
Total	650.9	409.3	785.4	335.7	954.0	2,866.2	6,001.5	100

7.1.2 Mobilising Green Climate Funds

The Real Sector Division of the Ministry of Finance is the National Designated Authority (NDA) for the Green Climate Fund (GCF). The Ministry of Finance coordinates the efforts to mobilise financial resources from the Green Climate Fund. An inter-agency technical committee supports the NDA work. The NDA's coordination activities involve the following:

- Facilitate the development of the GCF project pipeline among developers.
- Support for institutional designation as national implementing entities.
- Stakeholder engagement and awareness.
- Matchmaking among project developers.
- Liaison with the GCF secretariat.
- Participation in the global GCF activities

Tables 30, 31 and 32 show the status of GCF projects/proposal development in Ghana.

Table 31: Approved GCF funding proposals

No	Project	Executing Entity	Accredited Entity/Delivery Partner	Date Submitted	Amount Approved (US$ Million)		
					GCF	Co-Fin	Total
1.	Acumen Agricultural Fund (Regional project)	Demand Driven	Acumen Fund Inc.	March 2018	26.0	25.0	51.0
2.	Programme on Affirmative Finance Action for Women in Africa (AFAWA)	Ecobank Ghana	AfDB	July 2019	20.0	15.0	35.0
3.	Arbaro Fund – Sustainable Forestry Project (Regional project)	Micro Ltd	MUFG Bank	March 2020	25.0	175	200
4.	Ghana Shea Landscape Emission Reduction Project	Forestry Commission	UNDP	September 2020	30.1	24.0	54.1
5.	Inclusive Green Financing Initiative (IGREENFIN) ***PPF & Funding Proposal	ARB Apex Bank	IFAD	February 2021	1.5	0.000	1.5

Table 32: List of Approved GCF Readiness and preparatory proposals

NO.	Project	Executing Entity	Accredited Entity/Delivery Partner	Date Submitted	Amount Approved (US$Mn)		
					GCF	Co-Fin	Total
1.	Drought Early Warning and Forecasting System: Improving resiliency of crops to drought through strengthened early warning within Ghana.	Water Resources Commission	UN Environment	May 2017	0.300	0.000	0.300

2.	Strengthening national capacities to access climate finance through enhanced country strategies and stakeholder engagement in Ghana	NDA/UNDP	UNDP	Mar 2019	0.510	0.000	0.510
3.	Enhancing multi-sector planning and capacity for effective adaptation in Ghana	EPA	UN Environment	May 2019	2.960	0.000	2.960
4.	Ghana Industrial Energy Efficiency Readiness	Forestry Commission	UNDP	Sep. 2020	0.533	0.000	0.533

Table 33: GCF Funding proposal is awaiting approval

NO.	Project	Executing Entity	Accredited Entity/Delivery Partner	Date Submitted/ Status	Amount (US$Mn)		
					GCF	Co-Fin	Total
1.	Accelerated Solar Action Programme (ASAP)	Energy Commission	Ecobank Ghana.	9 Oct. 2018 / under review by GCF sec	15.0	15.0	30.0
2.	Climate-resilient landscapes for sustainable livelihoods in Upper East and Upper West Regions	MOFA and EPA	UN Environment	20 June 2018 / under review by GCF sec	17.0	9.3	26.3
3.	Greater Accra Resilient & Integrated Development Project	Min of Works & Housing	World Bank	20 Nov. 2019 / under review by GCF sec	75.0	201.0	276.0
4.	Accra City Electric Bus Project	Min of Transport	Ecobank / AFD	25 Sep. 2019 / under review by GCF sec	36.6	183.5	220.1
5.	Regional Off-Grid Electrification Project (ROGEP) (Regional project)	Energy Commission	IBRD	7 Sept. 2018 / under review by GCF sec	150.0	160.0	310.0
6.	Leveraging Energy Access Finance Framework project (Regional project: Nigeria, Kenya, Ghana, Tunisia, Ethiopia, Guinea)	Min. of Energy	Min. of Energy	22 Dec. 2020 / under review by GCF sec	170.0	723.0	893.0
7.	Building climate resilience of the agriculture sector in	Water Resources Com.	UN Env.	22 Dec. 2020 / under review by	10.0	1.0	11.0

	Ghana through improved climate information and early warning services			GCF sec			
8.	Green Cooling – Accelerating the transformation to climate-friendly and energy-efficient air conditioning (Costa Rica, Ghana (Amount: Euro 34.96Mn – rate Euro 6.82, US$5.72) (Regional project)	EPA	GIZ	22 Dec. 2020 / under review by GCF sec	41.7	15.8	57.4

7.1.3 Non-monetised support received

Ghana continued to receive capacity-building, technical assistance and technology support aimed at strengthening its mitigation efforts. The summary of climate support received for the period 2016-2021 is shown in Table 33.

Table 34: Information on non-monetised support received for the period 2014-2019

Activity	Developed country or partner	Status/Remarks
Information matter project. Training on GHG data management in the waste sector	German Federal Ministry for Economic Completed in Cooperation and 2018 Development (BMZ), GIZ	
Reporting for results-based REDD+ actions (RRR+). Hands-on training on Use of 2006 IPCC guidelines for the AFOLU sector. Technical support to Forestry Commission during the Technical Assessment of Ghana's FRL under the UNFCCC.	Coalition for Rainforest Nations	Completed
Training on Non-Annex 1 GHG Inventory software	United Nations Framework Convention on Climate Change (UNFCCC) Secretariat	2016, 2017, & 2018, 2019, 2021
UNFCCC GIR CASTT Training Programme on Greenhouse Gas	UNFCCC and Government of Korea	2016, 2017, 2018
Training on Low Emission Analysis Platform	Stockholm Environment Institute	2016, 2019, 2020
Training on the GACMO model for the construction of NDC baseline	UNEP-DTU	2017, 2019
Training on Annex 1 Party GHG Review, including methodological, reporting and review guidelines.	United Nations Framework Convention on Climate Change (UNFCCC) Secretariat	1 LULUCF expert qualified as a reviewer in 2017
Sustainable GHG Management Project in West Africa: Third-Party Review of National GHG Inventory Review - AFOLU	Australia, USA, Netherlands, UK, Belgium, New Zealand, UNFCCC, FAO, UNDP, UNDP	Completed in 2017

Section. Training on Land uses mapping using the Google Maps engine tool.		
Training on advanced topics on GHG inventory for a national expert	UNDP Nationally Determined Contribution Support Programme	2019
Collaboration on West Africa GHG Inventory Network	UNDP, Global Support Programme (GSP)	2018
Integrated LEDs modelling project	United Nation Environment Programme	On-going
Preparation and use of National GHG Manual and Uncertainty Management Guidance document	UNDP Low Emission Capacity Building Project	Completed in 2017
Training on GHG fresh entrants and experts	CBIT Project	2021
Advance training the Modalities, Procedures and Guidelines (MPG) for Article 13	CBIT Project	2021
Training on Advance topics on GHG inventory and mitigation actions	BUR3 Project	2020 and 2021
Training programme for review experts under UNFCCC	United Nations Framework Convention on Climate Change (UNFCCC) Secretariat	2019
Joint Global Training Workshop on the Energy Sector for Developing Countries to Prepare for an Effective Enhanced Transparency Framework under the Paris Agreement	United Nations Framework Convention on Climate Change (UNFCCC) Secretariat and International Energy Agency	2019
Training programme for review experts for the technical review of biennial reports and national communications of Parties included in Annex I to the Convention	United Nations Framework Convention on Climate Change (UNFCCC) Secretariat	2020
CGE training programme for technical experts undertaking technical analysis of biennial update reports from Partied not included in Annex I to the Convention	United Nations Framework Convention on Climate Change (UNFCCC) Secretariat	2020
UNFCCC QA Global Sock Take Workshop (14 - 15 October) and FLINT training workshop	United Nations Framework Convention on Climate Change (UNFCCC) Secretariat	2019
UNFCCC-GIR-CASTT (Climate Action and Support Transparency Training) Programme	UNFCCC and GIR	2018

7.1.4 Support received during BUR Preparation

The Global Environment Facility (GEF) funding under the Enabling Activities portfolio was the only direct funding Ghana received to prepare the third BUR. Following the approval of the BUR2 project proposal, Ghana received funding support totalling $352,000 through UN Environment as the implementing agency. The GEF funding enabled Ghana to compile the BUR3, but the funding amount did not cover the full cost for preparing the BUR3.

The contributions from other partners through technical assistance helped in the compilation of the BUR3. Below are some of the main additional technical assistance Ghana received in preparing the BUR3:

- CfRN and Ghana RRR+ Phase II support developing Ghana's second Forest Reference Levels and GHG inventory for the FOLU sector.
- UNEP-DTU ICAT Project uses the GACMO tool to assess mitigation action and effect and uses an in-built MRV template to systematically track and monitor climate measures.
- UNDP NDC Support programme on the development of the Ghana NDC tracking tool and energy sector MRV system. Ghana's NDC tracking tool is excel-based that use will be used for NDC accounting established Article 4.13 of the Paris Agreement.
- CfRN and FAO Training: Quality Control for Collect Earth Database to prepare a land-cover map for Ghana.
- Remote Training on the Building of Sustainable National Greenhouse Gas Inventory Management Systems-Ghana organised by the UNFCCC in collaboration with the US Environmental Protection Agency.
- FAO's Knowledge Transfer/ Capacity Building Programme on Forest Reference Levels for Ghana.
- Support from Ghana's CBIT Project on the training of national experts on GHG inventory, assessing institutional arrangement and data management.

7.2 Constraints and Gaps, and Related Financial, Technical and Capacity Needs

7.2.1 Financial constraints and Gaps

Access to finance and capacities are critical for climate actions and reporting. They provide essential support for implementing interventions to improve the national system's effectiveness and prepare a biennial update report. The findings from a national survey on constraints and gaps highlight the following:

- Lack of transparency on reporting non-financial support for training and technical assistance is difficult to monitor and report non-monetary support. Many institutions receive training and technical assistance support from donors without financial disclosure because the source of funding is part of the global budget. When such situations arise, it becomes difficult to report because the recipient organisation lacks full access to the funding and accounting information.

- Funding for climate change activities, including preparation of BURs, is mostly donor-driven and project-based. Ghana's contribution to the BUR preparation is mainly through in-kind support. The current funding gap for the BURs is a challenge for the continuous preparation of the report and the subsequent consideration stage.

7.2.2 Information on capacity needs and support received

During the report consideration stage of the BUR2 under the International Consultation and Analysis (ICA) process, Ghana, together with the Technical Team of Expert (TTE), identified the following capacity building needs that could facilitate the preparation of subsequent BURs and participation in ICA:

- Collection of AD on the consumption of F-gases, particularly SF6.
- Collection of AD and EFs to support the development of a tier 2 method for road transport.
- Support in expanding the current facility-level carbon accounting programme, considering lessons from the public electricity utility's current voluntary carbon accounting programme.
- Development of solid waste and wastewater balances to better understand the flow of solid waste and wastewater from the point of generation to the end site (e.g., solid waste disposal sites in the case of solid waste, or seas, rivers or lakes in wastewater).
- Data collection to improve upon the current expert judgement in the allocation of manure into various manure management systems.

- Developing concrete category-level plans to collect the necessary uncertainty values for AD, EFs and parameters.
- Aggregating the project-level results of mitigation actions to sectoral and national totals;
- Performing an ex-ante assessment of non-mitigation benefits of mitigation actions.

Table 34 gives the overview of the support needed and the status of implementation of the capacity building needs identified in the technical analysis of the second biennial update report of Ghana submitted on 19 February 2019

Table 35: Information on capacity building needs and status of implementation of needs identified during the Technical Analysis of the second BUR2

Activity	Objective	Amount Needed ($)	Implementing Entity	Identified by	Priority	Status
Study fugitive emissions in oil & gas industry	Make available high-quality activity and emission factors from oil and gas	300,000	EPA, Energy Commission, Petroleum Commission	Ghana	High (GHG inventory KCA)	Not started due to lack of funds.
Develop country-specific emission factors for road transport, livestock, solid and domestic liquid waste and improvement in data collection systems	Increase confidents in the transport GHG, livestock and waste emissions emission estimation	1,000,000	EPA, Ministry of transport, DVLA, Energy Commission, Ministry of Food and Agriculture	Ghana	High (GHG inventory KCA)	Not started because of unsecured funds. CBIT project assessed data systems in transport, energy, waste and agriculture.
Collection of AD and EFs to support the development of a tier 2 method for road transport.				Technical Team of Expert and Ghana	High (GHG inventory KCA	
Data collection to improve upon the current expert judgement in the allocation of manure into various manure management systems.				Technical Team of Expert and Ghana	High (GHG inventory KCA	
Development and improvement of non-energy sector mitigation assessment	Estimate mitigation potential in non-energy sectors with increased certainty.	200,000	EPA and relevant sectors	Ghana	Medium	Started ICAT project using the GACMO tool.

Activity	Objective	Amount Needed ($)	Implementing Entity	Identified by	Priority	Status
Development of solid waste and wastewater balances to better understand the flow of solid waste and wastewater from the point of generation to the end site (e.g. solid waste disposal sites in the case of solid waste, or seas, rivers or lakes in wastewater).	Identify, collect activity data and improve ways for continuous collection.	200,000	EPA and Ministry of Local Government and Rural Development	Technical Team of Expert and Ghana	High (GHG inventory KCA	Not started due to lack of funds.
Improve data collection on wood fuel supply and consumption	Improve the quality of activity data and emission factors for estimating involving the use of traditional solid biomass	350,000	Forestry Commission, Energy and EPA	Ghana	Medium	Not started due to lack of funds. Need a partner to develop a project proposal to seek international funding.
Support in expanding the current facility-level carbon accounting programme, taking into account lessons learned from the public electricity utility's current voluntary carbon accounting programme.	Facilitate regular reporting of emissions and activity from the industry.	120,000	EPA, Ministry of Trade, Associations of Industry, Association of Ghana Industries	Technical Team of Expert and Ghana	High	Received funding from UNDD under NDC-SP to incorporate GHG inventory data into the annual environmental report for the industry. Additional funding is needed to implement the activity industry-wide.
Energy statistics development and improvement project	Improve the quality of energy statistics, including its metadata and uncertainty estimation.	150,000	Energy Commission, EPA, Ghana Statistical Service	Ghana	High	Not started due to lack of funds.

Activity	Objective	Amount Needed ($)	Implementing Entity	Identified by	Priority	Status
Collection of AD on the consumption of F-gases, particularly SF6.	Collect relevant industry and ODS activity data through a national survey	130,000	EPA, Ministry of Trade, Ghana Custom Services	Technical Team of Expert and Ghana	High	Not started due to lack of funds.
Aggregating the project-level results of mitigation actions to sectoral and national totals.	Improve the methodology for computing the sectoral and economy-wide mitigation commitment from individual mitigation actions.	30,000	EPA	Technical Team of Expert and Ghana	High	Support provided through the ICAT project on using the GACMO model allows for the systematic and transparency aggregation of the emission reductions of individual mitigation actions.
Performing an ex-ante assessment of non-mitigation benefits of mitigation actions.	Assess the non-GHG benefits of mitigation actions	100,000	EPA	Technical Team of Expert and Ghana	Medium	Under the ICAT project, Ghana is Sustainable Development Methodology for Assessing the environmental, social and economic impacts of policies and actions

7.3 Update on economic and social consequences of Response Measures

7.3.1 Information on the Assessment of Consequences Response Measures

The guidelines in Annex III to Decision 2/CP.17 include issues of economic and social consequences of Response Measures (RM). The information in the BUR3 provides the latest update of information on the assessment of consequences of responses measures in Ghana. It builds on the information on RM reported in Ghana's Fourth National Communication (NC4) submitted to the UNFCCC in 2019. In the NC4, Ghana has reported information on the progress of studies on the consequences of RM and training programmes in the following areas:

- The EPA partnered with the International Labour Organisation (ILO) to provide the Green Jobs Assessment Model (GJAM).
- Training on the social and employment implications of climate policies and NDC.
- Green Jobs Assessment Model for Ghana.

In the BUR3, Ghana report on the latest assessment on the Impacts of Response Measures: Ghana Case Study conducted by the European Roundtable Climate Change and Sustainable Transition (ERCST) in collaboration with Ghana EPA. The study aimed at identifying, measuring and analysing the impacts of the implementation of response measures in Ghana. It also helped to test, refine and improve the methodology that ERCST has developed in different countries. The study identified global response measures that could have adverse economic and social consequences on some selected sectors in the country. These are carbon taxes; subsidies; Carbon Border Adjustment Mechanism (CBAM), organic standards and labelling requirements for agricultural goods and basic materials; and aviation and shipping measures.

The assessment identified several vulnerable sectors in Ghana that are at risk of impacts: palm oil, fishing, oil and gas, manufacture of beverages and food products (Joboba oil), mining and quarrying without oil and gas and gold (Aluminium and Manganese). The next study will continue to assess the impacts of international responses on key economic sectors in Ghana. The assessment will focus on the following areas:

- Response measures: IMO carbon tax
    - Vulnerable sectors in Ghana: oil and gas, mining and quarrying without oil and gas and gold (and aluminium and manganese), fishing products.

- ICAO/CORSIA carbon tax
    - Vulnerable sectors in Ghana: fishing products, oil and gas, tourism.

- EU CBAM tax
    - Vulnerable sectors in Ghana: oil, aluminium and manganese.

7.4 Transfer of climate-smart technology

7.4.1 Update on information on climate technology development and transfer

The BUR3 summarises information on technology development and transfer reported in the Fourth National Communication as the latest update below. Ghana has conducted two Technology Needs Assessments (TNA) in 2003 and 2013. Both assessments produced priority mitigation and adaptation technology option for addressing climate change. The 2003 assessment highlighted mitigation technology options in the Energy and Waste sectors. The 2013 TNA focused on adaptation technologies in the Water and Agriculture sectors. Although the 2013 TNA is the most current, it is nearly seven years old and needs to be updated to reflect its current technology needs (Table 36).

Table 36: Climate technology options identified in 2003 technology needs assessment

Priority technology portfolios	2003 TNA	Supporting policy document	Comments
Biofuels	x		
Industrial energy efficiency improvement	x	x	Consistent with Ghana's nationally determined contributions
Energy efficiency lighting	x	x	Aligns with 12 prioritised NAMAs and Ghana's NDCs, strategic national energy plan
Solar PVs	x	x	Aligns with Ghana's SEforALL Action Plan; 12 prioritised NAMAs, Renewable Energy Master Plan, Strategic National Energy Plan and Ghana's NDC, Internationally Transferred Mitigation Outcomes (ITMOs)
Natural gas combined cycle and Natural gas distribution system	x	x	The technology aligns with Ghana's nationally determined contributions, National Gas Master Plan.
Management technologies and efficiency improvement in transport sub-sector or BRT	x	x	The technology aligns with Ghana's NDC, National Transport Policy.
Wind Energy	x		The technology aligns with Ghana's NDC, Renewable Energy Master Plan, Strategic National Energy Plan, Scaling Up Of Renewable Energy Penetration Investment Plan (SREP-IP).
Solar water heater	x	x	Renewable energy master plan, strategic national energy plan, Ghana's SEforALL Action Plan, SREP-IP
Small and mini-hydro	x		The technology aligns with the Renewable Energy Master Plan, Strategic National Energy Plan, SEforALL Action Plan, SREP-IP and NDC.
Biomass for power generation (co-	x		The technology aligns with The Renewable Energy Master Plan, SEforALL Action Plan.

generation from sawmill residues)			
Landfill methane gas capture for power generation	x	x	The technology aligns with Ghana's NDC and the Renewable Energy Master Plan.
Anaerobic and CH_4 generation technologies for wastewater handling (Biogas technologies)	x	x	The technology aligns with Ghana's SEforALL Action Plan, 12 prioritised NAMAs, Renewable Energy Master Plan and Ghana's nationally determined contributions.
Incineration	x	x	
LPG and improved stoves		x	Aligns with Ghana's SEforALL Action Plan, Strategic National Energy Plan, LPG Promotion Policy, Renewable Energy Master Plan, National Gas Master Plan, Clean Development Mechanism (CDM), NDC, and ITMOs.
Efficient fridges		x	Strategic National Energy Plan and the nationally determined contributions.

Similarly, the top technology lists from the 2013 TNA were in line with relevant government policy documents. Notable are the National Climate Change Policy, National Climate Change Adaptation Strategy, National Disaster Management Plan, Nationally Determined Contribution and the Strategic Medium-Term Development Plan for the Ministry of Works and Housing. Table ES 8 shows adaptation technology options and their supporting policy documents.

Table 37: Climate technology options identified in 2013 technology needs assessment

Priority technology portfolios	Sector	2013 TNA	Links to policy	Comments
Rainwater collection from ground surfaces	Water	x	x	The technology aligns with the National Water Policy.
Post-construction support for community-managed water systems	Water	x	x	The technology aligns with the National Water Policy.
Improving the resilience of protected wells to flooding	Water	x	x	The technology aligns with the National Water Policy.
Demarcation and protection of buffer zones for water bodies	Water	x	x	The technology aligns with the Riparian Buffer Zone Policy.
Rainwater harvesting from roofs	Water	x	x	The technology aligns with the National Water Policy.
Community-based extension model	Agriculture	x	x	The technology aligns with Ghana's NDC, Planting For Food And Jobs, with the National Climate-Smart Agriculture Action Plan.
Water user associations	Agriculture	x		
Integrated soil nutrient management	Agriculture	x		The technology aligns with the Food and Agriculture Sector Development Policy II and the

				National Climate-Smart Agriculture Action Plan.
Ecological pest management	Agriculture	x	x	The technology aligns with the National Climate-Smart Agriculture Action Plan and Ghana's NDC.
Seed and grain storage	Agriculture	x	x	Aligns with Ghana's NDC, Planting For Food And Jobs (one district one warehouse programme).

8. Annexes

Annexe 1: Non-Annex 1 Reporting Table 1

Inventory Year: 2019							
	Emissions (Gg)			Emissions (Gg)			
Categories	Net CO_2 (1)(2)	CH_4	N_2O	NOx	CO	NMVOCs	BC
Total National Emissions and Removals	41,933.24	328.00	24.55	204.6	1276.7	273.4	448.6
1 - Energy	**26,377.78**	**23.05**	**1.16**	**204.6**	**863.2**	**273.4**	448.6
1.A - Fuel Combustion Activities	18,482.65	18.25	1.03	204.6	863.2	273.4	448.6
1.A.1 - Energy Industries	7,304.53	1.72	0.23				
1.A.2 - Manufacturing Industries and Construction	1,217.80	0.49	0.06				
1.A.3 - Transport	9,029.69	2.38	0.46				
1.A.4 - Other Sectors	930.63	13.66	0.28				
1.A.5 - Non-Specified	-	-	-				
1.B - Fugitive emissions from fuels	7,895.12	4.80	0.12				
1.B.1 - Solid Fuels	-	-	-				
1.B.2 - Oil and Natural Gas	7,895.12	4.80	0.12				
1.B.3 - Other emissions from Energy Production	-	-	-				
1.C - Carbon dioxide Transport and Storage	-	-	-				
1.C.1 - Transport of CO_2	-						
1.C.2 - Injection and Storage	-						
1.C.3 - Other	-						
2 - Industrial Processes and Product Use	615.80	-	-				
2.A - Mineral Industry	531.67	-	-				
2.B - Chemical Industry	-	-	-				
2.C - Metal Industry	82.05	-	-				
2.D - Non-Energy Products from Fuels and Solvent Use	2.08	-	-				
2.E - Electronics Industry	-	-	-				
2.F - Product Uses as Substitutes for Ozone Depleting Substances	-	-	-				
2.G - Other Product Manufacture and Use	-	-	-				
2.H - Other	-	-	-				
3 - Agriculture, Forestry, and Other Land Use	**14,924.02**	**166.38**	**21.23**		**413.5**		

3.A - Livestock	-	136.89					
3.B - Land	14,517.40	-	-				
3.C - Aggregate sources and non-CO_2 emissions sources on land	406.62	29.50	21.23		413.5		
3.D - Other	-	-	-				
4 - Waste	**15.63**	**138.56**	**2.17**				
4.A - Solid Waste Disposal	-	62.92	-				
4.B - Biological Treatment of Solid Waste	-	2.16	0.13				
4.C - Incineration and Open Burning of Waste	15.63	5.34	0.08				
4.D - Wastewater Treatment and Discharge	-	68.14	1.96				
4.E - Other (please specify)	-	-	-				
5 - Other	-	-	-				
5.A - Indirect N_2O emissions from the atmospheric deposition of nitrogen in NOx and NH_3	-	-	-				
5.B - Other (please specify)	-	-	-				
Memo Items (5)							
International Bunkers	648.67	0.0031	0.0097				
1.A.3.a.i - International Aviation (International Bunkers)	625.84	0.0044	0.0095				
1.A.3.d.i - International water-borne navigation (International bunkers)	22.83	0.0022	0.0001				
1.A.5.c - Multilateral Operations	-	-	-				

Annexe 2: Non-Annex 1 Reporting Table 2

Inventory Year: 2019

	Emissions CO_2 Equivalents (Gg)		
Categories	HFCs	PFCs	SF6
Total National Emissions and Removals	593.76	521.57	NE
1 - Energy			
1.A - Fuel Combustion Activities			
1.A.1 - Energy Industries			
1.A.2 - Manufacturing Industries and Construction			
1.A.3 - Transport			
1.A.4 - Other Sectors			
1.A.5 - Non-Specified			
1.B - Fugitive emissions from fuels			
1.B.1 - Solid Fuels			
1.B.2 - Oil and Natural Gas			
1.B.3 - Other emissions from Energy Production			
1.C - Carbon dioxide Transport and Storage			
1.C.1 - Transport of CO_2			
1.C.2 - Injection and Storage			
1.C.3 - Other			
2 - Industrial Processes and Product Use	593.76	521.57	-
2.A - Mineral Industry			
2.B - Chemical Industry			
2.C - Metal Industry		521.57	-
2.D - Non-Energy Products from Fuels and Solvent Use			
2.E - Electronics Industry			NE
2.F - Product Uses as Substitutes for Ozone Depleting Substances	593.76	-	-
2.G - Other Product Manufacture and Use			
3 - Agriculture, Forestry, and Other Land Use			

3.A - Livestock			
3.A.1 - Enteric Fermentation			
3.A.2 - Manure Management			
3.B - Land			
3.B.1 - Forest land			
3.B.2 - Cropland			
3.B.3 - Grassland			
3.B.4 - Wetlands			
3.B.5 - Settlements			
3.B.6 - Other Land			
3.C - Aggregate sources and non-CO2 emissions sources on land			
3.C.1 - Emissions from biomass burning			
3.C.2 - Liming			
3.C.3 - Urea application			
3.C.4 - Direct N_2O Emissions from managed soils			
3.C.5 - Indirect N_2O Emissions from managed soils			
3.C.6 - Indirect N_2O Emissions from manure management			
3.C.7 - Rice cultivations			
3.C.8 - Other (please specify)			
3.D - Other			
3.D.1 - Harvested Wood Products			
3.D.2 - Other (please specify)			
4 - Waste			
4.A - Solid Waste Disposal			
4.B - Biological Treatment of Solid Waste			
4.C - Incineration and Open Burning of Waste			
4.D - Wastewater Treatment and Discharge			
4.E - Other (please specify)			
5 - Other			
5.A - Indirect N_2O emissions from the atmospheric deposition of nitrogen in NOx and NH_3			
5.B - Other (please specify)			
International Bunkers			

1.A.3.a.i - International Aviation (International Bunkers)			
1.A.3.d.i - International water-borne navigation (International bunkers)			
1.A.5.c - Multilateral Operations			

Annexe 3: Snapshot of the NDC indicator tracking template

Programme of Action	Threshold Target by 2030	Sub-units	Indicators	Lead Institutions
Increase small-medium hydro installed capacity up to 150-300MW	300	MW	mini-hydro installed capacity	Ministry of Energy
Attain utility-scale wind power capacity up to 50-150MW	150	MW	Grid-connected wind power installed capacity	Ministry of Energy
Attain utility-scale solar electricity installed capacity up to 150-250 MW	250	MW	Grid-connected solar installed capacity	Ministry of Energy
Scale up the 200,000 solar systems for lightning in residential and non-residential buildings	200,000	500W	Number of installed solar home systems	Ministry of Energy
Establish 55 mini-grids with an average capacity of 40kW.	55	40kW	Number of 40kW mini-grids installed	Ministry of Energy
Increase solar lanterns penetration in rural non-electrified households to 2 million	2,000	1000 lamps	#of LED lamps distributed	Ministry of Energy
Scale-up adoption of LPG in at least 50% of households	134	1000 LPG stoves	#of LPG stoves adopted, % of household using LPG for cooking	Energy Commission
Scale-up access and adoption of 2 million efficient stoves	2,000	1000 efficient stoves	#of efficient stoves distributed	Energy Commission
Fuel switch from heavy fuel oil to natural gas in existing electric power plants	50	100 TJ fuel use/year	Quantity of natural gas per thermal electricity generated	Volta River Authority, IPPs
Improve the efficiency of the thermal power plants by converting the single-cycle power plants to combined cycle	3.3	100 MW increase	Amount of capacity added due to single cycle to combined cycle conversion	Independent Power Producers
Recovery and utilisation of associated gas from Jubilee and Tein oil fields	120	1 MMSCF/day	Amount of gas recovered from oil field	Ghana National Gas Company
Promote Efficient lighting with LED bulbs	20,000	1000 bulbs	#of LED bulbs distributed	Energy Commission
Scale up adoption of Efficient Refigeration	2,000	1000 refrigerators	# of efficient refrigerators distributed	Energy Commission
Scaling up the installation of power factor correction devices in 1,000 commercial and industrial facilities (capacitor banks).	1,000	1 facility	#of industrial and commercial facilities that have installed capacitors	Energy Commission
Ghana Cocoa REDD+ Programme	270	Avoided deforestation 1000 ha	Avoided deforested area (ha)	Forestry Commission
Ghana Shea Landscape REDD+ Programme				Forestry Commission
Wildfire management in the transition and savannah drylands in Ghana				

National Forest Plantation Development Programme Enrichment Planting	660	Reforestation of 1000 ha	Areas reforested (ha)	Forestry Commission
HFC Reduction in the RAC sector (scale-up market share of climate-friendly and energy-efficient air-condition)	70%	Market share of green and energy-efficient air conditioners	% Of market share of green and EE air conditioners	Environmental Protection Agency
Expansion of intracity transportation modes (Bus Rapid Transit)	200	1 km BRT line	Length of BRT km	Ministry of Transport
Expansion of inter and intra city transportation modes (Railway Transit System)	TBD	TBD	TBD	Ministry of Railways
Improve the effectiveness of urban solid waste collection up to 70-90% and the construction of engineered landfills for methane recovery	14	200 t/day plant	Quantity of gas recovered from engineered landfills	Ministry of Sanitation and Water Resources
Increase the current waste-to-compost capacity of 200 t/day to 500 t/day	0.5	1000 t/day plant	Waste-to-compost processing installed capacity	Ministry of Sanitation and Water Resources
Scale-up 200 biogas facilities	1	1000 t/year plant	Quantity of biogas produced	Ministry of Sanitation and Water Resources, Ministry of Environment, Science, Technology and Innovation
Adoption of modified community-based conservation agriculture/climate-smart agriculture in 54 districts	54	Number of districts	Number districts practising conservation agriculture/CSA	Ministry of Food and Agriculture
Scale-up penetration of climate-smart technologies to increase fisheries and livestock productivity by 10%	10	% Fisheries/Livestock Production	% Increase in fisheries/livestock production	Ministry of Food and Agriculture, Ministry of Fisheries and Aquaculture

Annexe 4: Screenshot of the NDC Accounting Tool