Republic of Ghana

Ghana's Second Biennial Update Report

To the United Nations Framework Convention on Climate Change

October, 2018

Ministry of Environment, Science, Technology
and Innovation (MESTI)

Environmental Protection Agency (EPA)

With kind support from

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Foreword

The Environmental Protection Agency (EPA) is delighted to be associated with the preparation of Ghana's Second Biennial Update Report (BUR2). Within EPA, the climate change team coordinated the preparation of the BUR2 which took nearly two years to complete. The EPA team worked closely with several experts drawn from key Ministries, Academia, CSOs, and the Private Sector who actively participated in the compilation of chapters assigned to them. We acknowledge the rich inputs from international experts and UNEP Environment staff who reviewed the draft BUR before submitting to UN Climate Change. Ghana has benefitted in many ways from BUR compilation process. Firstly, it has enabled Ghana to meet its reporting obligations under Articles 4 and 12 to the UNFCCC. Secondly, preparing the BUR2 has helped to revitalise the functionality of the national arrangement for the BURs. For instance, additional capacities have been built, the utility of the data management system has been strengthened and above all, it has bolstered awareness raising on climate change in the country. These achievements are critical for laying the foundation for having a robust and workable domestic monitoring and verification system needed for the future climate regime. Besides, the information carried in the BUR2 are suitable for climate mitigation planning because it showcases the key achievements and challenges in the implementation of climate change actions. It is also valuable for evaluating the progress of climate actions and pinpointing areas that require special attention. The BUR also contains insightful information and analysis on climate finance and support inflows from 2011 to 2017.

As the new climate regime kicks by 2020, national climate reports will be crucial especially for the Global Stocktake (GST) exercise. Therefore, the climate reports Ghana publishes as a contribution to the GST must be seen to be credible, defensible and relevant. So we intend to deepen our efforts to sharpen existing capacities and most of all, make sure that the preparation of climate reports ultimately becomes routine for the institutions involved in the BUR. Ghana anticipates the scrutiny and frequency of the national reports will become more intense under the Enhanced Transparency Framework (ETF). Therefore, a lot more resources will be required to transit smoothly into the new reporting regime. It is our hope that the necessary resources will be found to support the programmes to improve the quality of the climate reports.

John A. Pwamang
(Ag. Executive Director, EPA)

The final electronic version of this report will be made available to the general public on the website of EPA (www.epa.gov.gh).

For further information please contact
Executive Director, Environmental Protection Agency
P.O. Box MB 326
Ministries - Accra
Telephone: +233- 302-664697/98
Email: info@epa.gov.gh

List of Contributors

Coordinating Authors

Mr. John A. Pwamang, Ag. Executive Director, Environmental Protection Agency
Mr. Ebenezer Appah-Sampong, Deputy Executive Director, Environmental Protection Agency

Chapter Authors

Chapter 1: National Circumstances and Institutional Arrangements

Mr. K.Y. Oppong-Boadi (Environmental Protection Agency)
Mr. Foster Aboagye-Gyamfi (Ministry of Finance)
Dr. Antwi-Boasiako Amoah (Environmental Protection Agency)
Dr. Felix Addo-Yobo (National Development Planning Commission)
Dr. Albert Ahenkan (University of Ghana Business School)
Dr. Abdul-Razak Saeed (IRRP Project, ICF)

Chapter 2: National Greenhouse Gas Inventory

Energy sector

Mr. Kennedy Amankwa (Energy Commission)
Mr. Larry Kotoe (Environmental Protection Agency)
Mr. Emmanuel Appoh (Environmental Protection Agency)
Mr. Daniel Essel (Ministry of Transport)
Mr. Ben Sackey (Volta River Authority)
Dr. Daniel Tutu Benefoh (Environmental Protection Agency)
Mr. Salifu Addo (Energy Commission)
Mr. Mawunyo Dzobo (IRRP Project, ICF)

2. Industrial Process and Products Use sector

Mrs. Selina Amoah (Environmental Protection Agency)
Mr. Emmanuel Osae Quansah (Environmental Protection Agency)
Mr. Joseph Baffoe (Environmental Protection Agency)
Mr. Micheal Onwona Kwakye (Environmental Protection Agency)
Mrs. Esi Nerquaye-Tetteh (Environmental Protection Agency)

3. Agriculture Forestry and Other Land-use sector

Dr. Ernest Foli (Forestry Research Institute, CSIR)
Mr. Kingsley Amoako (Ministry of Food and Agriculture)
Mr. Christian Flafe (Ministry of Food and Agriculture)
Mr. Jacob Amoako (Forestry Commission)
Mr. Mohammed Yakubu (Forestry Commission)
Mr. Kofi Affum Baffoe (Forestry Commission)
Dr. Charles Zomozoro (Animal Research Institute, CSIR)
Dr. Winston A. Asante (Kwame Nkrumah University of Science and Technology)
Mr. Kwabena Owusu Asubonteng (UNU - Institute for Natural Resources in Africa)
Mr. Foster Mensah (CERSGIS, University of Ghana, Legon)
Mr. Kwame Boakye Fredua (Environmental Protection Agency)
Dr. Daniel Tutu Benefoh (Environmental Protection Agency)
Mr. Reuben Ottou (SNV, Ghana)

4. Waste Sector

Mrs. Juliana Bempah (Environmental Protection Agency)
Mr. Joseph Baffoe (Environmental Protection Agency)
Dr. George Rockson (Zoomlion Ghana Limited)
Mr. Joy Hesse-Ankoma (Environmental Protection Agency)
Mr. Daniel A. Lamptey (Environmental Protection Agency)

Chapter 3: Mitigation Actions and Their Effects and Domestic MRV System

Mr. Kennedy Amankwa (Energy Commission)
Ms. Paula Edze (Energy Commission)
Mr. Ebenezer Ashie (Energy Commission)
Mr. Micheal Abrokwa (Energy Commission)
Mr. Charles Duah (Forestry Commission)
Mr. Thomas Gyambrah (Forestry Commission)
Dr. Daniel Tutu Benefoh (Environmental Protection Agency)
Mr. Simpson Attieku (Energy Commission)
Mr. Peter Dery (MESTI)

Chapter 4: Constraints, Gaps and Support Received

Mr. Foster Gyamfi (Ministry of Finance)
Mrs. Angelina Tutuah Mensah (Environmental Protection Agency)
Dr. Emmanuel Tachie-Obeng (Environmental Protection Agency)
Mr. Mohammed Gyimah (MESTI)
Mr. Osei Karikari (Environmental Protection Agency)
Mr. Samuel Dotse (HATOF Foundation)
Mrs. Florence Agyei (Environmental Protection Agency)

Reviewers

Institutional Reviewers

Mr. Fredua Agyeman, Ministry of Environment, Science, Technology and Innovation
Mr. John A. Pwammang, Environmental Protection Agency
Mr. Ebenezer Appah-Sampong, Environmental Protection Agency
Mr. Patrick Addai, Environmental Protection Agency
Mr. Daniel Aggrey, Environmental Protection Agency
Dr. Christine Asare, Environmental Protection Agency
Mr. Lambert Faabeluon, Environmental Protection Agency
Mr. Kwadwo Brentuo Owusu, Renewable Electricity, Ministry of Energy
Ms. Charlotte A. Appiah, Health Safety Security and Environment Officer, Ministry of Energy
Mr. Eric Kofi Afornorpe, Assistant Director, Ministry of Local Government and Rural Development
Mr. Kwabena Badu-Yeboah, Environmental Protection Agency

International Reviewers

Mr. Stanford Mwakasonda, UNDP/UNEP GSP facilitated by Ms. Suzanne Lekoyiet of UN Environment.

Mr. Jongikhaya Witi, facilitated by Mr. Javier Fernandez of the Coalition for Rainforest Nations (CfRN) under the Reporting for Results-based REDD+ (RRR+) initiative.

Dr. Chris Malley, Stockholm Environment Institute, University of York under the CCAC SNAP Initiative.

Dr. Emmanuel Ackom of DTU-UNEP Partnership, Denmarks, Dr. George Manful, Mr. Hugh Brown of Forestry Commission offered useful inputs to enrich the report.

Review inputs from CSOs

List of CSOs that provided inputs are in Annex 4

BUR Compiler

Dr. Daniel Tutu Benefoh, Environmental Protection Agency

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Acronyms and List of Abbreviation

AFOLU - Agriculture Forestry and Other Land Use
ATS - Automatic Timer Switches
BAU - Business-as-usual
Bcf - Billion Cubic Feet
BRT - Bus Rapid Transit
BUR - Biennial Update Report
CBIT - Capacity Building Initiative for Transparency
CCGT - Combined Cycle Gas Turbine
CDM - Clean Development Mechanism
CER - Certified Emission Reduction
CERGIS - Centre for Remote Sensing and Geographic Information System
CFMP - Community Forest Management Project
CPA - CDM Programme Activity
CPESDP - Coordinated Programme of Economic and Social Development Policies
CREMA - Community Resource Management Area (CREMA)
CSCP - Climate Smart Cocoa Production
CSIR - Council for Scientific and Industrial Research
EEAs - Energy Efficiency Advisors
EPA - Environmental Protection Agency
ESCOs - Energy Service Companies
FAOSTAT - FAO Statistics
FCPF - Forest Carbon Partnership Facility
FSD - Forestry Services Division
FRL - Forest Reference Level
GCF - Green Climate Fund
GCARP - Ghana Climate Ambitious Reporting Programme
GCRFP - Ghana Cocoa Forest REDD+ Programme
GDP - Gross Domestic Products
GEF - Global Environment Facility
GFOI - Global Forest Observation Initiative
GHG - Greenhouse Gas
GPDP - Government Plantation Development Programme
GIS - Geographic Information System
GSLRP - Ghana Shea Landscape REDD+ Programme
GSP - Global Support Programme
GWh - GigaWatt hour

HIA - Hotspot Intervention Areas
HDI - Human Development Index
IPCC - Inter-governmental Panel on Climate Change
IPPs - Independent Power Producers
IPPU - Industrial Process and Product Use
IRRP - Integrated Resource and Resilience Planning
ISSER - Institute for Statistical, Social and Economic Research
KNUST - Kwame Nkrumah University of Science and Technology
LCO - Light Crude Oil
LULUCF - Land Use Land Use Change and Forestry
LPG - Liquified Petroleum Gas
MESTI - Ministry of Environment, Science, Technology and Innovation
MTS - Modified Taungya System
MtCO2e - Million Tonnes Carbon Dioxide Equivalent
MOU - Memorandum of Understanding
MRV - Monitoring Reporting Verification
MW - Mega Watts
NAMA - Nationally Appropriate Mitigation Actions
NCCP - National Climate Change Policy
NDC - Nationally Determined Contribution
NDPC - National Development Planning Commission
NFPDP - National Forest Plantation Development Programme
NIR - National Inventory Report
NSZ - Northern Savannah Zone
POA - Programme of Activities
PPP - Purchasing Power Parity
QA/QC - Quality Assurance Quality Control
REDD+ - Reducing Emission from Deforestation and Forest Degradation
RA - Reference Approach
SA - Sectoral Approach
SMEs - Small-Medium Enterprise
SPIS - Solar-Powered Irrigation System
SAR - Second Assessment Report
SREP-P - Scale-up Renewable Energy Penetration Programme
SREP-IP - Scale-up Renewable Energy Penetration Investment Programme
TEN - Tweneboa Enyenra Ntomme
TICO - Takoradi International Company
TNA - Technology Needs Assessment
TOR - Tema Oil Refinery
TT1PS - Tema Thermal 1 Power Station
UNFCCC - United Nations Framework Convention on Climate Change
VALCO - Volta River Authority
W2E - Waste to Energy

ES

Executive Summary

Seat of Government

ES 1. Updates on country situation

Ghana is a lower middle-income developing country in the West African-sub-region of Africa. It has a varied geography and a changing tropical climate. Despite the consistent steady economic growth over the last decade, the threats of the impacts of climate change militate against the prospects of doubling Ghana's GDP in the medium-term. The country's reliance on the exploitation of natural resources for economic development against the backdrop of rising population have instigated rapid urbanisation, deforestation and fossil-intensive energy consumption especially in transportation and electricity generation has led to increasing GHG emissions. Nevertheless, the development choices promises to deliver growth-focus, people-centred and climate-proof outcomes. Ghana's strategy tackle climate change has been articulated in its recent medium-term development policy framework (dubbed - Agenda for Jobs: Creating Prosperity and Equal Opportunity for All (2018-2021) and the National Climate Change Policy. The Ministry of Environment, Science, Technology and Innovation (MESTI) coordinates Environment and Climate change issues supported by the Environmental Protection Agency (EPA). The EPA facilitates the regular preparation of the National Communications (NATCOMs), National GHG Inventory Report (NIR) and Biennial Update Report (BUR) as well as its consideration under the International Consultation and Analysis (ICA). Besides MESTI and EPA, there are a host of Government institutions, CSOs, Academia and Private sector organisation that contributed to the preparation of BURs which took nearly 2 years to finish.

ES 2. National Greenhouse Gas Emissions and Short-lived Climate Pollutants Inventory

Greenhouse Gas and Short-lived Climate Pollutant emissions inventory was conducted for the period 1990-2016 using the 2006 IPCC Guidelines. The total national GHG emissions are estimated at 42.2 million tonnes carbon dioxide equivalent in 2016 which is 66.4% and 7.1% more than the levels reported in 1990 and 2012 (Figure ES1). The rising trends in the GHG emissions is attributed to the growing population, economic diversification measures being implemented by the government. The AFOLU sector, being the largest source, contributes 54.4% of the total national GHG emissions in 2016. In the AFOLU sector, grassland (38.4%) and cropland (36.3%) contribute most to the emissions through deforestation. The Energy sector is the second largest contributor (35.6%) to the national GHG emissions in 2016.

Within the sector, road transport (47.7%) and thermal electricity generation (32%) are the two dominant sources of greenhouse gas emissions. The rest of the emissions come from manufacturing industry and construction (7.2%), other sector (10.2%) and oil and natural gas (0.2%). GHG emissions from the Waste and IPPU sectors have been identified to contribute to 7.5% and 2.5% of the total national emissions respectively. In Waste, wastewater treatment (58%) and solid waste disposal (36.5%) are the main sources of GHG emissions. Under IPPU, product as substitute of ODS (58.8%) and mineral industry (32.1%). Some selected key categories are: (a) lands converted to cropland, (b) lands converted to grassland, (c) road transportation, (d) energy industries etc.

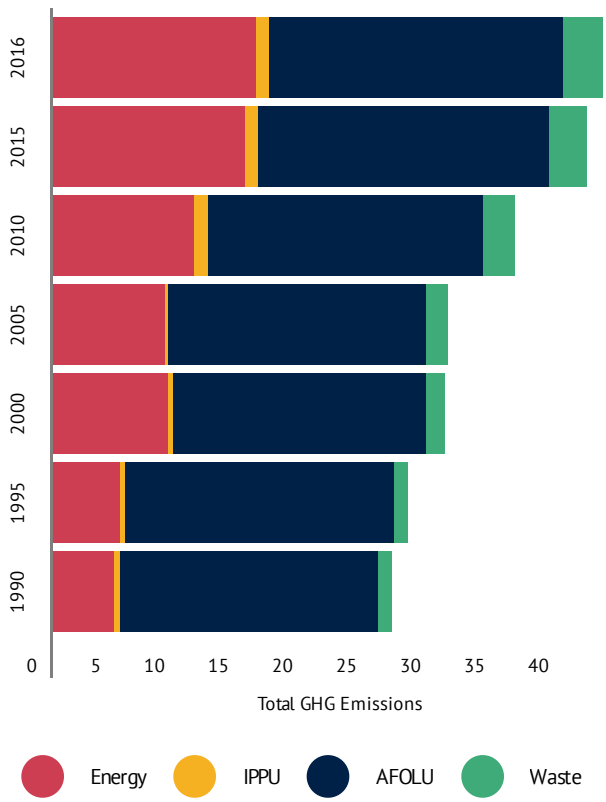

Figure ES1: GHG Emission Trends for the period 1990-2017

In 2016, when emissions were evaluated according to the type of gas, for the GHGs, carbon dioxide was the commonest totalling 27.7 Million tonnes (Figure ES2). The main sources of carbon dioxide emissions are as follows: (a) land use change (46.5%), road transport (21.4%) and electricity generation (17.3%). In the land category, while grassland (8.8 Mt) and cropland (8.3 Mt) were emission sources, the forestland was a net sink removing 4.7 Million tonnes of carbon dioxide from the atmosphere. Since 2012, the total carbon dioxide emissions recorded increases of 6.1% relative to the 2016 levels.

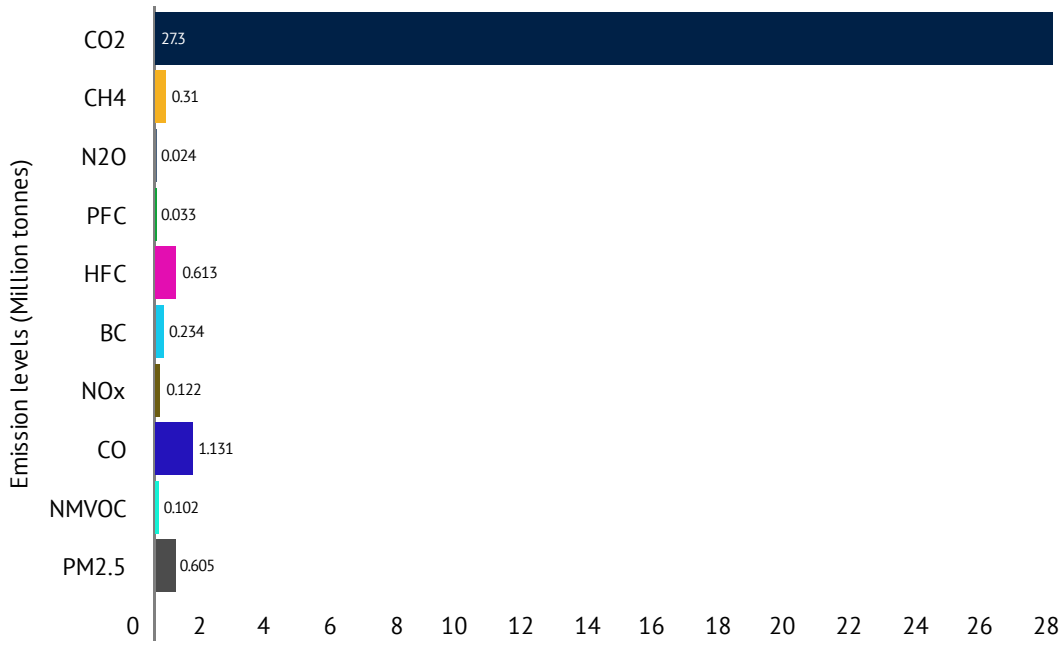

Figure ES2: Total emission levels according gases by 2016

Methane gas is both GHG and SLCP. It levels of 0.32 Mt makes methane the second dominant GHG and the largest source of SLCP. Majority of the methane emissions were produced from livestock (48.3%), of which 94% are emitted through enteric fermentation. The rest come from wastewater treatment and discharge (19%) and solid waste disposal (16.9%). Emission levels of the rest of the greenhouse gases are as follows: nitrous oxide (0.025 Mt), Perflourocarbons (0.613 $MtCO_2e$) and Hydroflourocarbons (0.033 $MtCO_2e$). Carbon Monoxide and Black Carbon recorded 1.1 Mt and 0.2 Mt respectively (Figure ES2).

ES 3: Mitigation actions and their effects

Emission reduction target (2011-2030)	Av. annual emission reduction (2011-2017)	3 Forestry Mitigation Actions (2011-2017)	16 Energy Mitigation Actions (2011-2017)	1 Waste Mitigation Action (2013-2017)
2.2 MtC/yr	**2.0 MtC/yr**	**24 ktC/yr** **Potential 4.2 MtC/yr**	**323.9 ktC/yr**	**355.9 ktC/yr**

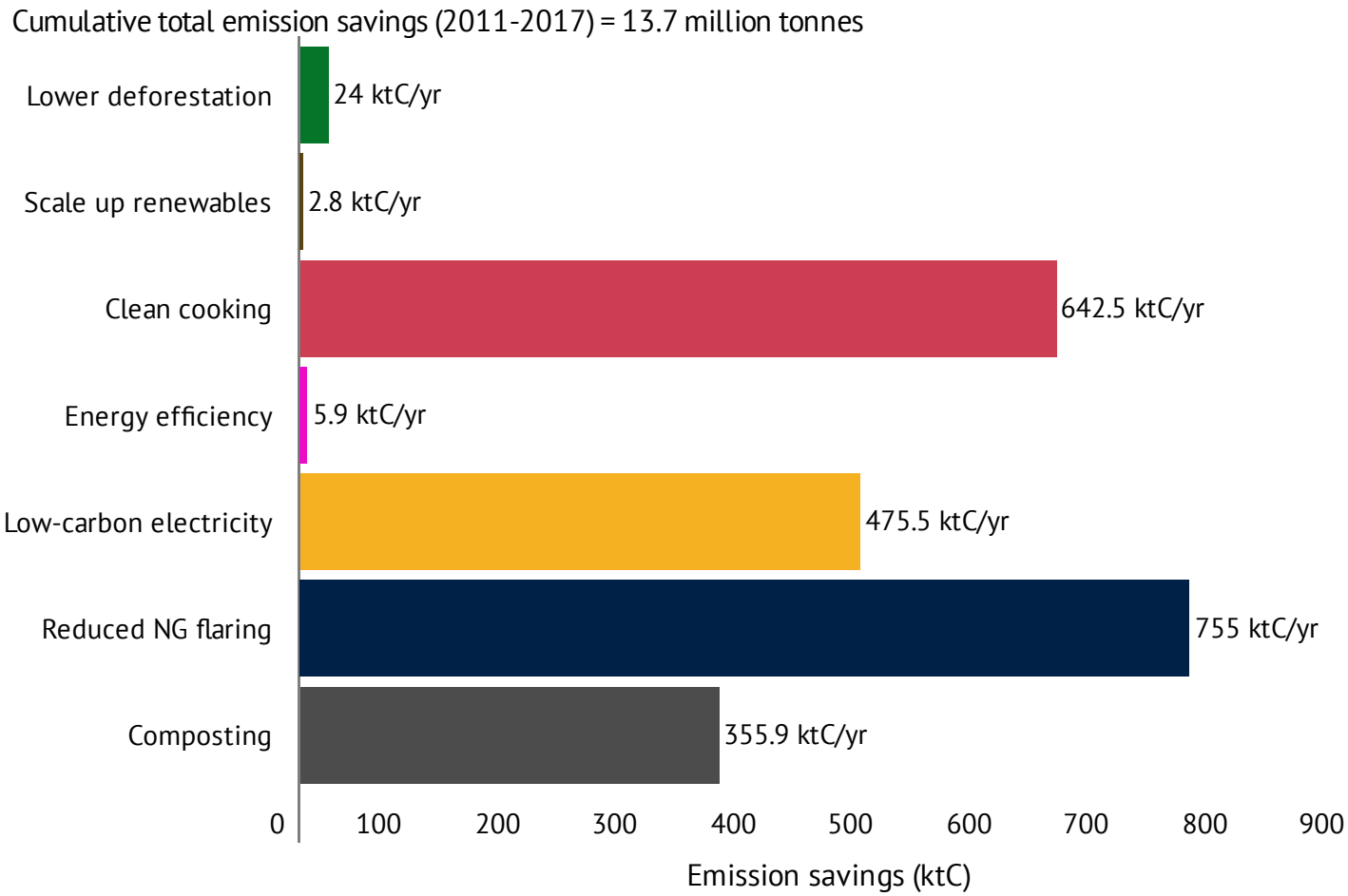

Figure ES3: Chat showing mitigation actions and emission savings

Overview of mitigation measures and components

Renewable energy measures
6 components. These are: utility-scale renewables, distributed solar PV, renewable energy-based mini grid, productive use of renewables, solar lamps and off-grid renewables.

Energy efficiency
5 components. These are: consumer awareness & training, capacitor banks, web-based energy efficiency APP for electronic appliance, LED street lighting, Automatic timer switches.

Energy policies & measures
4 key policy and measures including Renewable Energy Act, Renewable Master Plan, Scaling-up Renewable Energy-Investment Plan, SEforAll Action plan, Energy Efficiency Regulations.

Clean cooking
2 components. These are: LPG Promotion Programme, Efficient cookstoves.

Low carbon electricity
2 components. These are: single cycle to combined cycle thermal plants, Fuel switch for heavy fuels to natural gas.

Composting
1 component. Waste to compost

Reduced flaring
1 component. Reduced flaring from oil fields

ES 4: Updates on domestic MRV system

In 2013, Ghana launched the "Climate Ambitious Report Programme (GCARP) as its domestic MRV system. The GCARP is an integrated system for GHG, Climate Action and Support. Since the submission of Ghana's BUR 1, the following are some of the key achievements in the operationalisation of the GCARP:

- The Ministry of Finance has taken up the responsibility of tracking climate support received by the Ministries, Local Government Authorities, Private sector, and CSOs. Afterward, the Ministry has developed a climate finance tracking tool (http://www.mofep.gov.gh/sites/default/files/docs/Climate-Change-Tracking-Tool.pdf) for use.

- The EPA established an online climate data-hub (http://climatedatahubgh.com/gh/) dashboard for Ghana's climate reporting. It serves as a one-stop information sharing portal on facts about Ghana's actions to tackle climate change and the benefits thereof.

- The EPA has developed and adopted the following: (a) an automated standard mitigation template (http://mestiqna.igreengrowthsolutions.com) and put for public access for capturing information on climate actions); (b) GHG inventory manual and QA/QC and Uncertainty Management and (c) initiated the incorporation of climate change indicators into the environmental reporting by industrial facilities.

- The Forestry Commission has started work to establish a national forest monitoring system to improve REDD+ reporting. As part of this initiative, the Forestry Commission has developed 12 standard operating procedures (SOPs) to guide the setting up of forest reference level and LULUCF GHG inventory. The Commission has also started the process to establish a Forest Reference Levels.

- The Forestry Commission has developed a safeguard information management system web platform.

- The state-run Volta River Authority (VRA), the only public electricity utility, has introduced a voluntary carbon accounting programme. Under the programme, the VRA has finalised its first corporate carbon accounting reporting and being peer reviewed by Ghana's EPA before it is officially published.

ES 5: Information on support received

Climate change support inflows come in the form of finance, technical assistance and capacity building. The Ministry of Finance and the Environmental Protection Agency conducted national survey to collect climate inflow data on one hundred and one (101) projects. The data was obtained using questionnaire and information from the webpages of donors and recipient institution for the period 2011-2017. In all, climate finance data on were collected and a total of US$15.5 billion has been "committed*" to the projects. Of the 101 projects, 59 of them fall within the climate-specific category which of a total US$351.3 million was committed to for the same period. For 4 of the climate-specific projects, the funds committed are unknown because it is a pool of funds donor earmark for two more countries. The remaining 42 projects are classified as climate-relevant projects and US$15.12 billion were committed to them for the period. In terms of the type of financial instruments of the committed funding, 78 of all the projects are grants totalling up to US$949.9 million, 10 are loans with a value of US$14.4 billion, 3 are from national budget as co-finance with a total of US$78.6 million and the remaining 6 are unknown.

* Committed funds - are funds the development partner earmarked for disbursement in a given financial cycle. The committed amounts do not represent amount disbursed or realised by the donor to the recipient institutions.

ES 6: Financial, technical and capacity needs

Ghana still faces financial, technical and capacity challenges in the implementation of its national climate change strategies. The levels of financial and capacity needs differ for various Ministries. The list of financial, technical and capacity needs is in table ES1 below:

Table ES1: List of climate change support needed

Measures	Objective	Alignment to NCCP	Amount Needed ($)	Implementing Entity	Priority level
Comprehensive study of fugitive emissions in the emerging oil & gas sector	Make available high quality activity and emission factor from oil and gas operations	Focus programme 10: National Climate Change Policy	300,000	EPA, Energy Commission, Petroleum Commission	High
Development of country-specific emission factors for road transport, livestock, solid and domestic liquid waste categories and improvement in data collection systems.	Increase confidence in the transport GHG emission estimation	Focus programme 10: National Climate Change Policy	350,000	EPA, Ministry of transport, DVLA, Energy Commission	High
Development and improvement of non-energy sector mitigation assessment	Estimate mitigation potential in non-energy sectors with increased certainty	Low Carbon Development Strategy/NDCs	200,000	EPA and relevant sectors	Medium
Waste sector activity data improvement and management project	Identify, collect activity data and improve ways for continuous collection.	Low Carbon Development Strategy/NDCs	200,000	EPA and Ministry of Local Government and Rural Development	High
Sustainable wood-based fuel production and development for domestic energy supply	Improve efficiency of wood fuel production and ensure development of alternative bio-fuels for sustainable energy supply in Ghana	Focus programme: 4 & 5 of National Climate Change Policy	1,500,000	Ministries of Lands and Natural Resources, and Food and Agriculture	Medium
Expand facility level carbon accounting programme	Facilitate regular reporting of emission and activity from industry.	Low Carbon Development Strategy	120,000	EPA, Ministry of Trade & Industry, Associations of Industry	High
Energy statistics development and improvement project	Improve quality of energy statistics including its metadata and uncertainty estimation	National Energy Planning, Domestic MRV	150,000	Energy Commission, EPA, Ghana Statistical Service	High
Industry and ODS Activity data collection project	Collect relevant industry and ODS activity data through a national survey	Focus programme 10: National Climate Change Policy	130,000	EPA, Ministry of Trade & Industry, Ghana Custom Services	Medium

1 Introduction

1. Background

As a Non-Annex 1 Party to the UNFCCC, Ghana is enjoined by decision 2/CP.17, paragraph 41 (a) to submit its first Biennial Update Report (BUR) by December 2014 and every two years afterward 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. For continuity in the reporting, the Environmental Protection Agency facilitated the preparation and compilation of Ghana's second BUR (BUR2). The BUR2 has been prepared in accordance with the guidelines contained by decision 2/CP.17 for Parties not included Annex 1 to the Convention as a stand-alone report for submission in September 2018 to the UNFCCC secretariat.

New reforms were introduced into the national arrangement for BURs preparation particularly : (a) bettering institutional coordination, (b) automating data management system, (c) facilitating greater human capacity development, (d) dissemination and uptake of the BUR results. The BUR2 contains the results of the 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 20 public and private organisations, CSO and the academia were involved in the BUR2 preparation. The information in the BUR2 have been structured as follows:

- Introduction - frames the scene by providing the legal basis of the BUR.
- National circumstances - visualises the current state of Ghana, the future prospects and its implications for climate change.
- GHG inventory - captures the national GHG inventory steps for the period 1990-2016 and the results in terms of levels, trends and key sources/removals.
- GHG mitigation actions and their effects - provides an overview of the historical GHG emissions, projections, emission reduction targets and the strategies for achieving the targets.
- Domestic MRV system - contains an updates on the operationalisation of Ghana's domestic MRV.
- Constraints, gaps, and related financial, technical and capacity needs and support received.

Financial and technical support for the preparation of the BUR2 was provided by the Global Environment Facility (GEF) via the UN Environment. Additional support was received from the UNDP through the NDC Support Programme. Ghana's inability to submit the BUR2 on time was due to the delay in securing funds from the GEF immediately after submitting the BUR1.

2 National Circumstances and Institutional Arrangements

Accra central business district showing the National Theatre

2. National circumstances

2.1 Country Overview

Ghana is a lower-middle income developing nation in West Africa and has a vibrant democracy (Table 1). The economy relies strongly on the extractive industry and an agricultural production base. In spite of the consistent economic gains, the country is still facing challenges associated with rising population such as poverty, access to education and healthcare, pollution, environmental change and energy access (Table 2). A significant amount of the country's resources has been committed to better the lives of Ghanaians and secure the future economic prosperity of the nation. Ghana aspires to become a high-income country by 2056. The strategy is to put the economy on a sustainable growth trajectory by doubling per capita GDP in the medium-term. However, climate change threatens to retard current economic gains and future aspirations of the country. That is why Ghana is investing in climate proof intervention in the midst of myriad development challenges and promises to do even more through the ambitious actions it has committed to in its Nationally Determined Contributions (NDCs).

Table 1. Ghana at a glance

Indicators	Description of indicators
Territory	Land area of 239,460km2 with 560km2 coastline.
	Divided into 10 administrative regions and further into 254 districts
Population	Estimated 28.2 million people in 2016 with 54.6% living in urban areas.
Climate	Tropical; warm and comparatively dry along southeast coast.
	Hot and humid in southwest; hot and dry in north.
Ecosystem	Agro-ecological zones: Wet Evergreen, Rain forest, Deciduous forest.
	Transitional, Coastal savanna, Guinea savanna and Sudan savanna.
Water resorces	Freshwater covers nearly 5% of the total land area. (11,800km2)
	The Volta, South Western and Coastal river systems have total annual run-off of 54 billion m3.
Energy mix	In 2016, final energy consumption amounts to 7,085.5 ktoe of which, 47% petroleum products, 39% biomass and 14% electricity.
	Total installed generation capacity was 3,795 MW in 2016
	Total electricity generated was 13,022 GWh of which, 42.7% hydro, 57.1% thermal and 0.2% renewable sources (Biogas and Solar PV).
National GHG emissions	In 2016, 42.9 MtCO2e. Energy (36.8%), IPPU (2.4%), AFOLU (53.4%) and Waste (7.4%)
Vulnerable population	Over 12 million people who live in savanna drylands and coastal belt are the most vulnerable to climate change.

Sources: Ghana's Third National Communication, National Energy Statistics and Ghana Statistical Services

Table 2: Socio-economic parameters in Ghana

Indicators	1990	1995	2000	2005	2010	2016
Gross Domestic Product (GDP) ($ billions)	6.59	6.47	4.98	10.73	32.17	42.80
GDP per capita ($)	438.61	385.73	263.11	498.17	1312.61	1517.49
Agriculture Gross Domestic Product (% of GDP)	45.63	47.98	45.79	45.96	33.81	24.17
Industry Gross Domestic Product (% of GDP)	16.96	24.28	25.4	25.13	18.01	22.69
Service Gross Domestic Product (% of GDP)	37.41	27.74	28.81	28.91	48.18	53.14
Human Development Index (HDI)	0.45*	0.47	0.48	0.51	0.56	0.58
Gini Index	38.4	40.1	40.1	42.8	42.4	42.4
Percentage of population living with less than USD 1.90 (2011 PPP) per day	49.8	35.7	35.7	24.5	12	12

* Missing data. 1991 data repeated in 1990

Source: World Bank Data on Ghana

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2.2 Policies relevant to climate change

In the first BUR, Ghana outlined critical national and sector policies relevant to climate change. Implementation of the policies is continuing and already yielding positive results in scaling-up renewable energy, lowering deforestation, promoting clean cooking, mobilising finance, intensifying stakeholder engagement and developing capacities (Figure 1). Despite the fiscal challenges facing the country and the pressing economic needs, climate change has featured prominently in the latest national development policy. In addition, Ghana has further committed to concrete emission reduction goal in its nationally determined contributions (NDCs).

Since the submission of the first BUR, the following are some achievements on the policy front:

- Committed to unconditionally lower its GHG emissions by 15% relative to a business-as-usual (BAU) scenario emission of 73.95 $MtCO_2e$ by 2030.

- Voluntarily pledged an additional 30% emission reduction on condition that external support is made available to cover the full cost of implementing the mitigation action.

- Adopted National Gas Master Plan in 2016 to provide the enabling environment for increased investment in the gas sector. Mobilised investments to the tune of $13.2 billion in the Jubilee, TEN and Sankofa gas fields with an estimated 1,990 Billion cubic feet (Bcf).

- Increased utility-scale solar installed capacity from 2.5MW to 22.5MW and planned additional 72MW solar and 150MW wind in the next decade.

- Adopted the national REDD+ strategy and the Ghana forest plantation strategy to help tackle the drivers of deforestation and restoration of degraded lands.

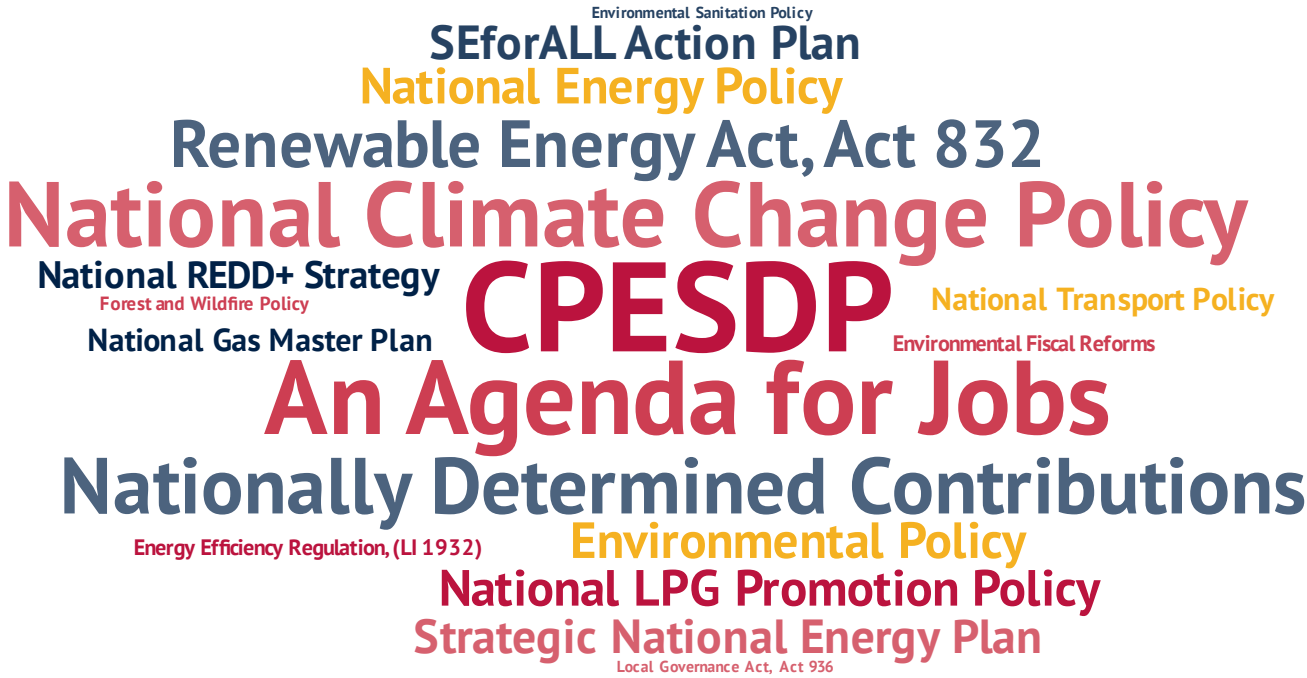


Figure 1: Climate change relevant policies, strategies and instruments

2.3 Institutional Arrangement

Ghana has put in place an institutional arrangement for regular preparation of its national communication and biennial update reports (Figure 2). The Ministry of Environment, Science, Technology and Innovation (MESTI) is the sector lead for Environment and Climate Change issues and works closely with the Environment Protection Agency (EPA) at its Agency. The EPA leads the preparations of Fourth National Communications (NC4), Second Biennial Update reports (BUR2) and the latest greenhouse gas inventory report (NIR) based on the legal mandate derived from EPA Act 490. The EPA reports to MESTI who chairs the steering committee. MESTI is also responsible for the official approval and endorsement of BUR and NC4 for onward submission to UNFCCC. The EPA ensures the overall quality of the BUR and also compiles of final BUR for third-party review before submission.

More than 20 public, private organisations, CSO and the academia contributed to the preparation of the BUR2 and they occupy the second tier in the organogram. The institutions involved in the preparation of the BURs are constituted into three working groups with each responsible for a specific reporting theme (Figure 2). The institutions** were selected based on the relevance of their work, experience and commitment levels through official nomination from the respective organisations. The role of the three working groups involving data collection, assessment and chapter compilation were captured in the memorandum of understanding (Table 3). The data providers are at the third tier of the organogram. They supplied data to the working groups an official request and are exchanged through an online portal address given below. Each sector data provider is granted access to this Url link (http://mestiqna.igreengrowthsolutions.com/).

Below are some of the changes and achievements in the institutional arrangement since the first BUR

- Intensified institutional participation in the BUR preparation. More than twenty organisations were involved in the second BUR.
- Ministry of Finance assigned the task of tracking climate finance.
- Prepared and adopted new GHG manual and QA/QC plan.
- Trained more than thirty experts on various topics on mitigation and GHG inventory.

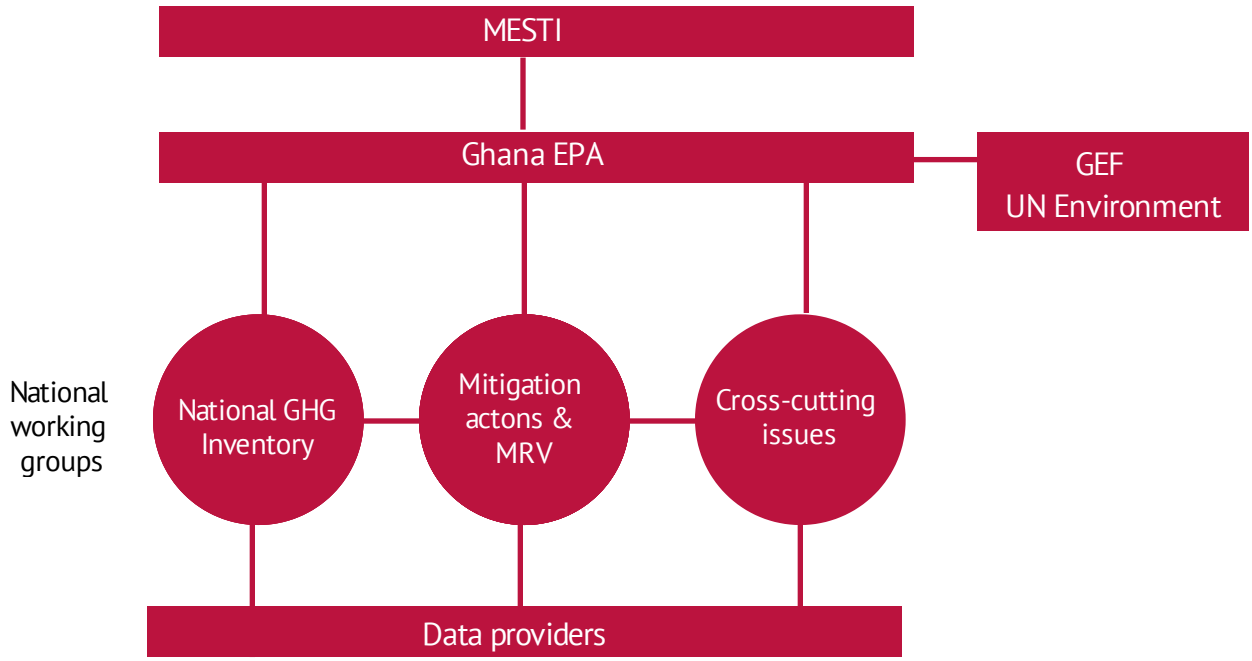


Figure 2: Overview of the institutional arrangement for the preparation of BURs

** Ministry of Agriculture, Forestry Commission, Energy Commission, Ministry of Finance, Kwame Nkrumah University of Science and Technology, CSIR- Forestry Research Institute, Animal Research Institute, UN-INRA, EPA, Zoomlion Ghana Limited, SNV, CERSGIS, Ministry of Transport, Volta River Authority, Ministry of Finance, NDPC, Ghana Civil Aviation Authority, University of Ghana Business School etc.

Table 3: Institutions and thier roles in the preparation of the BUR2

Institution	Chapter contribution	Relevant BUR chapters/Role	Data Source	Data Provider/Remarks
Ministry of Finance	Country overview, tracking finance	National circumstances	State of the Ghanaian Economy, Annual Budget Statement	ISSER, Ghana Statistical Services, Ministry of Finance
National Development Planning Commission	Development policies, institutional arrangement	National circumstances	Medium-term Development Policy Framework, State of the Nation Address (SONA)	NDPC, Parliament of Ghana
University of Ghana School of Business	Tracking finance, development policies	National circumstances	Survey data on climate finance tracking, State of the Ghanaian Economy	Ministry of Finance
ISSER	Country overview, tracking finance	National circumstances, Supported recieved	State of the Ghanaian Economy, Annual Budget Statement	ISSER, Ghana Statistical Services, Ministry of Finance
Environmental Protection Agency	Institutional arrangement, country overview	National circumstances	National Climate Change Policy, Third National Communication	MESTI, EPA
Ministry of Agriculture	Livestock Emissions	National GHG Inventory - AFOLU section	Agriculture Facts and Figures	SRID, Ministry of Food and Agriculture
	Emissions from fertiliser application	National GHG Inventory - AFOLU section	Agriculture Facts and Figures	SRID, Ministry of Food and Agriculture
	Emissions from rice cultivation	National GHG Inventory - AFOLU section	Agriculture Facts and Figures	SRID, Ministry of Food and Agriculture
Forestry Commission	Emissions from Land use changes	National GHG Inventory - AFOLU section	1990, 2000, 2012, 2015 Land use maps (National REDD+ FREL)	National REDD+ Secretariat, Forestry Commission
	Emissions & Removal Factors	National GHG Inventory - AFOLU section	REDD+ FREL	National REDD+ Secretariat, Forestry Commission
	Forestry mitigation actions	Mitigation actions and their effects	National forest plantation development annual report, Cocoa REDD+ Programme	National REDD+ Secretariat, Forestry Commission
Environmental Protection Agency	Quality control/Quality Assurance	BUR2 Report	Chapter Reports from the national working groups	Individual working groups
	Training of new and experienced experts	Prepare training materials and organise training for experts.	Training materials on new topic GHG inventory and mitigation action topics	EPA technical support group
	Templates for tracking of mitigation actions	Sector use the template to report on individual mitigation actions	Online data template	EPA

Forestry Commission	Wood removal, woodfuel & fire affected areas	National GHG inventory - AFOLU section.	RDD+ FREL	National REDD+ Secretariat, Forestry Commission
Energy Commission	Fuel supply and consumption patterns.	National GHG inventory - Energy section	Annual Energy Statistics	Energy Commission
	Energy sector mitigation actions.	Mitigation actions and thier effects	Annual Energy Statistics	Energy Commission
	Electricity generation and oil refinery, wood fuel consumption	National GHG inventory - Energy section	Annual Energy Statistics	Energy Commission
National Petroleum Authority (NPA)	National fuel consumption	National GHG inventory - Energy section	NPA fuel consumption data	NPA
Ministry of Transport	Vehicle population & Traffic data	National GHG inventory - Energy section	DVLA statistics	Ministry of Transport
Ghana Civil Aviation Authority (GCAA)	Domestic airplanes, Domestic and international ATK Consumption.	National GHG inventory - Energy section	GCAA Data	Ministry of Transport
Environmental Protection Agency	Industry output per sector	National GHG inventory - IPPU section	Environmental statistics	EPA
	Industrial wastewater	National GHG inventory - Waste section	Environmental statistics	EPA
	HFC consumption	National GHG inventory - IPPU section	National survey	EPA
Volta Aluminium Company (VALCO)	Aluminium Production	National GHG inventory - IPPU section	VALCO Production Figures	VALCO
Local government Authority	Municipal Solid Waste	National GHG inventory - Waste section	District Assembly waste data	District Assemblies

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

3. Updates of National GHG Inventory

3.1 Overview of the National GHG Inventory

New updates of the national GHG inventory results in the first BUR has been presented in the BUR2 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 annex to decision 17/CP.8". Full details of the results, the methodologies, and the steps followed will be provided in the third National Inventory Report (NIR 3) as a stand-alone report. The updates in the national GHG inventory are due to recalculations and the inclusion of new estimates in recent years. The current inventory covers the period 1990-2016. Recalculations have been conducted on GHG emission estimates for 1990 - 2012 for all sectors due to the discovery of new datasets and addition of new emission sources. The latest inventory GHG inventory estimates for 2013 - 2016 have been added. The IPCC Second Assessment Report (SAR) 100-year time horizon GWPs was used in inventory.

The national GHG inventory was conducted using 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. The EPA coordinates the overall preparation of the national GHG inventory. As the lead in the GHG inventory, the Agency collaborates with many stakeholders to plan, prepare and compile the national GHG estimates. Within the EPA, the Climate Change Unit is the national inventory entity and is directly responsible for the management of the entire inventory process. The unit ensures that the delivery of the inventory is timely, of good quality and above all meet international standards. There are four national working groups responsible for completing the inventory for the Energy, IPPU, AFOLU and Waste sectors.

3.2 Brief Description of the GHG Inventory Steps

The GHG inventory involved the following steps (Figure 3):

- 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 direct of GHG emissions CO_2, CH_4, N_2O, F-gases and selected 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 of all dataset on online database.

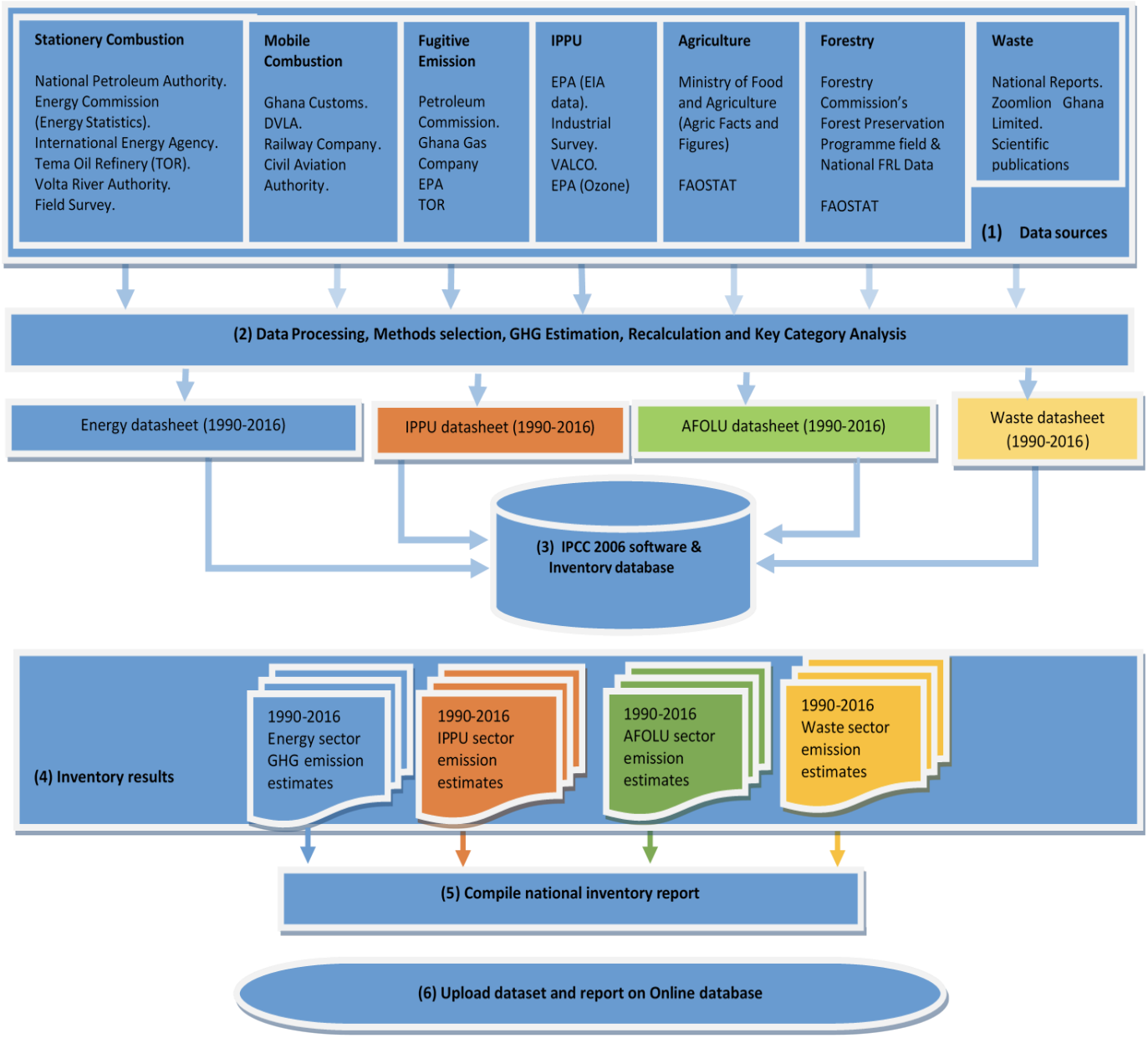


Figure 3: Steps followed in the National GHG inventory

3.3 Brief Description of Choice of Methods

The calculation of the emissions/removals for each category was done according to the 2006 IPCC Guidelines. The selection of the methods follow the decision-tree approach illustrated in IPCC, 2006. Generally, a tier 1 IPCC methodology was applied to most of the sectors, except in cases where available national data allows adoption of a higher tier. The availability of facility-level data from Volta Aluminium Company (VALCO) and land-use changes enabled the use of tier 2 methodology for the estimation of emissions from Aluminium production and the Land categories. On the whole, the methods for Ghana's GHG inventory have seen some improvements towards a combination of tier 1 and tier 2 estimation methods that capture new country-specific activity data (Table 4). The majority of EF used in the inventory were default IPCC factors except under the Land and Aluminium categories that country- specific factors have been used.

Table 4: List of emissions/removals category, methodological tiers and emission factors

Source and Removal Categories		CO2		CH4		N2O		PFCs		HFCs	
IPCC codes	Category	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	T1	D				NE				
2.B	Chemical Industry	NO	NO	NO	NO	NO	NO				
2.C	Metal Production	T2	PS					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	T1	D				
3C	Aggregate sources and non-CO2 emissions sources on land	T1	D			T1	D				
4.A	Solid waste disposal	T1	D	T2	D	T1	D				
4.B	Biological Treatment of Solid Waste	T1	D	D	D	D	D				
4.C	Incineration and Open Burning of Waste	T1	D	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

3.3.1 Methodological Choices for the Land category

The country-specific EF and AD used for the Land category inventory were obtained from the studies conducted under Forest Preservation Project (FPP) and recently during the preparation of the national forest reference level (FREL). As much as possible, the Land category inventory relied on the data used in the FREL. The major difference between the FREL and Land inventory is the level completeness of activity data. Under the Land category, the inventory cover all six IPCC classes, emissions/removals from land use changes pathways (loss, gain and persisted) were taken into account unlike the FREL that only considered forest loss, annual biomass increment for both natural forest and tree plantation were included but the FREL accounted for enhancement from tree plantation. The data used in land category inventory are in Table 5:

Table 5: List of activity data in the Land category and the methods used to generate them

Land inventory variable	Description of task	Output
Managed and unmanaged areas	Identification and extent of areas into managed and unmanaged	GIS layers of area of unmanaged and managed
Ecological zones	Delineation of boundaries of 9 ecological zones	GIS layers of eco zones
Soil classification	Soil and climate classifications	Country GIS soil and climate, FAO soil classification map
Land representations	Wall-to-wall mapping and calculation of areas of six IPCC land cover classes	Landsat satellite imagery
Land use change	Change detection of 1990, 2000, 2012, 2015 map to derive change matrix	Land change matrix
Accuracy Assessment of land use map	Build land use accuracy matrix using field validation data	Accuracy matrix
Enhancement	Categorisation of forest into natural forest and tree plantations	Forest land remaining forest land divided into areas of natural forest and tree plantation
Removal _timber harvesting	Legal and illegal logging extract from field records region & peer-reviewed literature (Hansen et al. 2012, Nketia et al, 2014 & Marfo, 2009)	Volume of wood extracted via legal and illegal logging
Removal_areas affected by fire	Mapping of parts of forest affected by fire based on number of fire spots and areas burnt using MODIS Burned Area Product	Fraction forest annually burned
Removal_woodfuel harvested	Extract figure of total national woodfuel supply and consumption from the National Energy Statistics.	Annual figures of wood fuel supply and consumption

3.4 National Greenhouse Gas Emissions

3.4.1 Greenhouse Gas Emissions Trends

The total national greenhouse gas emissions were estimated at 42.2 $MtCO_2e$ (million tonnes carbon dioxide equivalent) in 2016. The 2016 emissions are 66.4% and 7.1% higher than the previously reported 1990 and 2012 emissions levels as a results structural changes in the Ghanaian economy . The AFOLU sector has been identified to be consistently the most significant source of greenhouse emission in Ghana (Figure 4). In 2016, 54.4% of the total national emissions were from the AFOLU sector and followed by the Energy (35.6%), Waste (7.5%) and IPPU(2.5%) sectors.

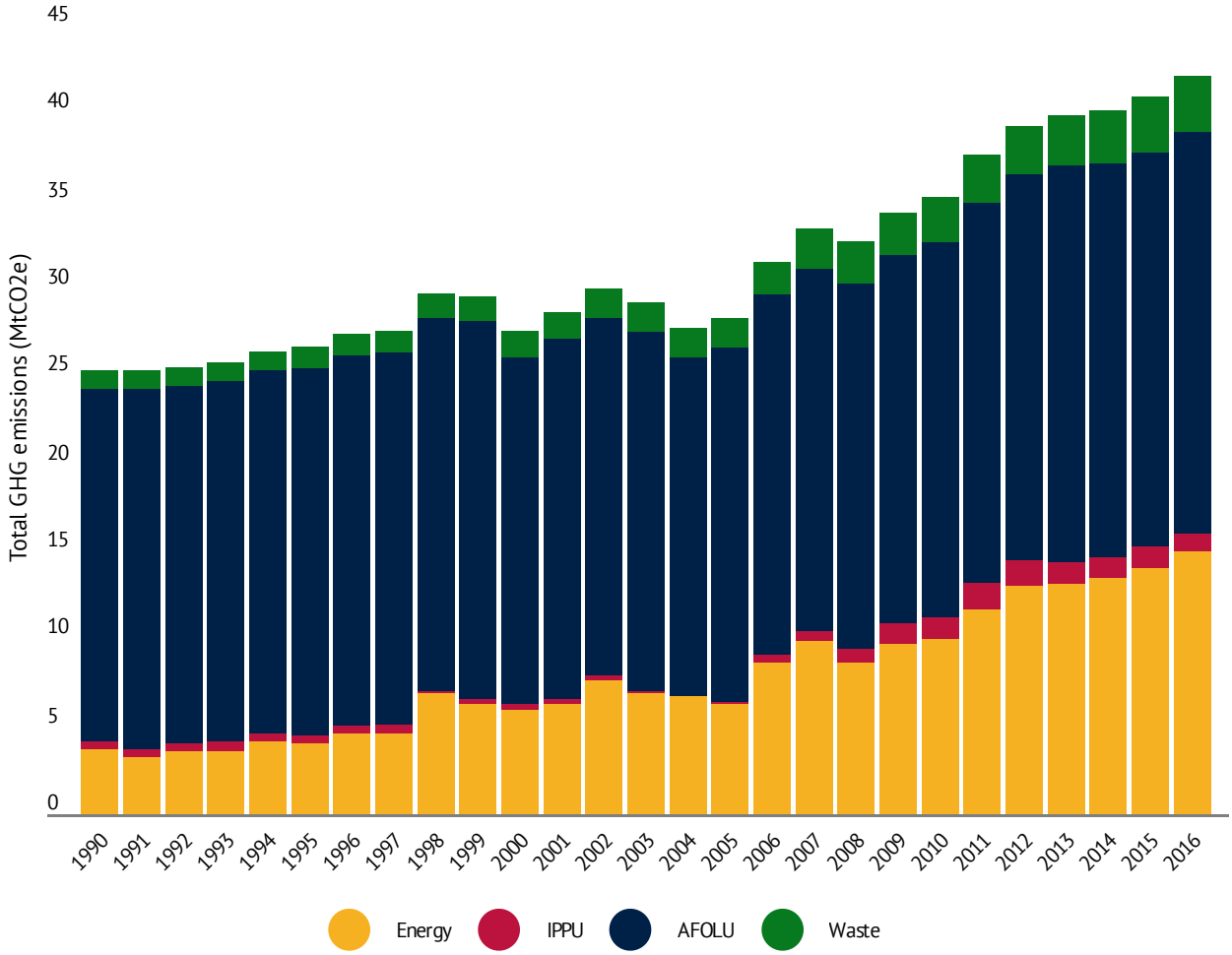


Figure 4: Total national GHG emission trends according to sectors for the period 1990-2016

When the emissions/removals from the Land category (IPCC Code 3B) were excluded from the national totals, the emissions were 19.2 $MtCO_2e$ in 2016 with the Energy sector as the main source. On the gas-by-gas basis, carbon dioxide is by far the most dominant direct greenhouse gases and followed by nitrous oxides, methane, HFCs and PFCs. Table 6 presents emission according to different types of gases. The AFOLU and Energy sectors are the two largest sources of carbon dioxide emissions. AFOLU and waste sectors are the main sources of methane emissions. Within the AFOLU sector, Livestock contributed 77.3% of the methane emissions. For nitrous oxide emissions, 86% are from Aggregate sources and non-carbon dioxide emission sources on land category (Table 7). All the F-gases are emitted from the IPPU sector. Within the IPPU sector, HFCs were from the product uses as a substitute to Ozone Depleting Substance (ODS) whereas the PFCs were from the metal industry. SF_6 emissions have not been estimated (NE) due to lack of data.

Table 6: GHG and Non-GHG emissions presented on gas-by-gas basis in 2016

Categories	Emissions (Gg)			Emissions (Gg CO2e)			Emissions (Gg)			
	Net CO2	CH4	N2O	HFCs	PFCs	SF6	NOx	CO	NMVOCs	BC
Total National Emissions and Removals	27,285.46	309.99	24.86	613	33.32	-	117.68	1,116.04	92.56	6.1
1 - Energy	13,973.47	31.34	1.24	-	-	-	95.68	588.29	92.56	6.1
1.A - Fuel Combustion Activities	13,965.23	30.58	1.24	-	-	-	95.68	588.29	92.56	6.1
1.B - Fugitive emissions from fuels	8.24	0.76	0.0001	-	-	-	-	-	-	-
2 - Industrial Processes and Product Use	394.89	-	-	613	33.32	-	-	-	-	-
2.A - Mineral Industry	334.08	-	-	-	-	-	-	-	-	-
2.C - Metal Industry	58.74	-	-	-	33.32	-	-	-	-	-
2.D - Non-Energy Products from Fuels and Solvent Use	2.08	-	-	-	-	-	-	-	-	-
2.F - Product Uses as Substitutes for Ozone Depleting Substances	-	-	-	613	-	-	-	-	-	-
3 - Agriculture, Forestry, and Other Land Use	12,908.42	156.76	21.69	-	-	-	22	527.75	-	-
3.A - Livestock	-	121.14	3.03	-	-	-	-	-	-	-
3.B - Land	12,872.05	-	-	-	-	-	-	-	-	-
3.C - Aggregate sources and non-CO2 emissions sources on land	36.37	35.62	18.66	-	-	-	22	527.75	-	-
3.D - Other	-	-	-	-	-	-	-	-	-	-
4 - Waste	8.68	121.89	1.93	-	-	-	-	-	-	-
4.A - Solid Waste Disposal	-	55.01	-	-	-	-	-	-	-	-
4.B - Biological Treatment of Solid Waste	-	2.45	0.15	-	-	-	-	-	-	-
4.C - Incineration and Open Burning of Waste	8.68	2.75	0.04	-	-	-	-	-	-	-
4.D - Wastewater Treatment and Discharge	-	61.69	1.75	-	-	-	-	-	-	-
Memo Items (5)										
International Bunkers	346.56	0.0031	0.01	-	-	-	-	-	-	-
1.A.3.a.i - International Aviation (International Bunkers)	339.06	0.0024	0.01				-	-	-	-
1.A.3.d.i - International water-borne navigation (International bunkers)	7.5	0.0007	0.00				-	-	-	-

3.4.2 Trends of Short-Lived Climate Pollutants

Short-Lived Climate Pollutants are powerful greenhouse gases and local air pollutants and are emitted through similar economic activities as the GHGs. 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 the period 1990-2016. Figure 5 is a chart showing the trend of direct SLCP for 1990-2016.

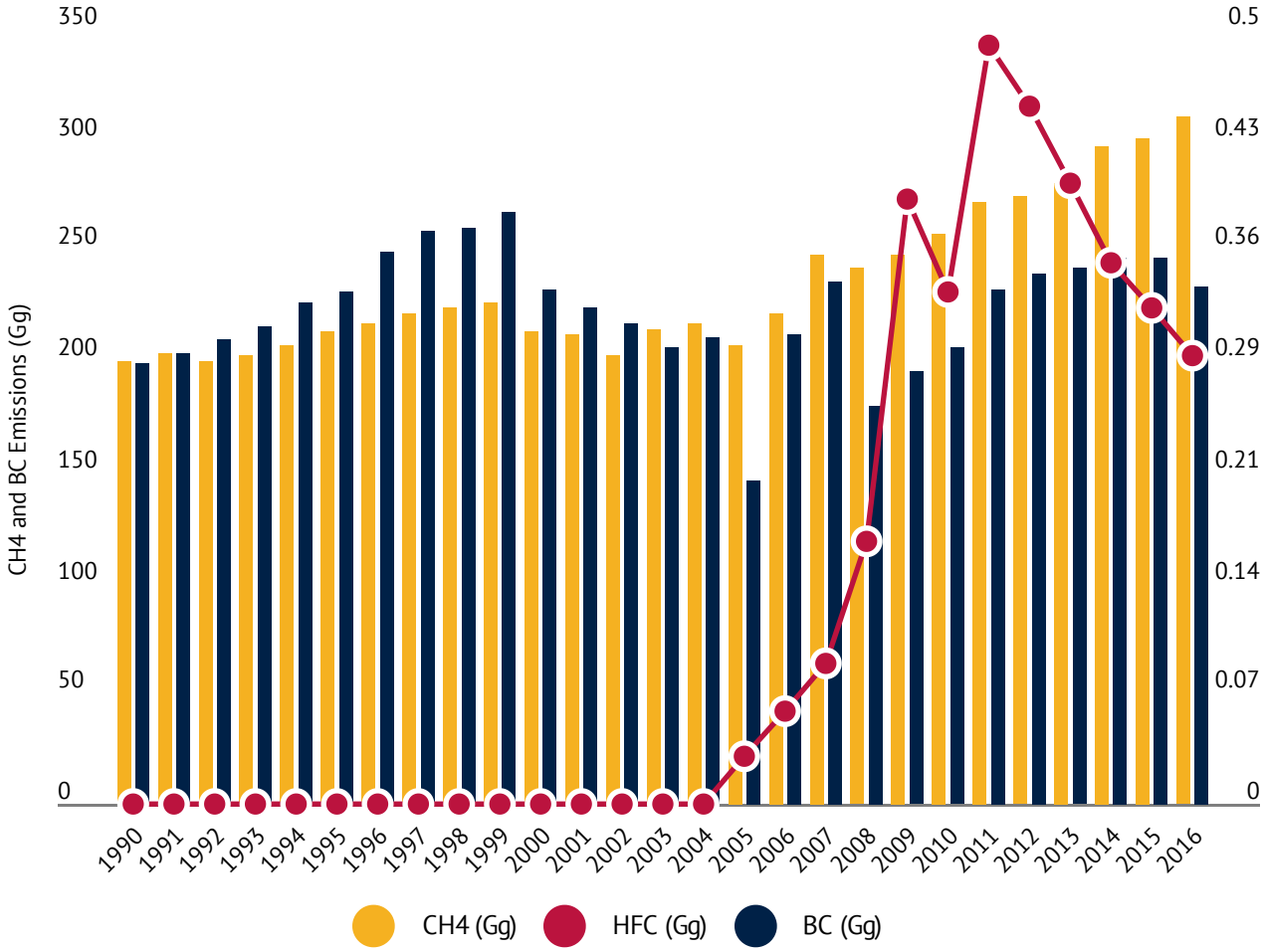


Figure 5: A chart showing SLCPs emission trends for the period 1990-2016

Methane is most dominant SLCP for the entire period 1990-2016. In 2016, the methane emissions level was 310 Gg and, 51% were from the AFOLU sector of which 39.1% of all the methane emission the AFOLU sector came from livestock enteric fermentation and manure management. The Waste sector was the second largest source of methane constituting 39.3% of the total national emissions. Within the Waste sector, Municipal solid waste disposal and domestic wastewater were the main sources of methane whereas, under the Energy sector, residential cooking with solid biomass contributed most to methane emissions. Black carbon levels increased from 199.29 Gg in 1990 to 234.28 Gg in 2016 and almost all of BC emissions came from the Energy sector. Under the IPPU, Products Uses as Substitutes for ODS was the only source HFC emissions.

Table 7: GHG emission trends and percentage changes for selected years according to sectors/categories

Secotors/Categories	Total Emissions (MtCO2e)				Percent Change
	1990	2000	2012	2016	(2012-2016)
National Emissions with Land category	25.34	27.26	41.62	42.15	66.4%
National Emissions without Land category	11.32	14.53	28.66	29.28	158.6%
1 - Energy	3.73	5.96	15.35	15.02	-2.2%
1A1, 1A2, 1A4 (Stationery combustion)	2.31	2.77	8.65	7.83	-9.6%
1A3 Transport	1.41	3.17	6.68	7.17	7.2%
1B2 - Oil and Natural Gas	0.016	0.023	0.012	0.024	101.3%
2 Industrial Processes and Product Use	0.49	0.36	1.52	1.04	-31.3%
2A Mineral Industry	0.01	0.04	0.48	0.33	-29.8%
2C Metal Industry	0.48	0.31	0.08	0.09	12.7%
2D Non-Energy Products from Fuels and Solvent Use	-	0.00	0.00	0.00	1.9%
2F Product Uses as Substitutes for ODS	-	-	0.96	0.61	-35.9%
3 - Agriculture, Forestry, and Other Land Use	20.10	19.47	22.05	22.92	4.0%
3A Livestock	1.72	1.82	2.91	3.48	19.7%
3B Land	14.01	12.73	12.96	12.87	-0.7%
3C Aggregate sources and non-CO2 emissions sources on land	4.36	4.91	6.18	6.57	6.3%
4 Waste	1.02	1.48	2.71	3.17	17.0%
4.A Solid Waste Disposal	0.26	0.48	0.99	1.16	16.6%
4.B Biological Treatment of Solid Waste	0.09	0.06	0.06	0.10	50.0%
4C Incineration and Open Burning of Waste	0.03	0.03	0.07	0.08	15.9%
4D Wastewater Treatment and Discharge	0.64	0.90	1.58	1.84	15.9%

3.4.3 Key drivers of the National GHG Emissions trend

The changes in the emissions relative to the figures reported in the first BUR were due to the impacts of recalculations rather than the natural growth in the national emissions. The reasons for the recalculations and the overall impacts on the previous emissions are provided in the recalculations section. Nevertheless, the observed changes in the national emission trends since 1990 are attributed to the expansion of the economy which strongly relies 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 the growth in Ghana's GHG emissions.

3.4.4 Key Category Analysis

Key category analysis (KCA) for 2016 was based on the level (L) assessment. The trend (T) assessment used to identify key categories for 2000 and 2016 emissions. The total emissions of the 20 identified key categories in the level assessment are 40.1 $MtCO_2e$ (Table 8). The total emissions without the Land key categories amounts to 45.3 $MtCO_2e$. For the trend assessment KCA, 17 categories were identified (Table 9). For both L and T assessment, categories with CO_2 emissions dominated followed by methane and then nitrous oxides. Some of the categories that emerged from the both L and T assessment are as follows: (a) Energy industries (1A1), (b) Land converted to cropland (3B2b), (c) Land converted to grassland (3B3b), Manufacturing industries and construction (1A2), Road transportation (1A3b), Forest Land remaining forest land (3B1a), Wastewater treatment and discharge (4D), Enteric Fermentation (3A1), Other Process Use of Carbonates (2A4) etc.

Table 8: Key category list from level assessment in 2016

IPCC Category	Gas	Emissions/Removals (GgCO2e)	Contribution to level	Cumulative
3.B.2.b - Land Converted to Cropland	CO2	8,837.88	16.59%	16.59%
3.B.3.b - Land Converted to Grassland	CO2	8,804.18	16.53%	33.12%
1.A.3.b - Road Transportation	CO2	5,918.52	11.11%	44.23%
1.A.1ai – Electricity generation	CO2	5,038.47	9.46%	53.69%
3.C.4 - Direct N2O Emissions from managed soils	N2O	4,142.82	7.78%	61.46%
3.B.1.a - Forest land Remaining Forest land (net sink)	CO2	(3,562.51)	6.69%	68.15%
3.A.1 - Enteric Fermentation	CH4	2,407.92	4.52%	72.67%
1.A.2 - Manufacturing Industries and Construction	CO2	1,937.40	3.64%	76.31%
4.D - Wastewater Treatment and Discharge	CH4	1,295.42	2.43%	78.74%
3.C.5 - Indirect N2O Emissions from managed soils	N2O	1,141.94	2.14%	80.89%
3.B.1.b - Land Converted to Forest land (net sink)	CO2	(1,105.57)	2.08%	82.96%
1.A.3.c - Railways	CO2	941.96	1.77%	84.73%
3.A.2 - Manure Management	N2O	938.68	1.76%	86.49%
4.A.1 - Managed Waste Disposal Sites	CH4	924.18	1.73%	88.23%
1.A.4.b - Residential	CH4	848.09	1.59%	89.82%
2.F.1 - Refrigeration and Air Conditioning	HFC	613.00	1.15%	90.97%
4.D - Wastewater Treatment and Discharge	N2O	541.12	1.02%	91.98%
3.C.1 - Emissions from biomass burning	CH4	528.69	0.99%	92.98%
3.B.2.a - Cropland Remaining Cropland	CO2	(506.42)	0.95%	93.93%
3.C.1 - Emissions from biomass burning	N2O	440.71	0.83%	94.76%

Table 9 : List of key categories using trend assessment for the period 2000-2016

Category	Gas (GgCO2e)	2000 estimate (Ex,o)	2016 estimate (Ex,t)	Trend Assessment(Tx,t)	Contribution to trend (%)	Commulative Total of trend
1.A.1ai – Electricity generation	CO2	548.79	5038.47	0.11	19.0%	19.0%
1.A.2 - Manufacturing Industries and Construction	CO2	3735.88	1937.40	0.07	12.0%	31.1%
3.B.2.b - Land Converted to Cropland	CO2	8837.88	8837.88	0.05	9.9%	40.9%
3.B.3.b - Land Converted to Grassland	CO2	8804.18	8804.18	0.05	9.8%	50.7%
1.A.3.b - Road Transportation	CO2	3038.71	5918.52	0.05	9.2%	59.9%
3.C.4 - Direct N2O Emissions from managed soils	N2O	2251.64	4142.82	0.03	5.8%	65.7%
3.B.1.a - Forest land Remaining Forest land	CO2	3709.98	3562.51	0.03	4.8%	70.5%
1.A.3.c - Railways	CO2	35.82	941.96	0.02	3.9%	74.4%
3.C.1 - Emissions from biomass burning	N2O	933.89	440.71	0.02	3.2%	77.6%
4.D - Wastewater Treatment and Discharge	CH4	464.63	1295.42	0.02	3.1%	80.7%
3.C.1 - Emissions from biomass burning	CH4	987.00	528.69	0.02	3.1%	83.8%
3.A.1 - Enteric Fermentation	CH4	1469.50	2407.92	0.01	2.5%	86.3%
3.C.5 - Indirect N2O Emissions from managed soils	N2O	608.04	1141.94	0.01	1.7%	88.0%
4.A.2 - Unmanaged Waste Disposal Sites	CH4	479.11	231.04	0.01	1.6%	89.6%
3.B.1.b - Land Converted to Forest land	CO2	1096.70	1105.57	0.01	1.2%	90.8%
2.A.4 - Other Process Uses of Carbonates	CO2	44.29	312.23	0.01	1.1%	91.9%
2.C.3 - Aluminium production	CO2	239.63	54.86	0.01	1.1%	93.0%
3.A.2 - Manure Management	N2O	565.52	938.68	0.01	1.0%	94.0%
1.A.4.b - Residential	CO2	193.18	28.52	0.01	0.9%	94.9%
3.B.2.a - Cropland Remaining Cropland	CO2	506.42	506.42	0.00	0.6%	95.5%

3.4.5 Recalculations

Recalculations was performed on the 1990-2012 emission estimates. The reasons for the recalculations are listed below:

- Availability of new and more accurate land-use change matrix for the period 1990-2012
- Revision and changes of areas affected by fires due to the use of MODIS fire dataset.
- Changed above-ground net biomass growth in natural forests from 4.7 tonnes d.m/ha/yr to 1.6 tonnes d.m/ha/yr
- Inclusion of new plantation areas and further categorisation into teak and non-teak species.
- Revisions in solid biomass (firewood and charcoal) dataset for 2006-2012.
- Inclusion of new dataset on manufacture of charcoal.
- Changes in fuel balance to be consistent to national energy statistics for 2006-2012.
- Revision of solid waste generation, collection and disposal dataset.
- Inclusion of newly available HFC consumption figures from 2000 to 2012.
- Recalculation for lubricant use with new dataset from company.
- Changes in methodology and the inclusion of extra data of due to the use 2006 guidelines

The recalculation led to an average 62% increase in the previous emissions trends. The largest increase of 148% recorded in 1991 and least increase of 17% in 2012 (Figure 6).

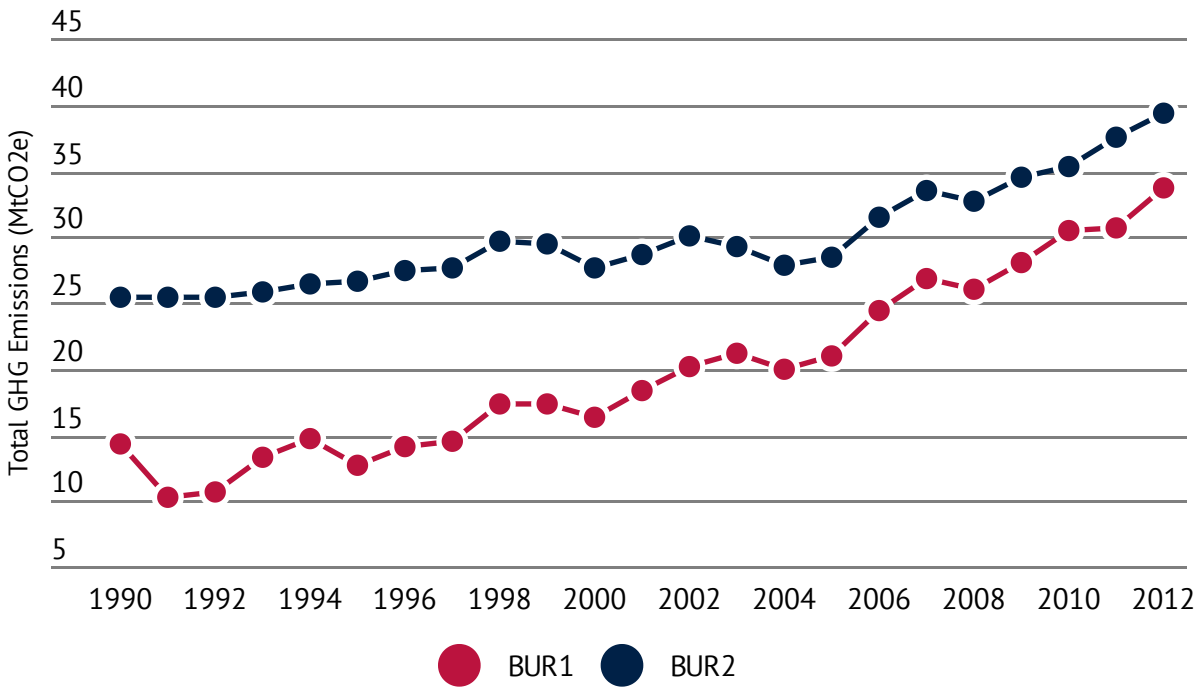


Figure 6: Comparison of total national emission trends in BUR1 and BUR2.

3.4.6 Completeness check

The GHG inventory was conducted at the economy-wide scale covering sectors and activities outlined in the IPCC 2006 guideline occurring in Ghana's territory. The emissions from activities (like Distribution of oil products - 1B.2a.iii.5 and Harvested wood products - 3D.i) were excluded from the inventory due to their insignificant levels or lack of activity data. All the direct gases - CO_2, CH4, N_2O and PFCs (CF_4 and C_2F_6) and HFCs have been covered for the entire time series. The emission inventory does not include activities that are not captured in the official records published by State institutions. For example, unreported fuel use, household animals that are not captured in the livestock census and unaccounted harvested wood etc.

3.4.7 Comparison of Carbon Dioxide emissions from fuel combustion

The CO_2 emissions have been estimated using the reference approach (RA) and sectoral approach (SA) methods. The RA and SA emissions and differences in the results are presented in Table 10. The differences in CO_2 emissions between RA and SA ranges from 0.4% to 4.6%. Generally, estimates for RA CO_2 emissions are higher than SA CO_2 emissions. The following reasons explain the inconsistencies in RA and SA CO_2 emissions: (a) statistical differences among petroleum products and (b)observed variations associated with secondary data used to derive the stock change. Steps are underway to improve fuel allocation formulae in the energy balance which is expected to correct the inconsistencies.

Table 10 : Comparison of the differences in CO_2 emissions estimated using RA and SA

QC Tasks	RA (MtCO2)			SA (MtCO2)			Differences (%)			
	Liquid	Solid	Gaseous	Liquid	Solid	Gaseous	Liquid	Solid	Gaseous	Total
1990	2.61	-	-	2.52	-	-	3.62%	-	-	3.62%
1991	2.10	-	-	2.02	-	-	3.78%	-	-	3.78%
1992	2.38	-	-	2.28	-	-	4.37%	-	-	4.37%
1993	2.38	-	-	2.33	-	-	2.01%	-	-	2.01%
1994	2.88	-	-	2.86	-	-	0.87%	-	-	0.87%
1995	2.72	-	-	2.67	-	-	1.87%	-	-	1.87%
1996	3.40	-	-	3.30	-	-	2.89%	-	-	2.89%
1997	3.35	-	-	3.25	-	-	3.16%	-	-	3.16%
1998	5.51	-	-	5.32	-	-	3.63%	-	-	3.63%
1999	5.08	-	-	4.88	-	-	4.14%	-	-	4.14%
2000	5.10	-	-	4.99	-	-	2.19%	-	-	2.19%
2001	5.65	-	-	5.36	-	-	5.47%	-	-	5.47%
2002	7.01	0.02	-	6.69	0.02	-	4.74%	0.03%	-	4.78%
2003	6.09	0.03	-	6.07	0.03	-	0.40%	0.03%	-	0.44%
2004	6.02	0.03	-	5.81	0.03	-	3.53%	0.03%	-	3.56%
2005	5.72	0.03	-	5.69	0.03	-	0.47%	0.03%	-	0.51%
2006	8.20	0.01	-	7.87	0.01	-	4.22%	0.03%	-	4.25%
2007	9.10	0.04	-	8.92	0.04	-	2.03%	0.03%	-	2.06%
2008	8.10	0.03	-	7.93	0.03	-	2.14%	0.03%	-	2.18%
2009	8.89	0.01	-	8.85	0.01	-	0.49%	0.03%	-	0.52%
2010	8.55	0.02	0.82	8.45	0.02	0.80	1.21%	0.03%	3.56%	4.81%
2011	9.30	0.02	1.81	8.92	0.02	1.81	4.22%	0.03%	0.06%	4.32%
2012	11.36	0.01	0.94	11.16	0.01	0.93	1.77%	0.03%	0.72%	2.52%
2013	11.77	0.01	0.68	11.49	0.01	0.68	2.48%	0.03%	0.82%	3.34%
2014	11.20	0.00	1.49	11.00	0.00	1.47	1.82%	0.03%	1.88%	3.73%
2015	10.36	0.00	2.68	10.30	0.00	2.62	0.56%	0.03%	2.46%	3.06%
2016	12.16	0.02	1.62	12.06	0.02	1.60	0.81%	0.03%	1.04%	1.88%

3.4.8 Uncertainty Management

The GHG inventory use activity data and emission factors that come with inherent uncertainties because of the way the data were generated through physical measurement of modelling. Majority of the activity data used in the inventory are secondary data and providers do not publish uncertainty ranges in the metadata. Apart from the land use dataset that has error matrix associated with it, the rest of them do not have error ranges. Ghana has not been able to confidently estimate uncertainties for the emissions except the Land category where error matrix for the land use maps has been provided Table 11 below.

Table 11: Accuracy assessment results for Land use maps for 2000, 2010, 2013 and 2015

ACCURACY ASSESSMENT – 2000 MAP

Class Name	Reference Total	Classified Total	Number Correct	Producers Accuracy	Users Accuracy	Kappa
Closed forest	40	43	33	81.25%	75.58%	0.7346
Open forest	163	152	136	81.87%	88.85%	0.8334
Water body	11	15	11	100.00%	70.00%	0.6936
Grassland	100	104	82	82.00%	78.85%	0.7356
Settlement / Bare ground	45	49	37	82.22%	76.29%	0.7394
Cropland	125	129	103	82.00%	79.77%	0.7302
Wetland	11	5	5	52.63%	100.00%	1
Other land	5	3	4	77.78%	100.00%	1
Total	**500**	**500**	**407**			
Overall Classification Accuracy		**81.70%**				
Overall Kappa Statistics		**0.7644**				

2000 map - 500 data points generated from Google Earth were used to assess the accuracy of this map. The assessment yielded an overall accuracy of 81.7%.

Table 2-10: Accuracy Assessment Result of LU Map of 2010

Reference data / Classified data	Forest land	Cropland	Grassland	Settlements	Wetlands	Other land	Classified Total	Users Accuracy (%)
Forestland	520	48	39	0	0	0	607	85.67
Cropland	57	493	48	1	0	2	601	82.03
Grassland	55	44	384	0	0	9	492	78.05
Settlements	17	13	12	283	1	5	331	85.50
Wetlends	0	0	1	0	152	0	153	99.35
Otherland	2	0	3	0	0	24	29	82.76
Reference Total	651	598	487	284	153	40	2213	-
Producer Accuracy (%)	79.88	82.44	78.85	99.65	99.35	60.00	-	83.87

2010 map - 2,213 field points were utilised for accuracy assessment of the 2010 map. The overall accuracy for this map is 83.87%.

Accuracy Assessment – 2013 map

Class Name	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy	Kappa
Close forest	54	55	51	94.44%	92.73%	0.9159
Open forest	146	148	129	88.36%	87.16%	0.7978
Water	20	20	20	100.00%	100.00%	1
Grass	67	73	53	79.10%	72.60%	0.6709
Settlement	15	8	8	53.33%	100.00%	1
Cropland	88	90	65	73.86%	72.22%	0.6439
Wetland	2	2	2	100.00%	100.00%	1
Otherland	8	4	3	37.50%	75.00%	0.7449
Totals	**400**	**400**	**331**			
Overall Classification Accuracy = 82.75%						
Overall Kappa Statistics = 0.7739						

2013 map - Accuracy assessment was completed using historical field data and data generated from Google earth. A total of 400 points were used. The overall classification accuracy is 82.75%.

Accuracy Assessment – 2015 map

Class Name	Reference Total	Classified Total	Number Correct	Producers Accuracy	Users Accuracy	Kappa
Closed forest	80	87	76	0.95	0.8735	0.7346
Open forest	331	263	255	0.7703	0.9696	0.8334
Water body	21	25	21	1	0.84	0.6936
Grassland	200	186	154	0.77	0.8279	0.7356
Settlement/Bare ground	90	142	84	0.933	0.5915	0.7394
Cropland	250	275	189	0.756	0.6872	0.7302
Wetland (Swampy)	19	15	15	0.7894	1	1
Other land	9	7	7	0.7778	1	1
Totals	**1000**	**1000**	**801**			
Overall Classification Accuracy = 80.1%						
Overall Kappa Statistics = 0.7644						

2015 map - Accuracy assessment of the 2015 map was done utilising 1,000 field data points. The overall accuracy is 80.1%.

Uncertainty assessment for the other sectors have not been done due to lack of adequate data for the uncertainty calculations. It is priority for Ghana to undertake at least tier 1 uncertainty assessment for all the sector especially those in in the key category.

3.4.9 Quality Assurance/Quality Control (QA/QC)

The EPA is responsible for QA/QC procedures in the inventory and performs the following routines: (a) ensures that the sector teams follow QC checklist, (b) collect and review completeness checklist submitted by the sector inventories; (c) facilitate all technical reviews of the inventory both in-country and at the international level. Ghana has prepared and adopted the use of new QA/QC plan. In this inventory, the following list of tier 1 QC procedures was followed (Table 12):

Table 12 : List of QC procedures followed in the inventory

QC Tasks	Description of 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 factor are the same.	EPA
	Ensured that parameters used in multiple categories (e.g., population of livestock) 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
Documentations	Created back-ups of all documentations in hard and soft copies and uploaded files on to central storage facility online.	All sectors, Web master
	Moved all files and documentations to an "online climate change data hub".	Web master
Data gathering, input, and handling checks	Checked that assumptions and criteria for the selection of activity data and emission factors are 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 correctly.	EPA
	For each category, compare 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

QA is an important part of the overall QA/QC procedures. In the BUR2, Ghana was the first Africa country to undergo a voluntary in-country review of its GHG inventory system. Five international sector experts thoroughly reviewed the entire Ghana's inventory system and together came up with a list of improvement activities Ghana will implement in the long-term. In addition, two international experts reviewed the draft BUR2 and provided comments which were addressed before the submission. Within two national validation workshops were organised for key line ministries, academia, and the CSOs.

3.4.10 Planned improvement list

The identified planned improvement areas in the inventory are presented in Table 13.

Table 13: List of planned improvement activities

QC Tasks	Description of task	Action by	Timelines	Theme
All categories	All sectors to have concrete plans on how to improve uncertainty assessment using default values from the IPCC guidelines, and implement the plans.	EPA	BUR 3	Uncertainity
Key categories	All key category are to use Tier 2 in the future inventory after improvements of uncertainties calculations.	All sectors & EPA	BUR4	KCA
Livestock	Apply enhanced characterisation since it is key category.	MoFA & CSIR Animal Research Institute	BUR3	Activity data
Rice cultivation	Check the use of amendment to include the incorporation of straw	MoFA	BUR3	Activity data
Fertiliser Application	Fertilizer consumption isn't estimated. The N import is used as activity data, however, N export isn't subtracted. Double check export and provide explanations for the large in inter-annual variability.	MoFA	BUR4	Activity data
F-gases	Collect additional dataset to fill the missing years in the time series	EPA	BUR3	Activity data
Sector fuel allocation	Conduct survey to validate share of fuel consumption allocation in the Energy Statistics	Energy Commission	BUR3 and BUR4	Activity data
Land representations	Continue to work to reduce the inconsistencies in the activities under FOLU by updating the existing land use maps.	Forestry Commission	BUR3 and BUR4	Activity data
Road transport	Revise fuel consumption allocation per vehicle technology and conduct survey to collect distance and speed information.	Ministry of Transport & EPA	BUR4	Activity data
Manure management	Improve upon current expert judgement used to determine the proportions of different manure management system.	MoFA & Animal Research	BUR3	Activity data
Energy balance	Improve fuel allocation formula for CO2 fuel combustion.	Energy Commission	BUR3	Activity data

4 Mitigation Actions and Their Effects

Kpong Hydrolectric Dam

4. National mitigation policies

4.1 Voluntary national emission target

Ghana has announced a voluntary two-tiered national GHG emission reduction target in its Nationally Determined Contributions (NDCs) to the UNFCCC in 2015. Ghana has committed to unconditionally lower its GHG emissions by 15% relative to a BAU scenario emissions of 73.9 million tonnes by 2030 (Figure 7). Furthermore, it is possible to achieve additional 30% emission reductions on condition that external support is made available to cover the full cost of implementing the mitigation actions. The full implementation of the identified mitigation actions is expected to yield a total of 44 million tonnes volume of emission reductions and sustainable development outcomes. Overall, Ghana has committed to 20 mitigation actions in energy, transport, waste, industry and the forestry sectors, of which 2 in the energy (fuel diversification in thermal electricity generation) and forest plantation development are unconditional commitments.

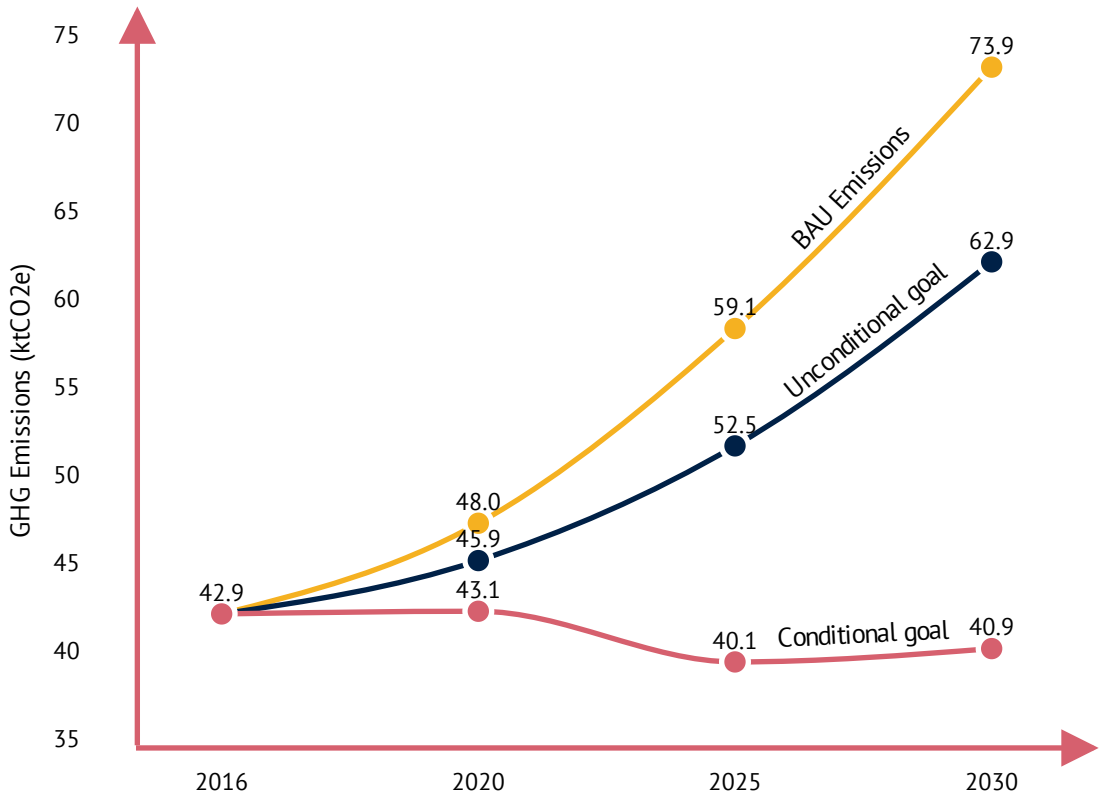


Figure 7: Emission projections from 2016 to 2030 showing three emissions trajectory

The total emissions reduction target of 44 million tonnes translates into an annual 2.2 million tonnes emission reductions between 2011-2030. The total cumulative emission reductions between 2011 to 2017 amount to 13.7 million tonnes from the implementation of 20 mitigation actions in the Energy, Forestry and Waste sectors. These emission reductions translate to an aggregate annual average of approximately 2 million tonnes which is 0.2 million tonnes lower than the national target. Without the Forestry mitigation actions, the overall annual emissions savings is 1.72 million tonnes. The mitigation measures are captured in Ghana's Low Carbon Development Strategy and the NDC commitments. Some of the specific mitigation policies are; Renewable Energy Act, SEforAll Action Agenda, LPG Master Plan, National Gas Master Plan, Energy Efficient Laws, National Energy Policy, Forest and Wildlife Policy, REDD+ Strategy, Forest Plantation Development Strategy, National Environmental Sanitation Strategy, National Climate Change Policy etc. It important to stress that in the midst of the development challenges confronting Ghana it has been able to invest in critical economic sectors that have led to more GHG emission reductions than anticipated. Yet, it is increasingly difficult to tap the required international funding to be able to achieve its conditional targets.

4.2 Policies and measures for the achievement of emission targets

Ghana has adopted variety of national and sector mitigation policies. The full outcomes of the mitigation policies are expected to contribute to achieving the national emission reduction commitments and the sustainable development objectives of the country. Below are the highlights of some of the policy achievements since the submission of the BUR 1 in the strategic priority areas of lowering deforestation, scaling-up adoption of renewable energy, promoting clean cooking and transforming public transportation.

- Implementing a National Climate Change Policy and Low Carbon Development Strategy which seek to unlock the investment opportunities in mitigation actions.
- Ramp-up investments to the tune of $13.2 billion in the expansion of the production, processing and utilisation of natural gas and adopted the National Gas Master Plan to back it.
- Increased annual installed capacity of renewable energy from 2.9 MW in 2013 to 42.7MW in 2017.
- Taking legislative steps to amend the Renewable Energy Act, 2011 (Act 832) to capture competitive bidding as one of the vehicles to achieve cost-effective pricing for utility scale renewables.
- Adopted a National LPG Promotion Policy to facilitate distribution and access to LPG fuels for clean cooking.
- Announced Ghana's commitments to achieve 1,000 institutional cookstoves and 2,000,000 households improved cookstoves.
- Deployed 1,000 improved institutional cookstoves in over 100 communities impacting over 100,000 people nationwide. Disseminated more than 1.2 million stoves to households.
- Implementing the National Railway Master Plan to modernise railway network nationwide by aiming at mobilising $7.8 billion investments into 1,394 km rail network.
- Implementing a 25-year Ghana Forest Plantation Strategy and National REDD+ Strategy to combat deforestation and restoration of degraded forest pursuance to the National Forest and Wildlife Policy . As at 2016, 192,253.19ha of tree plantation has been established.
- Initiated legislative steps for the ratification of the Kigali Amendment to phase down HFCs.
- Mobilising funds from the Green Climate Fund (GCF) to support the implementation of two mitigation projects in the areas of renewable energy and forestry.
- Under the G-20 compact with Africa for Sustainable Economic Development. The Government of Germany has agreed to promote private investments in renewable energy and vocational training.

4.3 Tracking Progress of Mitigation Actions and Information Flow for the Preparation of BUR

Information on the progress of mitigation was obtained from multiple sources in each sector. Most of the government institutions have established data platform from which some of the mitigation data are collected. The rest of the data are generated by filling the common MRV template. In each sector (be it Energy, Forestry and Waste) there are contact persons who have been tasked to collect, process and document information on specific mitigation actions assigned to them (Table 14). They collect the information using common MRV template mitigation action hosted on secured web-address URL http://mestiqna.igreengrowthsolutions.com/ which is opened to all target users.

Table 14: List of mitigation measures and the responsible institutions

Sector	Mitigation measures	Specific actions	Contact persons	Institution
Energy	Energy Efficiency	Automatic timer switches	Kennedy Amankwa	Energy Commission
		LED streetlight	Kennedy Amankwa	Energy Commission
		Capacitor banks	Kennedy Amankwa	Energy Commission
	Renewable Energy	Utility scale renewables	Ebenezer Ashie	Energy Commission
		On-grid distributed solar PV	Ebenezer Ashie	Energy Commission
		RE-base mini-grid	Ebenezer Ashie	Energy Commission
		Off-grid renewables	Ebenezer Ashie	Energy Commission
		Productive use of renewable energy in agric	Micheal Abrowka	Energy Commission
		Solar lamps in place of kerosene lanterns	Micheal Abrowka	Energy Commission
	Clean cooking	LPG stoves	Paula Edze	Energy Commission
		Improved stoves	Paula Edze	Energy Commission
	Low-carbon electricity & reduced flaring	Single cycle to combined cycle	Ben Sackey	Volta River Authority
		Fuel switch from crude oil to natural gas	Ben Sackey	Volta River Authority
		Reduced natural gas flaring	Simpson Attieku	Energy Commission
Forestry	Lower deforestation and restore degraded forest	National Forest Plantation Development Programme	Hugh Brown	Forestry Commission
		Ghana Cocoa Forest REDD+ Programme	Thomas Gyambrah	Forestry Commission
		Ghana Shea Landscape REDD+ Programme	Charles Duah	Forestry Commission
Waste	Waste to compost	Composting	Joy Hesse	Environmental Protection Agency

Table 15: Mitigation action progress tracker template

Type	Reduction option	Sub-type unit	2020	2025	2030	2016	2017	reduction
			plan	plan	plan		Actual	kt/CO2e/yr
EE households	Efficient residential airconditioning	1000 Airconditioners						
	Efficient lighting with CFLs	1000 Bulps						
	Efficient lighting with LEDs	1000 Bulbs	2500	5000	7000			0.0
	Efficient lighting with LEDs replacing CFL	1000 Bulbs	13000	13000	13000			0.0
	Efficient wood stoves	1000 stoves	100	500	2000		1200	8757.9
	LPG stoves replacing wood stoves	1000 stoves	10	50	134		85	737.9
	Efficient refrigerators	1000 refrigerators	200	1000	2000			0.0
EE service	Efficient electric motors	1 kW						
	Efficient office lighting with CFLs	1000 lights						
	Efficient street lights	1000 lights					18	7.2
	Energy efficiency in service	10% red. of energy demand	1	1	2			0.0
EE supply side	New high efficiency coal power plant	1 MW						
	New natural gas power plant	1 MW						
	Switch from fuel oil to natural gas	1 MW	0	100	0			
	Single cycle to combined cycle	100 MW increase	3.3	3.3	3.3		3.3	398.5

Each template is completed for an individual mitigation action by the responsible contact person online and a copy is documented for the archive. Then, the completed template is transmitted to EPA for further analysis. The relevant data in the templates are transferred to the modified GACMO model (originally developed by UNEP-DTU) which is a mitigation analysis dashboard that allows for the calculation of GHG effects of the individual mitigation action and their cost. The GACMO model emission projections, emission reduction targets and the aggregate effects of individual mitigation actions. With the GACMO model, it is possible to evaluate the emission reduction of individual actions, combined effects and the progress towards achieving the national target. The completed individual template are reported in the next section by sector and mitigation measure. A summary of information on individual actions that make up the mitigation package is provided to give a quick overview of the aggregate effects of the actions (Table 15).

Type	Reduction option	Sub-type unit	plan	plan	plan			kt/CO2e/yr
Energy distribution	Efficient electric grids	1 GWh loss reduction	0	0	0			
	Power factor increase	1000 commerce/industry buildings	0	1	1			0.0
Reforestation	Reforestation of 1000 ha	100	100	280			0.0	
REDD: Avoided deforestation	Avoided deforestation 1000 ha	50	150	270			0.0	
Assisted forest regeneration	Reforestation of 1000 ha	50	50	140			0.0	
Reforestation with Silvopasture	Reforestation of 1000 ha	50	100	70			0.0	
Switch from coal to natural gas in industry	100 TJ fuel use/year							
Switch from fuel oil to natural gas in industry	100 TJ fuel use/year	50	50	50			0.0	
Fugitive	Reduced flaring at oil field	1 MMSCF/day	118	120	120		2.8	64.3
	Reduced flaring at oil refineries	1 MMSCF/day						
	Charcoal production	100,000 ton charcoal/yr						
	Reduced PFCs from aluminum production	100,000 ton Aluminium/yr						
ODS phaseout	All flourinated gases	0.2	0.5	1.0			0.0	
Hydro power connected to main grid	1 MW							
Mini hydro power connected to main grid	1 MW	50	150	300		4	6.9	
Mini hydro power off grid	1 MW							
Landfills	Landfill gas plant with power production	200 t/day plant						
	Landfill gas flaring	200 t/day plant	3	7	14			0.0
	Incineration plant	200 t/day plant	0	0	0			0.0
	Biogas from Municipal Solid Waste	1000 t/year plant	1	1	1			0.0
	Composting of Municipal Solid Waste	1000 t/day plant	0.5	0.5	0.5	0.1	0.1	355.9

Type	Reduction option	Sub-type unit	plan	plan	plan			kt/CO2e/yr
	Composting of Municipal Solid Waste	1000 t/day plant	0.5	0.5	0.5	0.1	0.1	355.9
	Biogas at rural farms replacing wood	1000 units						
Solar water heater, residential	1000 locations							
Solar water heater, large	1 unit							
Solar PVs, large grid	1 MW	50	150	250		39	27.8	
Solar home PVs	50 W	50000	100000	200000			0.0	
Solar/diesel mini-grid	40 kW from solar	5	50	138			0.0	
Solar LED lamps	1000 lamps	500	1000	2000			0.0	
Solar street lights	1000 locations (0.05 MW)							
Bus Rapid Transit (BRT)	1 km BRT line	55	100	200			0.0	
Electric cars	1000 cars	0	0	0			0.0	
Wind turbines, on-shore	1 MW	20	50	150			0.0	
	Wind turbines, off-shore	1 MW						

Lower deforestation and restore degraded forest

192,253 ha

Total forest plantations established since 2002.

CO_2 savings - 24 kt CO_2/yr

Direct jobs - 370,000

Food production - 2.6 Mt

2.3 MtC/yr

Expected CO2 emissions savings from avoided deforestation in the cocoa landscape

6.1 MtC/yr

Expected CO2 emissions savings from avoided deforestation in the shea landscape

Form Ghana Plantation

4.4 Information on Mitigation Actions and Their Effects

Information on individual mitigation actions and their effects have been presented in tabular format below according to sectors.

4.4.1 Forestry sector mitigation actions

Name	National Forest Plantation Development Programme
Type of action	Afforestation/Reforestation
GHG	CO2
Implementing entity	Forestry Commission
Start year	2002
Status	On-going
Objective of the action	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.
Specific target	Establish and maintain tree plantation of annual average of 20,000 ha on degraded on-reserve and off-reserve forest lands.
Steps taken or envisaged to achieve mitigation action	Creation of land banks (including land acquisition, surveying and demarcation of on-reserves and off-reserves).
	Established model plantations and seed orchards.
	Established plantation along watershed and boundary of external forest reserves.
	Enrichment planting of degraded and poorly stocked forest reserves
	Seed supplied to selected fringe communities and farmers.
	Field verification and vetting visits.
	Signed land lease agreement and benefit sharing agreement for commercial plantations and community groups.
Description	The NFPDF was launched in 2001 and implementation started in 2002 as a strategic initiative to restore forest cover of the degraded forest, reduce wood supply deficit, create jobs, enhance carbon stocks and contribute to food production. The NFPDF is a public-private joint programme targeting degraded lands in on-reserve and off-reserve areas and has the following components: (a) Modified Taungya system (MTS), (b) Community forest management project (CFMP), (c) Government plantation development programme (GPDP), (d) Private developers on-reserve, (e) FSD Plantation, (f) Forest investment programme, (g) Expanded plantation programme, (h) FC/Industry plantations fund and (i) Large-scale off-reserve plantations. The NFPDP is supported by the Ghana Forest and Wildfire Policy, Ghana Forestry Plantation Strategy and the Ghana REDD+ Strategy.
Results achieved	An area of 5,389.64ha of forest plantations was established on-reserve in 2016.
	Verification of plantations reported established under the Modified Taungya System (MTS) and Community Forestry Management Project (CFMP), between 2002 and 2009, was undertaken in 2016
	A total of 4,493.76ha of degraded forest reserve lands was retrieved from 23 poorly performing commercial developers and reallocated for plantation development
	Established 12 nurseries in 12 forest districts in the transitional and savannah zones.
	Teak trees with a standing tree volume of 29,753.2m3 were allocated for harvesting by logging companies.

Estimated GHG emission reduction	24 kt C/yr since 2002 to-date
Co-benefits	Estimated 2,632,467.01 metric tonnes of food produced from the plantations for 2002-to-date
	A total of 192,253.19 ha tree plantation established under NFPDP for the period 2002-2016
	Created 370,000 direct jobs since 2002 to-date
Progress indicators	Annual area planted (ha), Number of seedling orchard (no.), Amount of seedling supplied(no), Mortality rate (%), Jobs created (no), Amount of food produced (metric tonnes), investment ($)
Funding model	Public Private Partnership (Grant, Loan and Equity)
	Estimate budget - more than $52m direct investment
	Aggregate contribution amounts - Government of Ghana (80%), Donors (5%) and Private Sector (15%).
Methodology	2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 4 Agriculture, Forestry and Other Land Use.
Assumptions	25-year rotation cycle after first year planting
	Annual increment in biomass is constant throughout the 25-year rotation cycle.
	The annual biomass increment depends on the degree of permanence which determined by the risk posed by pest, fire and intermittent unplanned harvesting.
	Biomass stock before plantation (8.7 tonnes dm/ha) and biomass stocks after plantation (92.2 tonnes dm/ha)

Name	Ghana Cocoa Forest REDD+ Programme (GCRFP)
Type of action	Avoided deforestation
GHG	CO2
Implementing entity	Forestry Commission (FC) and Ghana Cocoa Board (Cocobod)
Start year	2018
Status	On-going
Objective of the action	To improve land-use and socio-economic development in the high forest zone and the cocoa growing areas of Ghana by increasing cocoa yields on farm lands through intensification with climate smart practices whiles preventing the expansion of cocoa farms into forest lands.
Specific target	To curb escalating deforestation and forest degradation and reduce total emission by approximately 295.4 MtCO2e over a 20-year period. In the first seven year (phase 1) GCFRP would achieve emission reductions of 13.5 MtCO2e.
Steps taken or envisaged to achieve mitigation action	Completion of GCFRP documents and admittance into the World Bank's Forest Carbon Partnership Facility Carbon Fund portfolio.
	Developing consortium partnerships with private sector players in the cocoa industry.
	In-country capacity enhancement in MRV implementation framework for eventual measuring and reporting of deforestation.
	Development of safeguard information system and feedback grieverance redress mechanism.
	Developed communication plan for engaging relevant stakeholder at all levels.
	Developed benefit sharing arrangement plan.
Description	The GCFP is a government flagship initiative in the promotion of sustainable and climate smart cocoa production. It seeks to significantly reduce emissions driven by cocoa farming and other agricultural drivers as well as illegal logging and illegal mining in a manner that will contribute securing the future of Ghana's forest. The GCFRP has five components namely: (a) institutional coordination and MRV, (b) landscape planning in hotspot intervention areas (HIAs), (c) climate smart cocoa practices to increase yield and sustainability, (d) legislative and policy reforms.
Results achieved	
Component 1: (Institutional coordination and MRV)	Steps taken or envisaged: (a) formation of joint coordinating committee between FC and Cocobod (b) creation of hotspot intervention areas, (c) enhancing national forest monitoring system.
	Results achieved: Trained 900 individuals drawn from stakeholder institutions on REDD+ safeguards. Retooled the capability of the GIS infrastructure within the FC.
Component 2: (Landscape planning within hotspot intervention areas (HIA):	Steps taken or envisaged: (a) create a number of climate smart cocoa consortiums for the HIAs, (b) Develop management plans for the HIAs.
	Results achieved: signed memorandum of understanding (MoUs) to govern the operations in 3 HIAs, launched Juabeso Bia HIA, started implementing the partnership for productivity protection and resilience project in the Juabeso Bia HIA.

Component 3: (climate smart cocoa practices to increase yield and sustainability)	Steps taken or envisaged: (a) create climate smart cocoa operational guidelines, (b) double cocoa yield per hectare in the HIAs.
	Results achieved: Developed framework for the implementation and validation of Ghana's standards for climate smart cocoa.
Component 4: (Risk management and financing)	Steps taken or envisaged: Create access to financial credits by linking registered cocoa farmers to credit Agencies or schemes.
Component 5: (Legislative and policy reforms)	Steps taken or envisaged: (a) enact and implement a legislative instrument on tree tenure, (b) Revise national farm input supply policy.
Estimated GHG emission reductions	2.250 million tonnes per year.
Co-benefits	Increase cocoa productivity from 400kg/ha to 600kg/ha.
	Double incomes of 126,000 farmers from the current $6.52/ha to $13.04ha.
	Increase protection of threatened and endangered species in the HIA.
	Reduce deforestation risk due to expansion of cocoa farms adjoining natural forests.
Progress indicators	Farmers trained under CSCP (No)
	Areas planted (Ha)
	Fam yield (kg/ha)
	Investment made ($)
	Farmer income levels ($)
Funding model	Estimated budge - $ 236 million
	Instrument - results-based payment scheme
	Funding sources: REDD+ funding (21.1%), private sector(51.3%), Grants (4.9%), Ghana Government (22.7%)
Methodology	Methods and Guidance Document (MDG) developed by the Global Forest Observation Initiative (GFOI) as the FCPF methodological framework
Assumption	A reforestation rate has not been included in this FRL.
	Conservative estimate of successfully reducing the rate of deforestation by 45% over the lifetime of the program, less a 15% risk buffer

Name	Ghana Shea Landscape REDD+ Programme (GSLRP)
Type of action	Avoided deforestation
GHG	CO2
Implementing entity	Forestry Commission (FC) (Climate Change Unit)
Start year	2018
Status	Pipeline
Objective of the action	To mitigate GHG emissions of 6.1 MtCO2e over seven year of the project and further to 25.2 MtCO2e in a 20-year timeframe through reduced emissions and enhanced removals from productive, sustainable management of savannah forests, shea parklands and forest plantations.
Specific target	Restore 200,000 hectares of off-reserve savannah forests and place them under self-financing community management in Community Resource Management Areas (CREMA)
	Reduce fire impacts on 220,000ha for deforested grasslands and degraded forest outside CREMA.
	Plant 1.75 million shea trees in shea parklands.
	Create 25,500 hectares of modified taungya system/forest plantation in severely degraded forest reserves
Steps taken or envisaged to achieve mitigation action	Completed the full proposal document of the GSLRP and submitted to GCF for funding.
	Finalised spatial demarcation of the target area for the project implementation
	Engaged in community-level consultations and awareness creation as part of the full proposal development
	GCF board to take funding decision on the project proposal
Description	The GSLRP will be Ghana's leading effort to stem the increasing threats of deforestation and desertification targeting the Northern Savannah Zone (NSZ). The project has four interrelated components that will be implemented through a cross-sectoral, comprehensive and holistic approach, driven by communities and women's groups. This will be done through setting up 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 are reduced emissions from deforestation through fire and wood fuel resources management, sustainable management of forests through community forest management and enhanced carbon stocks through shea restoration.
Expected Results	200,000 ha of deforested grasslands restored to forests and managed for sustainable wood fuel in CREMAs
	220,000 ha of deforested grasslands and degraded forest outside CREMAs restored with reduced fire impacts
	18,500 ha of modified Taungya system of plantations created on deforested lands
	26,000 ha of of surrounding forest improved through fire management.
Expected Emission Reductions	6.135 million tCO2e in emission reductions and removals over the first seven years of the project's lifetime and 25.24 million tCO2e over 20 years
Co-benefits	The project will directly strengthen the livelihoods and climate resilience of 100,200 people (78,850 women and 21,350 men)
Progress indicators	Number of people trained, Number of nurseries, seedling produced and supplied to number of beneficiaries, Area planted (Ha) and Deforestation rate (%)
Funding model	Estimated budget: $ 80M. Grant from GCF (About UDS 30M), Shea Private Sector (About USD 35M), Ghana Government (About USD 15M)
Methodology	2006 IPCC Guidelines Vol 4 AFOLU Sector
Assumptions	Carbon dioxide removals from natural regeneration excluded from the baseline. Biomass removal through illegal logging is from single study in the high forest zone.

Scaling-up renewable energy penetration in Ghana

43 MW

Installed renewable capacity as at 2017

CO2 savings
2.8 kt C/yr

39 MW

90% of installed capacity is solar PV

4 MW

10 % of installed capacity are mini hydro, wind & W2E

BXC Ghana Solar PV

4.4.2 Energy sector mitigation actions

Name	Scale-up Renewable Energy Penetration Programme (SREP-P)
Type of action	Solar PV technology backed by fiscal and regulatory instruments
GHG	CO2
Implementing entities	Ministry of Energy, Energy Commission, Volta River Authority, IPPs, Individuals, Hotels, Hospitals, Banks etc
Start year	2012
Status	On-going
Objective of the action	Increase the contribution of renewable energy in the overall energy mix whiles ensuring efficient production and utilisation of biomass energy resource with the view to reduce greenhouse gas emissions.
Specific target	Scale up renewable energy penetration to 10% by 2030.
Steps taken or envisaged to achieve mitigation action	Enacted Renewable Energy Act, 2011 (Act 832).
	Drafted a Renewable Energy Master Plan.
	Rolling out Net Metering.
	Drafted for adoption a Renewable Energy Purchase Obligation guideline
	Implementing renewable energy licensing framework
	Implementing a mini-grid electrification policy
	Implementing a Scaling-up Renewable Energy Programme Investment Plan.
	Conducted Renewable Energy Resource mapping
Description	The SREP-P is a government-wide cum private-sector initiative led by the Ministry of Energy in promoting adoption of renewable energy technologies at all levels of the economy.
	This mitigation action has six components based on the technology application:
	(1) Utility scale renewables.
	(2) Distributed solar PV.
	(3) Renewable Energy-based mini-grid.
	(4) Off-grid renewables.
	(5) Productive use of renewable energy in agriculture.
	(6) Solar lamps replacement.

Results Achieved	
Component 1 (steps taken or envisaged)	Put in place regulatory scheme for the licensing of proposed renewable energy projects prior to operations.
	Publishes monthly Wholesale Electricity Market Bulletin.
	Training artisans on solar installation and maintenance.
	Organises annual renewable energy investment fora for renewable businesses and key stakeholders in the market.
Component 1 (results achieved)	Installed 26.6 MW grid-connected renewable capacity of which 22.5 MW solar, 0.1MW waste-to-energy and 4 MW hydro.
	As of 2017, a total of 67 (3,528MW) provisional licensing issued, 29 (1,147MW) sitting permit issued and 5 (240MW) construction permit issued to IPPs.
	Organises Annual Renewable Energy Fairs to promote Renewable Energy Uptake.
	Over 6,500 participants have attended the Ghana Renewable Energy Fair from 2014 -2017.
	Over 200 Exhibitors have exhibited in the fair from 2014 -2017.
	Over 40 Radio and television slots used to air and create awareness on the Ghana Renewable Energy Fair from 2014 -2017.
Component 2(steps taken or envisaged)	Introduced a rooftop solar PV programme for households nation-wide with the target to distribute 200,000 solar PVs including individual installations.
	Established a licensing scheme for solar installers and importers.
	Developed net metering scheme to facilitate exchange of surplus solar power on the grid.
	Developed comprehensive programme to engage the public on awareness campaigns.
Component 2 (results achieved)	Installed 8.53MW distributed solar PV under the Rooftop solar project and individual initiatives.
	Developed and distributed more than 50,000 flyers to educate the public on the benefits of solar energy technology.
	Licensed 105 installation and maintenance and 5 solar PV import companies.
	Trained 250 existing and new technicians in grid connected solar PV system.
	Organised exchange learning visits for 20 senior officers on grid interactive systems in Germany.

Component 3: Steps taken or envisaged	Designed a programme to install 55 mini-grids to service a total population of 137,500 (26,442 households including SMEs, public facilities such as schools, clinics, and community water schemes).
	Support the development of a dedicated on-line RE portal to improve the availability of RE information for interested stakeholders.
	Map and prioritised potential beneficiaries districts/communities for mini grid electrification using GIS tool under the Ghana Energy Development & Access Project.
	Train beneficiary communities and stakeholders on the 5 deployed mini-grids and develop innovative business models to sustain the growth and use of mini-grids.
Component 3 (Results achieved)	Sensitised 5 communities on the benefits of having a mini-grid system to supply power 24/7.
	5 mini-grids have been successfully installed on 5 island communities translating into 0.33 MW (97% solar and 3% wind).
	Over 20 stakeholders engagements organised. A total of 200 island communities have been mapped through the GIS tool.
	5 community level training have been done and over 20 senior officers have visited islands for training and guided tour for solar PV installers. 5 different business models have been developed for the operation and management of mini-grid electrification.
Component 4: (Steps taken or envisaged)	Stakeholders engaged and public sensitised on the benefits of solar PV systems nationwide
	Training to build capacity of key institutions and industry players undertaken
	Regular monitoring was conducted for the installed systems
Component 4: (Results achieved)	Installed 7.3 MW off-grid renewable capacity of which 0.3% is wind installation and remaining being solar.
Component 5: (Steps taken or envisaged)	Establish 750 grid connected and solar irrigation schemes and 250 solar dryers deployed by 2030.
	Organised workshops in seven regions of Ghana for public and private stakeholders in the productive use of energy market.
	Train agricultural extension officers, solar PV and pump installers and farmer-based organisations on solar-powered irrigation systems (SPIS)
	Pilot viability solar irrigation systems in Ghana.
	Pilot solar dryers in Ghana.
Component 5: (Results achieved)	Organised 8 regional Productive Uses of Energy workshops: 2 in Greater Accra, and 1 each in Volta, Ashanti, Northern, Western, Brong Ahafo and Upper West Regions. A total of 350 participants from MMDAs and private sector attended
	Trained over 84 participants in Solar Powered Irrigation Systems. Additionally, trained over 1900 farmer-based organisation members in the use of solar dyers and farm management practises.
	Installed over 537 irrigation systems (484 On-grid irrigations, 53 solar powered) irrigation. 16 solar-hybrid ballon dryers installed in the Brong Ahafo Region of Ghana with support from the Ghana Grains Council. Over 1900 members of FBOs trained in the use of solar dyers and better farm management practices.
	Quarterly publishes SEforAll Newsletter and widely disseminated since 2014.

Component 6: (Results achieved)	99,840 solar lantern distributed in 199 districts for lighting to displace the use of kerosene and other unsustainable lighting sources"
Estimated emission reductions	2.79 ktCO2/yr since 2012 to-date
Co-benefits	Increased renewable energy share of national energy mix.
	Contributed to improving economic activities in rural communities and private companies.
	Reduced indoor air pollution and associated health benefits.
	Reduced risk in fire disasters from Kerosene lamps
	Removal of recurring household expenditure on fuel for lighting.
	Reduction in post-harvest losses and better market price for produce for farmers.
	Improved child education through the provision of better lighting for study in the night.
Progress indicators	Renewable share of installed capacity (% of MW)
	Renewable electricity generated (GWh)
	Number and capacity of renewable energy system installed (No and MW)
	Installed capacity of distributed renewables (MW)
	Number of mini-grid and installed capacity (No and MW)
	Number trained in renewables (No)
	Number of renewable installation and maintenance companies registered.
	Beneficiaries of solar lantern programmes (No)
	Number of jobs created (No)
	Investment made in renewables ($)
Funding model	Budget - $ 230 million based SREP-IP estimates
	Indicative expenditure - $ 40.5 million
Methodology	CDM AM0019, AMS - I.A., AMS - I.L
Assumptions	Grid Emission Factor (combined Margin (CM) Solar & Wind) - 0.43
	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).

Promotion of clean cooking for wood-fuel users

85,000

LPG cookstoves distributed

CO2 savings
642.5 kt CO2e/yr

1.2 million

Improved cookstoves sold to households

1,000

Number of institutional stoves in use

Women with new Ahotor stoves. Credit: SNV

Name	Promotion of clean cooking solutions
Type of action	Improved cookstoves and clean cooking fuels
GHG	CO2, N2O, CH4
Implementing entities	Ministry of Energy, Energy Commission, Global Alliance for Clean Cookstoves and Fuels, CSIR, Ghana Standards Authority, SNV, Ministry of Local Government & Rural Development, Ghana Cylinder Manufacturing Company, National Petroleum Authority & LPG Marketing Companies
Start year	2013
Status	On-going
Objective of the action	Improve access to energy efficient and improved cookstoves by woodfuel users; and improve access to LPG for cooking
Specific target	(1). 50% of households adopts LPG as primary fuel for cooking by 2030. (2). 1000 institutional stoves distributed in public and commercial institutions by 2020. (3) 2,000,000 improved biomass stoves adopted by households by 2030.
Description	This mitigation action aims at the promotion and adoption of clean cooking solutions in households, commerce and service sectors. It has two main components and these are: (1) LPG promotion programme and (2) Access to energy efficient and improved cookstoves by wood-fuel users.
Steps taken or envisaged to achieve mitigation action	Increase public awareness on the benefit of improve cookstoves.
	Develop and implement National LPG Promotion Policy.
	Institutionalise the collection of data on the adoption of improved cookstoves
	Introduce LPG cylinder recirculation model.
	Redirect subsidy on LPG to finance LPG access by rural communities.
	Distribution of the cylinders, stoves and accessories in beneficiary communities.
	Conduct gap assessment for selected local stoves manufacturers
	Providing 40% subsidy to women involved in agro-processing activities to purchase improved institutional biomass stove through micro-finance institutions.
	Developed and published national standards for biomass cookstoves in December 2017.
	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.
	Facilitate access to financing to enable manufacturers increase their production capacity.
Results Achieved	Over 22.3% of households use LPG as primary cooking fuel
Component 1 (LPG Promotion Programme)	Distributed 149,500 cylinders and 85,000 single burner stoves and accessories have been distributed across 97 metropolitan, municipal and district assemblies.
	Increased awareness on the benefits of LPG use and the negative impacts of using wood-fuel in inefficient stoves.
Component 2 (Access to energy efficient and improve cookstove for wood fuel users)	Deployed 1,000 improved institutional cookstoves in over 100 communities impacting over 100,000 people nationwide under different interventions.
	For households, over 1.2million stoves have been disseminated to date.
	Developed star-label for cookstoves and draft regulations being prepared.
	LPG cylinder recirculation model is being worked on.

	National standards for biomass cookstoves published.
	Increased public awareness on improved cookstoves and benefits through regional markets activation and behavioral change campaigns
	Installed 155 improved institutional biomass stoves through a 40% subsidy scheme to women involved in agro-processing activities under the Energising Development Programme
	Ghana Statistical Service has included as part of their survey questions an indicator to measure the number of households using improved cookstoves
	Facilitated access to financing to enable manufacturers increase their production capacity.
Estimated emission reductions	642.5 kt C/yr since 2013 to-date
Co-benefits	Reduced dependence on wood-fuel.
	Improved ambient air and reduced household exposure to CO and particulate matter and improved health.
	Reduction in spending on cooking fuels.
	Job creation through the manufacture and sales of improved cookstoves and LPG cylinder distribution outlets.
Progress indicators	Number of new LPG retail outlets established in low access areas nationwide (No).
	Number of improved cookstoves sold or distributed (No).
	Percentage of beneficiary households switched to LPG as primary cooking fuel (%)
	Number of LPG bottling plants established (No).
	Number of people trained and sensitised (No)
	Investments ($)
Funding model	Overall budget - $ 20.3 million
Methodology	Methodology AMS-II G
Assumptions	Fraction of non-renewable biomass (99%), efficiency of improve cookstove (20%), Carbon content of wood (2.6 tC/yr).

Energy Efficiency improvements in homes, services & industry

32,893 automatic timer switches installed.

★

CO_2 savings

5.9kt C/yr

★★★★★

18,000 inefficient 250W streetlight replaced with 150W LED.

★★★★★

46 capacitor banks installed in public buildings.

207 energy managers in MDAs & MMDAs trained.

★★★★★

120,000 education materials on energy conservation printed for nation-wide distribution.

Name	Energy efficiency improvements in households, services & industry
Type of action	Technology penetration - timer switches, solar street lights, capacitors
GHG	CO2
Implementing entities	Ministry of Energy and Energy Commission
Start year	2016
Status	On-going
Objective of the action	This mitigation action has multiple objectives enumerated as follows:
	Improve power factor of beneficiary institutions and reduce their demand charges
	Reduce energy consumption of street lights and peak demand.
	Reduce household electricity consumption for freezers during peak hours
	Establish a web-based appliance database on refrigerators, and air conditioners appliances with related Application (APP) to assist consumers to buy only energy efficient appliances.
	create consumer energy efficiency awareness and inspire changes in energy use behaviour
Specific targets	Install 42 capacitor banks in selected institutions nationwide by 2019.
	Replace 18,000 inefficient streetlights 250W (halogen, helium) with energy efficient LED types 150W.
	Deploy 40,000 automatic timer switches to households nationwide.
Description	Energy efficiency improvements is an integral part of Ghana's mitigation efforts in the energy sectors. The component of this action are:
	(1) Improvements of power factor in public buildings.
	(2) Efficient street lighting.
	(3) Installation of automatic timer switches.
	(4) Web-based APP for electronic appliance.
	(5) Consumer awareness and training.
Steps taken or envisaged to achieve the action	Developed jingles and documentaries on refrigeration, air conditioning and lighting energy efficiency for regular airing on radio and TV.
	Training of energy managers in energy efficiency measures extended to the security agencies (Police, Prisons service, Immigration and the Army to reduce energy consumption and Government energy bill
	Official launching of deployment of the automatic timers to kick-start the free distribution by the Ministry of Energy at the graduation of certified electrical wiring personnel event on 6th September 2017.
	Selected 42 public buildings to benefit from this phase of the capacitor installation programme. The public buildings/facilities include hospitals, clinics, schools and government offices.
	Procurement of the 46 capacitors for installation is ongoing and the first batch has been delivered.
	Developed the database application (APP) for refrigerators and running on Google Play store. The Application will be expanded to include data on air conditioners and lighting bulbs.

Results Achieved	Developed energy efficient appliance database for refrigerators, air conditioners and lighting bulbs and being populated with the collected data. Developed energy efficient refrigerator APP and running helping consumers to identify energy efficient refrigerators and the retail shops where they can be bought. So far there has been over 4,000 downloads of the certified refrigerating appliance APP.
	A total of 42 public buildings/ facilities selected to benefit from this phase of the capacitor installation programme
	A total of 32,893 ATS have been distributed to consumers in among security agencies, government institutions and households.
	Conducted test on the energy saving potential of the timers over a 48 hour period indicated an energy savings of about 30% can be achieved. It is estimated that the 32,893 ATS distributed nationwide will lead to a total electricity savings of about 3,215 MWh (3 GWh) a year.
	Over 120,000 educational materials in the forms of leaflets, brochures, flyers produced for distribution nationwide.
	More than 12 radio and 2 TV discussions on energy efficiency held nationwide in 2018.
	Hundred energy efficiency and conservation jingles aired.
	In 2017, trained 60 Energy Efficiency Advisors (EEAs) who went into selected communities for education and sensitisation. A total of 2,880 beneficiaries (1,376 households and 1,504 SMEs) were covered.
	A total of 207 Energy Managers from MMDAs and MDAs were trained nationwide.
Estimated emission reductions	5.9 kt C/yr since 2016 to date.
Co-benefits	Reduction in energy expenditure for consumers
	Job creation for ESCOs through installation and maintenance.
	Short payback period for required investments.
	Reduced electricity bills/energy cost for ATS users.
	Reduced risk of brownout.
Progress indicators	Number of ATS distributed (No).
	Energy savings from the deployment of ATS (MW)
	Number of Energy Managers trained (No).
	Number of radio and TV programmes undertaken(No).
	Reduced energy and demand charges ($)
	Number of feedback received from consumers using the Application (No).
Funding model	Overall budget : Unknown
Methodology	WRI GHG project protocol.
Assumptions	ATS will switch the freezers off during peak period for 6 hours each day.
	Grid emission factor of 0.47 tCO2/MWh.
	Streetlight will work for 12 hours each day.

Promote low-carbon electricity generation & reduced flaring

330 MW

CO_2 savings
1.2 Mt C/yr

Thermal capacity additions from combined cycle conversions.

595.4 ktoe

Average annual natural gas consumption for electricity generation.

775.01 ktC/yr

Avoided emissions from reduced natural gas flaring

Atoabo Gas Processing Plant

Name	Fuel switch from heavy fuel oil to natural gas in existing power plants for electricity generations
Type of action	Fuel switch from heavy fuels (LCO or HFO) to natural gas
GHG	CO2
Implementing entities	Volta River Authority and Independent Power Producers
Start year	2010
Status	on-going
Objective of the action	To replace the utilisation of heavy fuel oil (LCO or HFO) with gas to reduce the cost of electricity generation and emissions.
Specific targets	Majority of thermal power plants being fired by natural gas by 2030.
Description	This mitigation action is one of the unconditional commitments under Ghana's nationally determined contributions. It involves investing in the development of gas infrastructure to facilitate production, transportation and processing of natural gas as primary fuel inputs for the generation of thermal electricity.
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.
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 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 4,167.52 ktoe of natural gas for electricity generation.
Estimated emission reductions	428.7 kt C/yr since 2010
Co-benefits	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	Quantity of gas from supplied production field (mmscf).
	Quantity of lean gas produced and delivered to the thermal plants.
	Quantity of electricity generated from natural gas fired thermal power plants.
Funding model	Overall budget - $ 13.1 billion
Methodology	CDM ACM0011
Assumption	IPPs that operate dual fuelled-thermal plants will cease from using LCO and replace it with natural when gas is delivered in the market at competitive price.
	Average heat rate of BTU/kWh

Name	Conversion from an open-cycle gas power plant to a combined-cycle gas power plant.
Type of action	Energy efficiency - fuel savings through energy efficiency improvement
GHG	CO2
Implementing entities	Volta River Authority and Independent Power Producers
Start year	2014
Status	on-going
Objective of the action	To increase the installed capacities of thermal plant by converting open-cycle gas power plant is to a combined- cycle one for more-efficient power generation.
Specific targets	Upgrade the installed capacity of each of three open-cycle thermal power plants by 330 MW through retrofits to convert the technology and thereby improve the thermal efficiency or heat rates .
Description	There is a national policy to retrofit existing and new thermal plants to combined cycle power plants. In line with the policy, there were conversions 2 x110MW simple cycle Takoradi 2 Thermal Power Plant (T2) to 330MW combine cycle Plant, conversion of 110MW simple cycle Tema Thermal 1 Power Station (TT1PS) and 110 MW Simple Cycle CENIT Plant to 330MW combined cycle, conversion of 2x 110MW simple cycle Kpone Thermal Power Plant to 330MW combined cycle and 10MW capacity addition by Karpowership.
Steps taken or envisaged to achieve the action	Retrofit of T2 started in 2012 and was completed in 2014. Feasibility study Report completed for TT1PS upgrade, Environmental permits acquired. CDM project design document submitted.
Results Achieved	Conversion of 2 x110MW Simple Cycle Takoradi 2 Thermal Power Plant (T2) to 330MW combine cycle Plant by Takoradi International Company (TICO).
	Conversion of 110MW Simple Cycle Tema Thermal 1 Power Station (TT1PS) and 110 MW simple cycle CENIT Plant to 330MW Combined Cycle by Volta River Authority and CENIT Energy Limited.
	Conversion of 2x 110MW Simple Cycle Kpone Thermal Power Plant to 330MW combined cycle by Volta River Authority.
Estimated emission reductions	109.9 kt C/yr since 2014
Co-benefits	Increase electricity generation and supply to meet growing electricity demand.
	Depending on demand scenarios, savings are estimated to be between US$67 million and US$610 million
	Projected 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.
	Additional production of electricity with the same amount of fossil fuels, thus increasing the efficiency of power generation in the country.
	Upgradation of Technological base would occur leading to lesser emissions.
Progress indicators	Number of single cycle power plants reduced.
	Share of thermal electricity from steam
Funding model	Overall budget - $ 600 million
Methodology	CDM ACM0007
Assumption	On-site fossil fuel consumption to operate the project power unit(s) in combined cycle mode.

Name	Recovery and utilisation of associated gas from Jubilee and TEN Fields
Type of action	Recovery and utilisation of associated from oil fields that would otherwise be flared or vented
GHG	CH4
Implementing entities	Volta River Authority and Independent Power Producers (IOCs, GNPC and Ghana National Gas Company)
Start year	2014
Status	on-going
Objective of the action	To recover associated gas from the Jubilee and TEN oil fields for Ghana National Gas Company to produce downstream products (Lean Natural Gas thermal power generation, LPG and Condensate).
Specific targets	Expand installed capacity of three thermal plant by 330MW through technology efficiency improvements.
Description	The mitigation action resulted from Government policy to expand the domestic gas market. This has led to the investment in national gas infrastructure to facilitate harnessing and processing of associated gas. This initiative is part of the zero flaring policy as well as a strategic move to enhance energy supply security.
Steps taken or envisaged to achieve the action	Construction started in 2012 and commissioned in 2014. Feasibility study Report completed for TT1PS, Environmental permits acquired. CDM project design document submitted.
Results Achieved	Investment of $1billion in Gas Processing Plant managed by the Ghana National Gas Company (GNGC).
	Since 2014, GNGC has processed and supplied, annual average of 477,416.71 cubic meter of lean gas to the Volta River Authority's power plants in Aboadze Power Enclave and other clients for electricity generation.
Estimated emission reductions	755.01 kt C/yr since 2014
Co-benefits	Produced a total of 170,030 Mt of LPG for domestic cooking since 2014.
	Supplied 37,327.89 mmbtu of condensate to business clients downstream activities
Progress indicators	Amount of wet gas received annually from oil field (MMscf/annum).
	Amount of associated gas recovered for utilisation (MMscf)
	Amount of LPG produced annually (MMscf/annum)
	Amount of condensate produced (MMscf)
Funding model	Overall budget - US $ 13.11billion
Methodology	CDM AM0009
Assumption	Proportion of associated recovered as re-injected, flared and served as own use.

Alternative solid waste management - waste to compost

CO_2 savings
355.9 kt C/yr

8,545.4 tonnes

Amount of average compost produced yearly since 2013

★★★★★

600 tonnes/day capacity

Installed capacity of compost facility

4.4.3 Waste sector mitigation actions

Name	Solid waste to compost
Type of action	Avoided methane from disposal of solid waste through compositing
GHG	CH4
Implementing entities	Accra Compost and Recycling Plant Limited (ACARP) and Jakora Ventures Limited
Start year	2013
Status	on-going
Objective of the action	Produce compost for agricultural use from organic waste that would have been disposed to the landfill to emit methane.
Specific targets	Install compost facility with capacity of 1000 tonne per day.
Description	This action is joint effort between local government and two private businesses. The businesses have established compost facilities that receives Municipal Solid Waste from the Waste operators at an agreed tipping fee. The compost produced is sold as fertilizer mainly in the agricultural business.
Steps taken or envisaged to achieve the action	Constructed 600 tonnes per day capacity compost plant by ACARP and completed feasibility to expand to 1000 tonnes per day. ACARP Compost is part of the Fertilizer Subsidy for Cocoa Farmers. ACARP plans to establish another 600 tonnes per compost plant in Kumasi. Jekora Ventures Limited produces JV Compsoil and Fortifier Compost for the local market.
Results Achieved	Since 2013, an average of 8,545.3 tonnes of compost are produced annually.
Estimated emission reductions	355.9 kt C/yr since 2013
Co-benefits	Average of 8,545.3 tonnes of compost are produced annually
	More than 2,000 direct and indirect jobs created.
	Amount of plastic waste recycled for export and further use in the country.
Progress indicators	Amount of Municipal Waste Treated (Tonnes).
	Number of compost bags produced (No).
	Number of jobs created (No).
	Amount of non-organic waste recyled.
Funding model	Unknown
Methodology	ACM0022
Assumption	Organic fraction of Municipal Solid Waste (MSW) is 60%. MSW would have been sent to Landfill to emit methane if compost plant was not constructed, heavy metal content of compost is within tolerable levels.

4.5 Information on International Market Mechanism

4.5.1 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 Executive Board (EB). The four CDM projected are expected to generate a total for 3,026 kCER per year in the first crediting period. However, the compost project has not successfully gone through verification phase to qualify for CERs because the original buyer of the CERs is no longer interested in the project, emission reduction claims from the project has not been realised. Project development of additional four CDM projects with potential CERs of 2,541 $ktCO_2e$ commenced and are at different stages of validation. Furthermore, there are a total of 18 registered POA CDM projects, with potential CERs of 1,544.9 $ktCO_2e$ that Ghana is involved. Tables 16 and 17 contain brief overview of CDM

Table 16: List of CDM Projects and status in Ghana

Project Name	Category	Status	Crediting starts	CERs (ktCO2e/yr) (1st period)	Crediting Period
Zoomlion Ghana LTD Composting of Municipal Solid Waste in Accra area	Composting	Registered	March, 2012	69	10
Jubilee Oil Field Associated Gas Recovery & Utilization Project	Oil field flaring reduction	Registered	December, 2014	2603	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 oil seed crop cultivation at Yeji in the Pru district, Ghana	Reforestation	Validation termininated	January, 2009	2036	20
Saltpond Oil Field Associated Gas Recovery and Utilization 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 - GSC record withdrawn	Landfill flaring	Replaced validation terminated	January, 2014	22	10

3.33.2 NAMA Projects

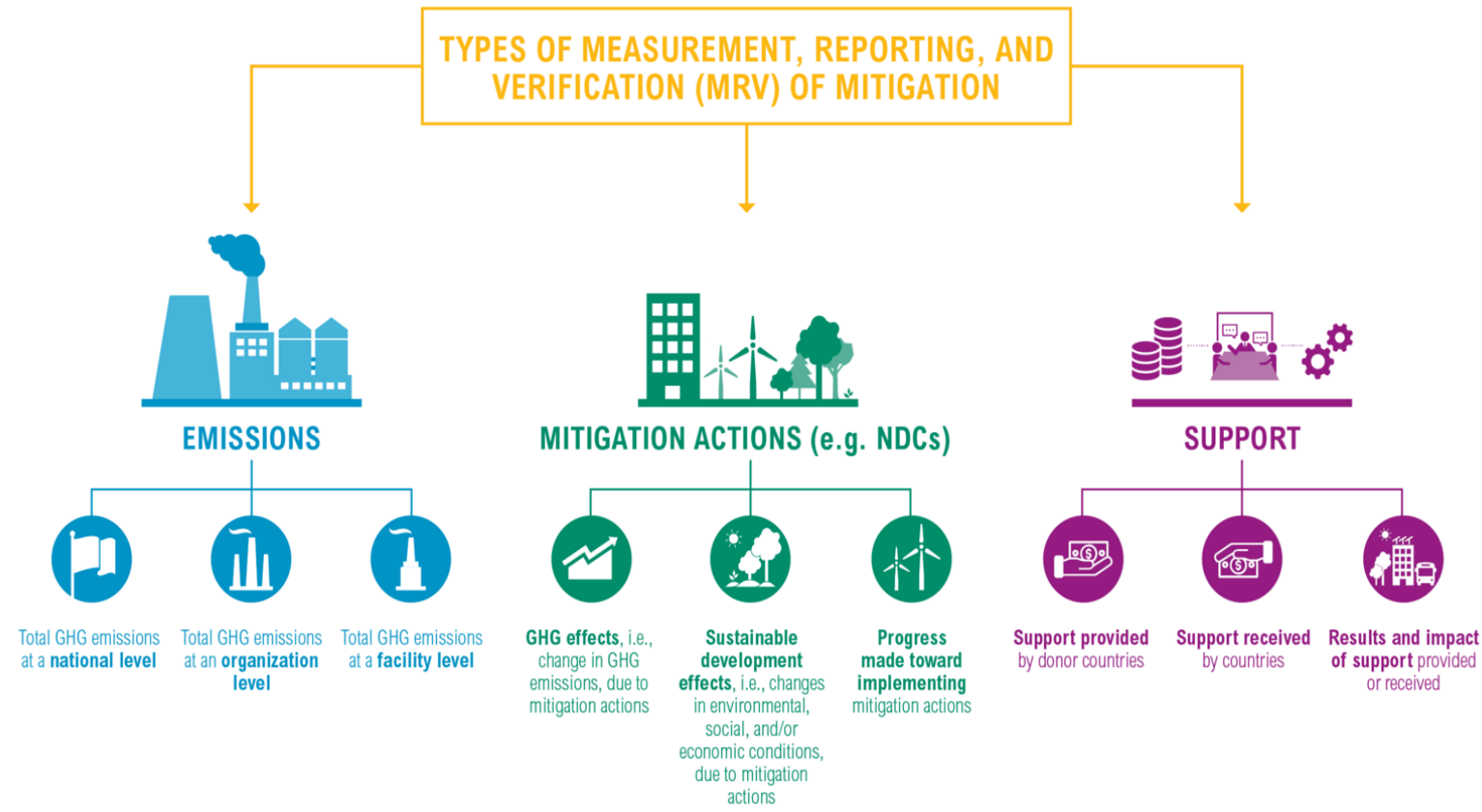
Ghana has developed four NAMA projects in the energy, transport and the forestry sectors. The energy project was on "Access to clean energy through the establishment of market based solution" prepared under the UNDP Low Emission Capacity Building Project and it is awaiting funding. Under the FIRM project implemented by UNEP-DTU, Ghana prepared two NAMA project 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.

Table 17: List of POA and status in Ghana

POA Title	POA Boundary	Region	Coordinating entity	Status	CER 1 period (ktCO2e/yr)	POA Life time
CPA- GA-001-Ghana	Ghana	Ghana	Green Development AS	Registered	111.4	21
African Improved Cooking Stoves Programme of Activities	Ghana, Nigeria	Many	Envirofit International	Registered	240.1	21
African Improved Cooking Stoves Programme of Activities – CPA No. 00001 (Ghana)	Ghana	Many	Envirofit International	Registered	15.5	21
African Improved Cooking Stoves Programme of Activities – CPA No. 00002 (Ghana)	Ghana	Entire country	Envirofit International	Registered	47.0	21
African Improved Cooking Stoves Programme of Activities CPA 00003 (Ghana)	Ghana	Many	Envirofit International	Registered	47.0	
Standard Bank Renewable Energy Programme	Ghana, Kenya, Nigeria	Ghana	Standard Bank	Registered	47.0	20
Standard Bank Renewable Energy Programme –Solar Bundled CPA in SADA zone	Ghana	Upper West	Standard Bank	Registered	1.1	
Standard Bank MSW Composting Programme	Ghana	Ghana	Standard Bank	Registered	1.1	20
CPA001 Kumasi Composting Plant at Adagya	Ghana	Ashanti	Standard Bank	Registered	27.9	
Landfill gas capture, flaring and utilization program in Africa	Ghana and rest of Africa	Ghana	Puresphere Limited	Registered	27.9	
CPA-1: Oti Landfill gas capture, flaring and utilization at Kumasi (Ghana)	Ghana	Ashanti	Puresphere Limited	Registered	103.2	21
Clean Cook Stoves in Sub-Saharan Africa by ClimateCare Limited	Ghana and rest of Africa	Ghana	ClimateCare Limited	Registered	466.6	
CookClean Ghana Limited —CPA01	Ghana	Ghana	ClimateCare Limited	Registered	135.7	21
CookClean Ghana Limited - CPA02	Ghana	Ghana	ClimateCare Limited	Registered	145.5	21
Decentralised Community Water Purification System installations in Ghana, Africa	Ghana	Volta and Greater Accra	Water Health India Pvt	Validation terminated	19.0	20
20MW Ningo PV Power Generation Project in Ghana	Ghana	Accra	Scatec Solar ASA	Registered	31.7	30
Man and Man Enterprise Improved Cooking Stoves CDM Programme in Ghana supported by Republic of Korea	Ghana	Ghana	AERA GROUP	At validation	10	
Man and Man Enterprise Improved Cooking Stoves CDM Programme in Ghana supported by Republic of Korea – CPA001	Ghana	Brong Ahafo	AERA GROUP	At validation	10	21

5 Updates of information on domestic MRV system

Credit: World Resource Institute, 2016



*For simplicity, this graphic uses the term "emissions" as shorthand for "emissions and removals."

5.0 Updates on Domestic Monitoring, Reporting & Verification

5.1 Updates on Domestic Monitoring Reporting Verification

This section provides information on the updates on Ghana's domestic MRV. The updates cover the highlights of major modifications in the MRV setup and the progress made in the operationalisation of the domestic MRV road-map reported in the BUR1 (Figure 8). In 2013, Ghana launched a Climate Ambitious Reporting Program (GCARP) as its domestic MRV system with the aim to facilitate the establishment of an integrated climate data management to support regular national and international reporting.

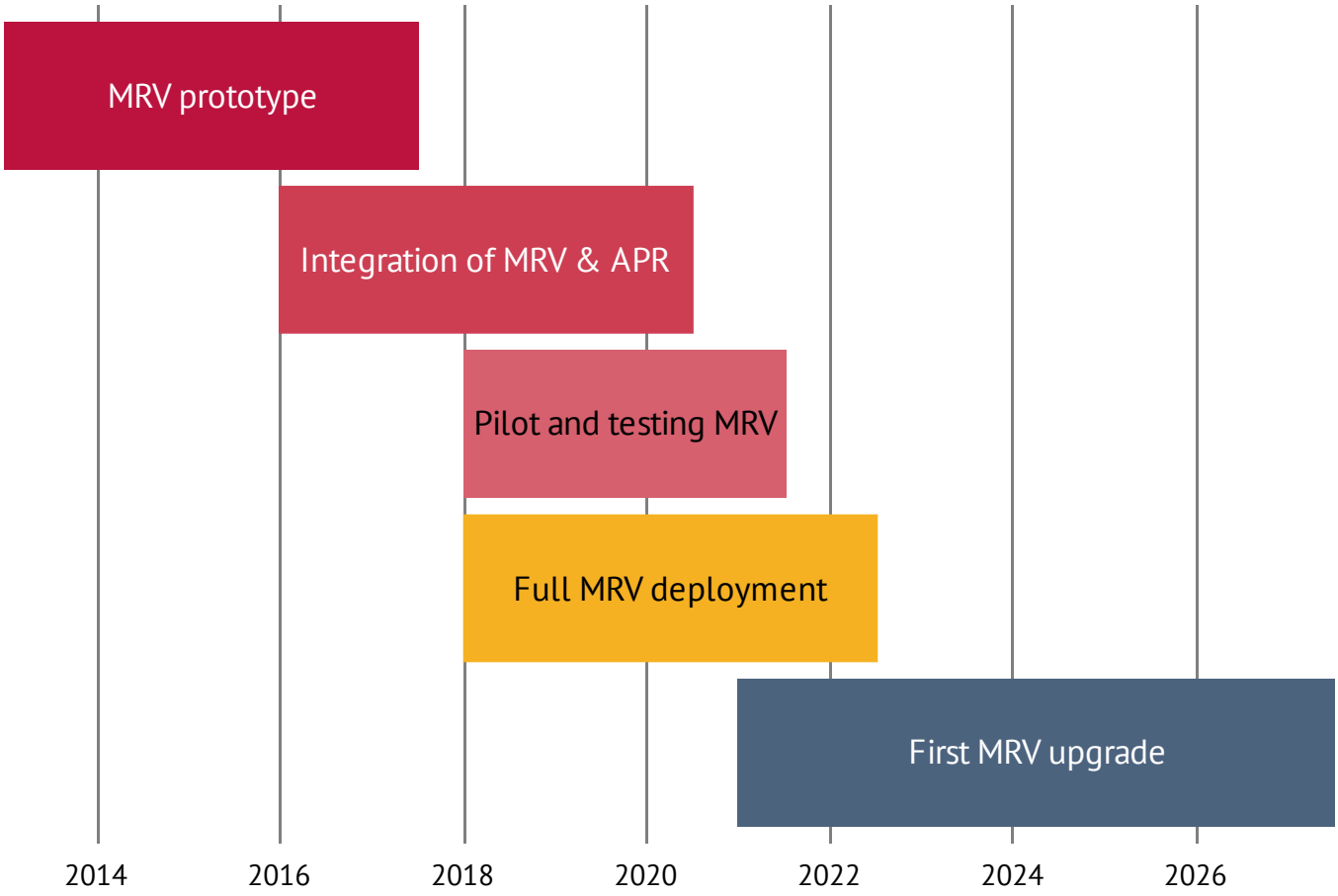


Figure 8: Overview of milestones in the operationalisation of the domestic MRV

The GCARP has four components namely (a) institutions (b) data management (c) methods and tools and (d) training and has since its introduction in 2013 seen consistent improvements. Nevertheless, the GCARP system continues to face operational challenges upon which Ghana's CBIT proposal to the GEF seeks to help address. The CBIT project aims at consolidating and building on the foundation laid in setting up the GCARP and further entrench the culture of reporting within the governmental structures by (a) establishing an effective institutional arrangement to plan, implement and report climate actions, (b) putting in place a centralised national infrastructure for improved data access and information management, (c) mainstreaming five climate change indicators into the medium-term development framework (Yr. 2017-2021) and (d) testing and piloting of domestic transparency framework in energy and transport sectors.

5.2 Key achievements in the operationalisation of the Domestic MRV since BUR1

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

- The Ministry of Finance has taken up the responsibility of tracking climate support and has since developed a climate finance tracking tool (http://www.mofep.gov.gh/sites/default/files/docs/Climate-Change-Tracking-Tool.pdf) for its use, line ministries and local government authorities.

- The EPA has established a climate data-hub (http://climatedatahubgh.com/gh/) online dashboard for Ghana's climate reporting. It serves as a one-stop information sharing portal on facts about Ghana's actions to tackle climate change and the benefits thereof.

- Ghana's EPA has developed the following MRV related guidelines on:

    (a) Automated standard mitigation template (http://mestiqna.igreengrowthsolutions.com) put for public access for capturing information on climate actions.

    (b) GHG inventory manual and QA/QC and Uncertainty Management.

    (c) Incorporation of climate change indicators into the environmental reporting by industrial facilities.

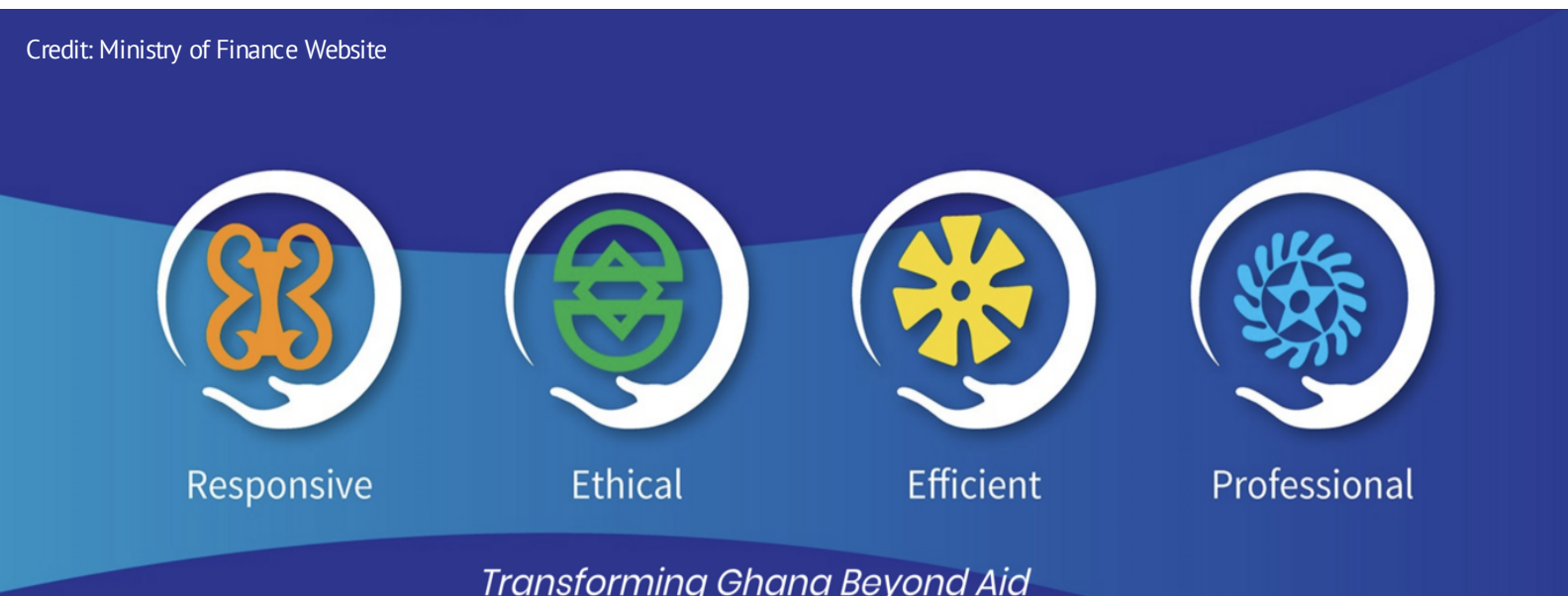
- The Forestry Commission has started work to establish a forest monitoring system to improve the forest monitoring capacities. As part of this initiative, the Forestry Commission has developed 12 standard operating procedures (SOPs) to guide the setting up of forest reference level. and LULUCF GHG inventory.

- The Forestry Commission is in the process of establishing forest and safeguard information management.

- The state-run Volta River Authority (VRA, the only public electricity utility has introduced a voluntary carbon accounting programme. The programme has finalised its first corporate carbon accounting reporting and being peer reviewed by Ghana's ERPA before it is officially published.

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

Credit: Ministry of Finance Website



6.1 Mobilising climate support

Climate support is critical to achieve high climate ambition. Therefore, Ghana has been consistent in mobilising financial resources and technical assistance. The GEF is the traditional source of grant for climate change initiatives in Ghana. And recently, the Climate Investment (CIF) and GCF have become the favourite sources for mobilising climate finance. The BUR2 contain updates on funding and non-monetised inflows are for period 2011 to 2017. The updates are reported in a tabular format according to the channel (multilateral, bilateral and both), type of financial instruments (grant, loan, equity etc) and the source (public, private, international, national). The climate inflows are also categorised into climate-specific (CS) and climate-relevant (CR) projects. The CS projects are climate tagged** projects whereas CR projects are not specifically labelled as climate change project but its implementation results in climate benefits.

6.2 Update information on support received

6.2.1 Financial support received

The data on financial inflows were collected through national survey and information published on the websites of donor and recipient institutions. Most of the reported information in this BUR are more of international donor inflow than Ghana government funding. Ghana plans to start reporting on Ghana government climate change expenditure/budget lines in the next BUR. Majority of donor funding for climate change is in the form of projects financing. So the climate change finance inflow information is presented at the project scale or according to projects. All projects without adequate information and worth less than $10,000 are excluded from the analysis. Financial inflows are reported in US dollar terms.

Projects that started in 2011 and are still active or on-going have been included in the analysis. Those projects that began in the past and ended before 2011 have been excluded from the compilation. Projects that may be global or regional in nature in that it serves a number of countries and the specific budget for Ghana is unknown and are not included in this report. For the active or on-going projects, the information on "committed funds" have been reported. This is because information on specific expenditures and its corresponding outputs were difficult to evaluate and would take more time to collate. It worth to note that there may be significant variations in the amount of funds designated as "committed", "disbursed" and "released" depending on the reporting period. Actual funds disbursed have been reported for completed projects. All the climate change funding compiled are presented without the loans unless otherwise stated. Financial inflows have been considered and reported as non-ODA funding.

6.2.2 Summary of donor funds committed to climate change projects in Ghana (2011-2017)

This tracking exercise of climate change projects captured 101 projects over the period of 2011-2017. A total amount of US$15.5 billion was "committed" to the projects. Of the 101 projects captured, 59 fall under the CS category and an estimated amount of US$351.3 million was committed to them for the 6 year period. For 4 of the CS projects, because they are classified as global projects, the specific amounts allocated to Ghana is unknown. The remaining 42 projects are classified as CR projects with fund commitment of US$15.12 billion for the same period. In terms of the type of financing instruments, 78 of all the projects are grants with a total amount of US$949.9 million, 10 projects are loans with a total value of US$14.4 billion, 3 are from national budget in the form of co-finance, which has a total amount of US$78.6 million and the remaining 6, the funding levels are unknown (Figure 9).

** Projects that are originally designed with climate change objective and funded climate earmark funds.

When the 101 projects are grouped into climate change themes they are addressing, 45 projects fall in the Mean of Implementation (MOI) cluster to which a total amount of US$119.9 million have been committed. This is followed by 38 Mitigation projects with a total amount of US$15.3 billion committed for investments. The remaining 15 projects are in the categories of Adaptation (US$44.1 million committed to) and Enabling Activities (US$1.7 million). Overall, the Agriculture and Forestry sectors, recorded the highest number of projects numbering 34 with financial commitment of US$352.6 million. The Energy sector had 22 projects with US$ 14.9 billion committed to them and there are 20 projects in the Environment sector with US$ 35.8 million committed. The financial commitment to the remaining 18 projects in others sectors (such as Finance, Water, Health etc) amounted to US$131.7 million (Table 18)

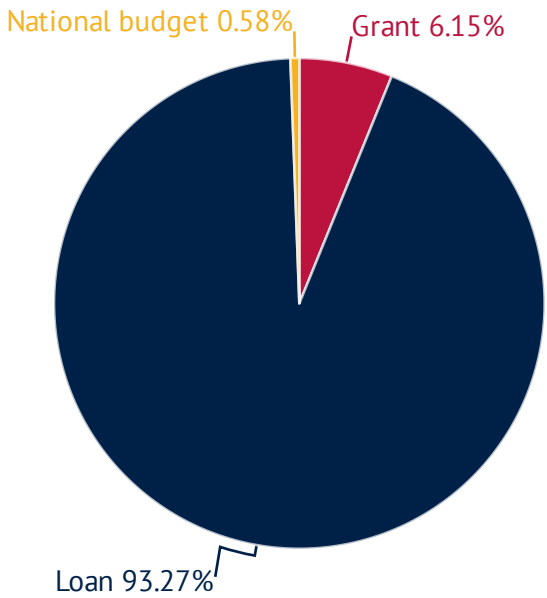


Figure 9: Share of committed funds to climate projects according to financial instruments

Table 18: Summary of funds committed to climate change projects in Ghana for the period 2011-2017

	Amounts committed (US$, million)						
Category	**Totals**	**Mitigation**	**Adaptation**	**MOI**	**Enabling Activities**	Climate-specific	Climate-relevant
Loans	14,429.5	14,429.5	-	-	-	10	14,419.5
Grant	949.5	783.8	44.1	119.9	1.7	341.3	608.2
National budget	78.5	78.5	-	-	-	-	78.5
Amounts committed by channel of flow							
Bilateral	590	514.9	8	67.1	-	65.6	524.3
Multilateral	380	323.2	22.7	34.1	-	103.8	276.2
GEF	58.4	43.2	13.4	-	1.7	13.3	45.1
National budget	78.5	78.5	-	-	-	-	78.5
Private sector	14,198.6	14,180	-	18.6	-	16.6	14,182.1
Amounts committed by sectors							
Agric & forestry	352.6	265.4	18.6	68.7	-	290.7	61.8
Energy	14,939.3	14,936.4	-	2.9	-	-	14,939.3
Environment	35.8	-	11	23	1.7	35.7	0.05
Finance	14.8	-	-	14.8	-	6.9	7.9
Others	115	90	8.5	16.5	-	17.9	97

6.2.2.1 Sourcing finance from Green Climate Fund

The Real Sector Division of the Ministry of Finance is responsible for tracking climate finance and serves as the National Designated Authority (NDA) for the Green Climate Fund (GCF). The NDA focuses on: developing the GCF project pipeline; facilitating institutional designation as national implementing entities; creating awareness and match-making for project developers. Table 19 shows the status of GCF projects/proposal development in Ghana.

Table 19 - Status of GCF Projects/Proposal Development in Ghana

Type of Proposal/Application	No. of projects/entities application received by the NDA	No of projects/entities applications approved by the NDA/TAC	Full proposals/Concept note submitted to GCF	Project receive approved by GCF
Programme/Projects	34	6	3	1
Readiness Support	4	3	3	1
National Adaptation Plan	1	1	1	0
Project Preparation Facility	0	0	0	0
NIE/DEAs Application	18	3	2	0

Details of the three (3) full proposal/concept notes that have submitted to the GCF are below:

(1) Name of Project: Resilient Landscape for Sustainable Livelihoods
- Executing Entity: Ministry of Agriculture
- Accredited Entity: UN Environment
- Total project financing: USD 50 million
- Type of financial instrument: Grant

(2) Name of Project: Ghana Shea Landscape for Sustainable Livelihoods REDD+
- Executing Entity: Forestry Commission
- Accredited Entity: UNDP
- Total project financing: USD 50 million
- Type of financial instrument: Grant

(3) Name of Project: Sustainable Energy Access
- Executing Entity: Energy Commission
- Accredited Entity: Ecobank Ghana
- Total project financing: USD 30 million
- Type of financial instrument: Loan

6.2.3 Non-monetised support received

Ghana also received non-monetised support in the form of capacity-building, technical assistance and technology. The summary of non-monetised climate support received for the period 2014-2017 is shown in Table 20.

Table 20: Summary information on non-monetised support received for the period 2014-2017

Activity	Developed country or partner	Status/Remarks
Information matter project. Training on GHG data management in the waste sector	German Federal Ministry for Economic Cooperation and Development (BMZ), GIZ	Completed in 2018
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	On-going
Training on Non-Annex 1 GHG Inventory software	United Nations Framework Convention on Climate Change (UNFCCC) Secretariat	2016, 2017, & 2018
UNFCCC GIR CASTT Training Programme on Greenhouse Gas	UNFCCC and Government of Korea	2015, 2016, 2017
Training on Long-range energy alternatives planning system.	Stockholm Environment Institute	2016
Training on the GACMO model for the construction of NDC baseline	UNEP-DTU	2017
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 reviewer in 2017
Sustainable GHG Management Project in West Africa: Third Party Review of National GHG Inventory Review - AFOLU Section. Training on Land use mapping using Google map engine tool.	Australia, USA, Netherlands, UK, Belgium, New Zealand, UNFCCC, FAO, UNDP, UNDP	Completed in 2017
Training on advance topics on GHG inventory for national expert	UNDP Nationally Determined Contribution Support Programme	On-going
Collaboration on West Africa GHG Inventory Network	UNDP, Global Support Programme (GSP)	On-going
Integrated LEDs modelling project	UNEP	On-going
Preparation and use of National GHG Manual and Uncertainty Management Guidance document	UNDP Low Emission Capacity Building Project	Completed in 2017
Capacity building for Readiness for Green Climate Fund (GCF)	UNDP/Frankfurt	Completed in

6.2.4 Support received during BUR Preparation

The Global Environment Facility funding under the Enabling Activities portfolio was the main direct funding Ghana received for the preparation of the BUR2. Following the approval of the BUR2 project proposal, Ghana received funding support of a total amount of US$ 352, 000 through UN Environment as the implementing agency. The GEF funding, allowed Ghana to compile the BUR2, the funding amount did not cover the full cost for preparing the BUR2, so other partners also contributed through technical assistance. Table 21 presents the list capacity building support received during the preparation of BUR2.

Table 21: Support received during preparation of the BUR

Activity	Capacity needs	Capacity received	Source of Capacity
Use of 2006 IPCC guidelines and AFOLU GHG Accounting	Training on 2006 IPCC Guidelines and software	Training on AFOLU, National FRL GHG Inventory.	RRR+ Project, Rainforest Coalition Nations
	QA/QC Protocols & Management of Uncertainty Management	Workshop on QA/QC and Uncertainty Assessment	RRR+ Project, Rainforest Coalition Nations
		Development of LULUCF Standard Operating Procedures.	Forest Carbon Partnership Facility, World Bank
		Training on Land use mapping using Google map engine tool.	West Africa GHG Management Project
Improvement in GHG National System	Strengthening national system for GHG	Development of GHG Manual	Low Emission Capacity Building Project, UNDP
		Development of QA/QC Plan and Uncertainty Assessment Plan	Low Emission Capacity Building Project, UNDP
	GHG Data management and institutional arrangement.	Establishment of online climate change data hub	Low Emission Capacity Building Project, UNDP
		Development sector-specific MRV	Nationally Determined Contribution Support Programme, UNDP
		Introduce corporate carbon accounting to VRA	Integrated Resource and Resilience Planning, USAID, IRRP
Continuous training of GHG Experts	Training new technical experts on GHG at the international level	One expert participated in training Annex 1 GHG review and qualified as LULUCF Reviewer.	UNFCCC GHG Review Training Programme
Development of Marginal abatement cost curve	Training on abatement cost curves	Training on GACMO tool for the development of marginal abatement curves	ICAT Project, UNEP-DTU
Development of mitigation scenario for non-energy sector	Improving on emission baselines	Training on mitigation assessment using LEAP-IBC tool	Stockholm Environment Institute (SEI)
Quality Control of BUR2 Report	Third Party Review	Voluntary in-country review of Ghana GHG Inventory System	Global Support Programme, UNDP

6.2.5 Information on Support Needed

Table 22 contains the summary of information on the financial support Ghana needs to be able to effectively respond to climate change. The financial needs that have been identified are based on the priority in Ghana's NDCs and the National Climate Change Policy.

Table 22: Information on financial support needed

Measures	Objective	Alignment to NCCP	Amount Needed ($)	Implementing Entity	Priority level
Comprehensive study of fugitive emissions in the emerging oil & gas sector	Make available high quality activity and emission factor from oil and gas operations	Focus programme 10: National Climate Change Policy	300,000	EPA, Energy Commission, Petroleum Commission	High
Development of 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 emission estimation	Focus programme 10: National Climate Change Policy	350,000	EPA, Ministry of transport, DVLA, Energy Commission	High
Development and improvement of non-energy sector mitigation assessment	Estimate mitigation potential in non-energy sectors with increased certainty	Low Carbon Development Strategy/NDCs	200,000	EPA and relevant sectors	Medium
Waste sector activity data improvement and management project	Identify, collect activity data and improve ways for continuous collection.	Low Carbon Development Strategy/NDCs	200,000	EPA and Ministry of Local Government and Rural Development	High
Sustainable wood-based fuel production and development for domestic energy supply	Improve efficiency of wood fuel production and ensure development of alternative bio-fuels for sustainable energy supply in Ghana	Focus programme: 4 & 5 of National Climate Change Policy	1,500,000	Ministries of Lands and Natural Resources, and Food and Agriculture	Medium
Expand facility level carbon accounting programme	Facilitate regular reporting of emission and activity from industry.	Low Carbon Development Strategy	120,000	EPA, Ministry of Trade and Industry, Associations of Industry	High
Energy statistics development and improvement project	Improve quality of energy statistics including its metadata and uncertainty estimation	National Energy Planning, Domestic MRV	150,000	Energy Commission, EPA, Ghana Statistical Service	High
Industry and ODS Activity data collection project	Collect relevant industry and ODS activity data through a national survey	Focus programme 10: National Climate Change Policy	130,000	EPA, Ministry of Trade and Industry, Ghana Custom Services	Medium

6.3 Constraints and gaps related to Financial, Technical and Capacity Needs

Ghana faces challenges in the implementation of its climate change programmes and the regular preparation of the BUR2. Chief among them is inadequate access to resources to meet prioritised financial, technical and capacity needs. The emissions reduction gap of about 700,000 tonnes/yr is an indication of the need to step up implementation of mitigation actions requiring additional finance and technical support. Besides, the current levels of the GEF funding for the regular preparation of the BUR are not adequate to meet the full cost for compiling the report. So, Ghana is exploring other options including considering GEF's medium-size proposal window to mobilise additional funding. Some of the identified financial constraints and gaps are as follows:

- **Inadequate funding in the national budget** – funding for climate change activities in the country is largely donor driven and project-based. Domestic financing of climate change activities is difficult to estimate over a given time frame. This is because in the national budget, there are no clear differentiation of climate expenditure items and this leads to challenges in tracking actual government expenditures on climate change.
- **Duplication of activities and funding** – weak institutional coordination within government and among donors leads to duplication of activities and in most cases resources are not directed to where they are needed most. In Ghana, regular sharing of information among donors is already paying off in building synergies and avoiding duplications.
- **Insufficient transparency on non-financial support for training and technical assistance**– there are cases where Ghanaian institutions have received training and technical assistance support without much financial disclosure from the donor because most of this support are tapped from global projects that might have different financial contributors. In such situations, reporting is constrained because the recipient countries do not have full access to the funding and accounting information.
- **Gaps in tracking capacity and technical assistance** - Most of the climate change activities take place at different levels so it is difficult to track them. This means that information on capacity may not be complete to inform future capacity planning.

6.4 Technology Needs Assessment

Ghana has conducted two rounds of Technology Needs Assessment (TNA) in 2003 and 2014 to identify, select and prioritise technologies to support the implementation of the climate actions. The 2003 TNA focused on mitigation technologies in the energy and waste sector whereas 2013 looked at adaptation technologies in the water and agriculture sectors. In both processes, national stakeholders and experts were involved in the consultation for identifying and prioritising key technology portfolios. The initial technology portfolios built on during the preparation of Ghana's NDCs. There is a number of policy and financial reforms that are under implementation to help address policy and financial barriers that prevent greater transfer and diffusion of climate technology. Some of them are listed below:

- Enacted Renewable Energy Act 832, 211 to promote adoption of renewable technologies.
- Law on ban on importation of used fridges and air-conditioners.
- Established Ghana Climate Innovation Centre to catalyse technology deployment through private sector.
- Established skills development fund to support training of technician and artisan in installation and maintenance of solar and biogas technologies

Table 23: Overview climate technology portfolio identified during the TNA

Technology Portfolio	2003 TNA	2014 Revisions	Comments
Biofuels	x		
Industrial energy efficiency improvement	x	x	Aligns with the NDCs
Energy efficiency lighting	x	x	Aligns with 12 prioritised NAMAs and NDCs
Solar PVs	x	x	Aligns with Ghana's SE4ALL Action Plan, 12 prioritised NAMAs and the NDCs
Natural gas combined cycle and Natural gas distribution system	x	x	Aligns with the NDCs
Management technologies and efficiency improvement in transport sub-sector or BRT	x	x	Aligns with the NDCs
Wind Energy	x		Aligns with the NDCs
Solar Water Heater	x	x	Aligns with Ghana's SE4ALL Action Plan and 12 prioritized NAMAs.
Small and mini hydro	x		Limited potential but aligns with the NDCs
Biomass for power generation (Co-generation from sawmill residues)	x		
Landfill methane gas capture for power generation	x	x	Aligns with the NDCs
Anaerobic and CH4 generation technologies for waste water handling (Biogas technologies)	x	x	Topmost priority. Aligns with Ghana's SE4ALL Action Plan and 12 prioritized NAMAs.
Incineration	x	x	Target Public Schools and Hospitals
LPG and Improved Stoves		x	Aligns with Ghana's SE4ALL Action Plan
Efficient Fridges		x	Aligns with the NDCs

Capacity building is core to technology adoption at all levels. Therefore, any effort to improve the capacity of climate technology users is the key move towards catalysing technology diffusion. In this regard, their efforts to (a) improve capacities of farmers, engineers, technicians and artisans (b) create awareness and knowledge exchange and (c) facilitate lessons sharing on pilot technology adoption initiatives. Some of the initiatives to build capacity for technology transfer are:

- Human Resource Development for disseminating solar PV - Technical Guidelines for PV Rural Electrification in Ghana, Solar PV Resting Manual, Solar PV system Technical Service Guidelines and Community Agent Manual.
- Master courses on Renewable energy - Formal training on renewable energy. Two year MSc degree at Mechanical Engineering Department, Kwame Nkrumah University of Science and Technology.
- Established University of Energy and Natural Resources - Skilled labour for the energy market. Fully fledged energy training institution to produce high skilled labor on energy technologies.

7 Annex

7.1. Annex 1: GHG inventory summary (2016)

7.1.1 Annex 1.1: Table A (Summary table)
7.1.2 Annex 1.2: Table B (Short summary table)

7.2. Annex 2: Climate finance inflows (2011-2017)

7.3 Annex 3: List of activity data used in the GHG inventory

7.4 Annex 4: List of CSOs that participated in the BUR Reviews

7.1.1 Annex 1.1: Table A (Summary table) for 2016

	Emissions (Gg)			Emissions CO2 Equivalents (Gg)			Emissions (Gg)				
Categories	Net CO2	CH4	N2O	HFCs	PFCs	SF6	NOx	CO	NMVOCs	BC	PM2.5
Total National Emissions and Removals	27,285.46	309.99	24.86	613.00	33.32	-	121.26	1751.42	270.49	234.80	598.86
1 - Energy	13,973.47	31.34	1.24	-	-	-	97.21	1207.71	261.00	234.53	594.74
1.A - Fuel Combustion Activities	13,965.23	30.58	1.24	-	-	-	97.21	1207.71	261.00	234.53	594.74
1.A.1 - Energy Industries	5,098.01	1.70	0.23				9.16	320.71	108.18	1.29	8.88
1.A.2 - Manufacturing Industries and Construction	1,065.70	0.31	0.04				7.73	37.35	5.36	23.85	1.66
1.A.3 - Transport	6,918.61	1.68	0.68				66.52	270.64	37.41	87.76	236.00
1.A.4 - Other Sectors	882.90	26.89	0.28				13.80	579.01	110.05	121.63	348.20
1.A.5 - Non-Specified	-	-	-				-	-	-	-	
1.B - Fugitive emissions from fuels	8.24	0.76	0.0001	-	-	-	-	-	-	-	
1.B.1 - Solid Fuels	-	-	-				-	-	-	-	
1.B.2 - Oil and Natural Gas	8.24	0.76	0.0001				-	-	-	-	
1.B.3 - Other emissions from Energy Production	-	-	-				-	-	-	-	
1.C - Carbon dioxide Transport and Storage	-	-	-	-	-	-	-	-	-	-	
1.C.1 - Transport of CO2	-						-	-	-	-	
1.C.2 - Injection and Storage	-						-	-	-	-	
1.C.3 - Other	-						-	-	-	-	
2 - Industrial Processes and Product Use	394.89	-	-	613.00	33.32	-	-	-	-	-	
2.A - Mineral Industry	334.08	-	-	-	-	-	-	-	-	-	
2.A.1 - Cement production	21.85						-	-	-	-	
2.A.2 - Lime production	-						-	-	-	-	

	Emissions (Gg)			Emissions CO2 Equivalents (Gg)			Emissions (Gg)				
Categories	Net CO2	CH4	N2O	HFCs	PFCs	SF6	NOx	CO	NMVOCs	BC	PM2.5
2.A.3 - Glass Production	-						-	-	-	-	
2.A.4 - Other Process Uses of Carbonates	312.23						-	-	-	-	
2.A.5 - Other (please specify)	-	-	-				-	-	-	-	
2.B - Chemical Industry	-	-	-	-	-	-	-	-	-	-	
2.B.1 - Ammonia Production	-						-	-	-	-	
2.B.2 - Nitric Acid Production			-				-	-	-	-	
2.B.3 - Adipic Acid Production			-				-	-	-	-	
2.B.4 - Caprolactam, Glyoxal and Glyoxylic Acid Production			-				-	-	-	-	
2.B.5 - Carbide Production	-	-					-	-	-	-	
2.B.6 - Titanium Dioxide Production	-						-	-	-	-	
2.B.7 - Soda Ash Production	-						-	-	-	-	
2.B.8 - Petrochemical and Carbon Black Production	-	-					-	-	-	-	
2.B.9 - Fluorochemical Production				-	-	-	-	-	-	-	
2.B.10 - Other (Please specify)	-	-	-	-	-	-	-	-	-	-	
2.C - Metal Industry	58.74	-	-	-	33.32	-	-	-	-	-	
2.C.1 - Iron and Steel Production	3.87	-					-	-	-	-	
2.C.2 - Ferroalloys Production	-	-					-	-	-	-	
2.C.3 - Aluminium production	54.86				33.32		-	-	-	-	
2.C.4 - Magnesium production	-					-	-	-	-	-	
2.C.5 - Lead Production	-										
2.C.6 - Zinc Production	-										

	Emissions (Gg)			Emissions CO2 Equivalents (Gg)			Emissions (Gg)				
Categories	Net CO2	CH4	N2O	HFCs	PFCs	SF6	NOx	CO	NMVOCs	BC	PM2.5
2.C.7 - Other (please specify)	-	-	-	-	-	-	-	-	-	-	
2.D - Non-Energy Products from Fuels and Solvent Use	2.08	-	-	-	-	-	-	-	-	-	
2.D.1 - Lubricant Use	2.08						-	-	-	-	
2.D.2 - Paraffin Wax Use	-						-	-	-	-	
2.D.3 - Solvent Use							-	-	-	-	
2.D.4 - Other (please specify)	-	-	-				-	-	-	-	
2.E - Electronics Industry	-	-	-	-	-	-	-	-	-	-	
2.E.1 - Integrated Circuit or Semiconductor				-	-	-	-	-	-	-	
2.E.2 - TFT Flat Panel Display					-	-	-	-	-	-	
2.E.3 - Photovoltaics					-		-	-	-	-	
2.E.4 - Heat Transfer Fluid					-		-	-	-	-	
2.E.5 - Other (please specify)	-	-	-	-	-	-	-	-	-	-	
2.F - Product Uses as Substitutes for Ozone Depleting Substances	-	-	-	613.00	-	-	-	-	-	-	
2.F.1 - Refrigeration and Air Conditioning				613.00			-	-	-	-	
2.F.2 - Foam Blowing Agents				-			-	-	-	-	
2.F.3 - Fire Protection				-	-		-	-	-	-	
2.F.4 - Aerosols				-			-	-	-	-	
2.F.5 - Solvents				-	-		-	-	-	-	
2.F.6 - Other Applications (please specify)				-	-		-	-	-	-	
2.G - Other Product Manufacture and Use	-	-	-	-	-	-	-	-	-	-	

	Emissions (Gg)			Emissions CO2 Equivalents (Gg)			Emissions (Gg)				
Categories	Net CO2	CH4	N2O	HFCs	PFCs	SF6	NOx	CO	NMVOCs	BC	PM2.5
2.H - Other	-	-	-	-	-	-	-	-	-	-	
2.H.1 - Pulp and Paper Industry	-	-					-	-	-	-	
2.H.2 - Food and Beverages Industry	-	-					-	-	-	-	
2.H.3 - Other (please specify)	-	-	-				-	-	-	-	
3 - Agriculture, Forestry, and Other Land Use	12908.42	156.76	21.69	-	-	-	22.00	527.75	-	-	
3.A - Livestock	-	121.14	3.03	-	-	-	-	-	-	-	
3.A.1 - Enteric Fermentation		114.66					-	-	-	-	
3.A.2 - Manure Management		6.48	3.03				-	-	-	-	
3.B - Land	12872.05	-	-	-	-	-	-	-	-	-	
3.B.1 - Forest land	-4668.07						-	-	-	-	
3.B.2 - Cropland	8331.46						-	-	-	-	
3.B.3 - Grassland	8804.18						-	-	-	-	
3.B.4 - Wetlands	30.48		-				-	-	-	-	
3.B.5 - Settlements	173.75						-	-	-	-	
3.B.6 - Other Land	200.25						-	-	-	-	
3.C - Aggregate sources and non-CO2 emissions sources on land	36.37	35.62	18.66	-	-	-	22.00	527.75	-	-	
3.C.1 - Emissions from biomass burning		25.18	1.42				22.00	527.75	-	-	
3.C.2 - Liming	-						-	-	-	-	
3.C.3 - Urea application	36.37						-	-	-	-	
3.C.4 - Direct N2O Emissions from managed soils			13.36				-	-	-	-	

	Emissions (Gg)			Emissions CO2 Equivalents (Gg)			Emissions (Gg)				
Categories	Net CO2	CH4	N2O	HFCs	PFCs	SF6	NOx	CO	NMVOCs	BC	PM2.5
3.C.5 - Indirect N2O Emissions from managed soils			3.68				-	-	-	-	
3.C.6 - Indirect N2O Emissions from manure management			0.19				-	-	-	-	
3.C.7 - Rice cultivations		10.44					-	-	-	-	
3.D.1 - Harvested Wood Products	-						-	-	-	-	
3.D.2 - Other (please specify)	-	0.00	-				-	-	-	-	
4 - Waste	8.68	121.89	1.93	-	-	-	-	-	-	-	
4.A - Solid Waste Disposal	-	55.01	-	-	-	-	2.06	15.96	9.49	0.27	4.12
4.B - Biological Treatment of Solid Waste	-	2.45	0.15	-	-	-	-	-	-	-	
4.C - Incineration and Open Burning of Waste	8.68	2.75	0.04	-	-	-	2.06	15.96	9.49	0.27	4.12
4.D - Wastewater Treatment and Discharge	-	61.69	1.75	-	-	-	-	-	-	-	
4.E - Other (please specify)	-	-	-	-	-	-	-	-	-	-	
5.A - Indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3	-	-	-	-	-	-	-	-	-	-	
5.B - Other (please specify)	-	-	-	-	-	-	-	-	-	-	
Memo Items											
International Bunkers	346.56	0.0031	0.01	-	-	-	-	-	-	-	
1.A.3.a.i - International Aviation (International Bunkers)	339.06	0.003	0.01				-	-	-	-	
1.A.3.d.i - International water-borne navigation (International bunkers)	7.50	0.001	0.0002				-	-	-	-	
1.A.5.c - Multilateral Operations	-	-	-	-	-	-	-	-	-	-	

7.1.2 Annex 1.2: Table B (Short summary table) for 2016

	Emissions (Gg)			Emissions CO2 Equivalents (Gg)			Emissions (Gg)				
Categories	Net CO2	CH4	N2O	HFCs	PFCs	SF6	NOx	CO	NMVOCs	BC	PM2.5
Total National Emissions and Removals	27,285.46	309.99	24.86	613.00	33.32	-	121.26	1751.42	270.49	234.80	598.86
1 - Energy	13,973.47	31.34	1.24	-	-	-	97.21	1207.71	261.00	234.53	594.74
1.A - Fuel Combustion Activities	13,965.23	30.58	1.24	-	-	-	97.21	1207.71	261.00	234.53	594.74
1.B - Fugitive emissions from fuels	8.24	0.76	0.0001	-	-	-	-	-	-	-	
1.C - Carbon dioxide Transport and Storage	-	-	-	-	-	-	-	-	-	-	
2 - Industrial Processes and Product Use	394.89	-	-	613.00	33.32	-	-	-	-	-	
2.A - Mineral Industry	334.08	-	-	-	-	-	-	-	-	-	
2.B - Chemical Industry	-	-	-	-	-	-	-	-	-	-	
2.C - Metal Industry	58.74	-	-	-	33.32	-	-	-	-	-	
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	-	-	-	613.00	-	-	-	-	-	-	
2.G - Other Product Manufacture and Use	-	-	-	-	-	-	-	-	-	-	
2.H.3 - Other (please specify)	-	-	-				-	-	-	-	
3 - Agriculture, Forestry, and Other Land Use	12,908.42	156.76	21.69	-	-	-	22.00	527.75	-	-	
3.A - Livestock	-	121.14	3.03	-	-	-	-	-	-	-	
3.B - Land	12,872.05	-	-	-	-	-	-	-	-	-	
3.C - Aggregate sources and non-CO2 emissions sources on land											

	Emissions (Gg)			Emissions CO2 Equivalents (Gg)			Emissions (Gg)				
Categories	Net CO2 (1)(2)	CH4	N2O	HFCs	PFCs	SF6	NOx	CO	NMVOCs	BC	PM2.5
4 - Waste	8.68	121.89	1.93	-	-	-	-	-	-	-	
4.A - Solid Waste Disposal	-	55.01	-	-	-	-	2.06	15.96	9.49	0.27	4.12
4.B - Biological Treatment of Solid Waste	-	2.45	0.15	-	-	-	-	-	-	-	
4.C - Incineration and Open Burning of Waste	8.68	2.75	0.04	-	-	-	2.06	15.96	9.49	0.27	4.12
4.D - Wastewater Treatment and Discharge	-	61.69	1.75	-	-	-	-	-	-	-	
4.E - Other (please specify)	-	-	-	-	-	-	-	-	-	-	
5.A - Indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3	-	-	-	-	-	-	-	-	-	-	
5.B - Other (please specify)	-	-	-	-	-	-	-	-	-	-	
Memo Items											
International Bunkers	346.56	0.0031	0.01	-	-	-	-	-	-	-	
1.A.3.a.i - International Aviation (International Bunkers)	339.06	0.0024	0.01				-	-	-	-	
1.A.3.d.i - International water-borne navigation (International bunkers)	7.50	0.0007	0.0002				-	-	-	-	
1.A.5.c - Multilateral Operations	-	-	-	-	-	-	-	-	-	-	

7.2 Annex 2 : Summary table (Climate finance inflows - 2011-2017)

Number	Name of Project	Scope	Amounts committed (USD)	Type of intrument	Donor	Reciepient	Status
1	Expanded Sustainable Land and Water Management Project	Climate relevant	29700000	Grant	GEF	MESTI	Active
2	Promotion of integrated approaches for climate risk management and transfer	Climate specific	Unknown		BMUB, Germany	MoF	Active
3	Energizing Development (EnDEV) - Energy Access Program	Climate relevant	Unknown	Grant	BMZ, Germany	SNV	
4	Adaptation of Agro-Ecological Systems to Climate Change	Climate specific	3448276	Grant	BMUB, Germany	MoFA	Active
5	Promoting value chain approach to climate change adaptation in Ghana	Climate specific	11500000	Grant	GEF /IFAD	MoFA_RTIMP	Complete
6	CARE Adaptation learning programme for Africa	Climate specific	6000000	Grant	DFID, DANIDA, Ministry of Foreign Affairs Finland,	Care Interanationl	Complete
7	Building Capacity to meet the Climate Change Challenge (B4C-Ghana) Project	Climate specific	16400000	Grant	Open society Foundation	Centre for Africa Wetlands, Legon	Active
8	CLIMAFRICA Project	Climate specific	68966	Grant	European Union	CSIR, CRI, SRI &FORIG for Ghana	Complete
9	PEER Science Project	Climate specific	41000	Grant	USAID, United States	UCC	Complete
10	Ghana Energy Development and Access Project GEDAP (formerly) Development of Renewable Energy and Energy Efficiency	Climate relevant	6500000	Grant	GEF	ECG	Complete
11	Ghana Energy Development and Access Project GEDAP (formerly) Development of Renewable Energy and Energy Efficiency	Climate relevant	100000000	Loan	IDA	ECG	Complete
12	Ghana Energy Development and Access Project GEDAP (formerly) Development of Renewable Energy and Energy Efficiency	Climate relevant	50000000	Loan	Africa Catalytic Growth Fund	ECG	Complete

Number	Name of Project	Scope	Amounts committed (USD)	Type of intrument	Donor	Reciepient	Status
13	Ghana Energy Development and Access Project GEDAP (formerly) Development of Renewable Energy and Energy Efficiency	Climate relevant	18250000	Loan	AFDB	ECG	Complete
14	Ghana Energy Development and Access Project GEDAP (formerly) Development of Renewable Energy and Energy Efficiency	Climate relevant	11000000	Grant	Switzerland	ECG	Complete
15	Ghana Energy Development and Access Project GEDAP (formerly) Development of Renewable Energy and Energy Efficiency	Climate relevant	6250000	Loan	Global Partnership on output based aid	ECG	Complete
16	Ghana Energy Development and Access Project GEDAP (formerly) Development of Renewable Energy and Energy Efficiency	Climate relevant	43280000	National budget	Ghana	ECG	Complete
17	China-Ghana South-South Cooperation on Renewable Energy Technology Transfer	Climate relevant	2720000	Grant	Denmark	Ministry of Energy	Active
18	Institutional Support to the Implementation of the Sustainable Energy for All (SE4ALL) Action Plan	Climate relevant	730000	Grant	UNDP	EC	Active
19	Millennium Development Challenge Account Compact 2 – Ghana Power Pact	Climate relevant	498200000	Grant	United States	ECG, NEDCO, Energy Commission, Ministry of Energy	Active
20	Energy, Poverty and Gender in Agro Processing (EPGAP)	Climate relevant	517241	Grant	Netherlands	SNV	Active
21	Developing Sustainable Energy Value Chains in Fish Smoking Markets in Ghana	Climate relevant	747126	Grant	Netherlands	SNV	Active
22	Integrated Clean Cookstoves and Biomass Fuel Market Assessment Project	Climate relevant	206897	Grant	Netherlands	SNV	Active
23	Solar Lantern Saving scheme for Ghana	Climate relevant	206897	Grant	Netherlands	SNV	Active
24	Energy, Poverty and Gender (EnPoGen)	Climate relevant	172414	Grant	Netherlands	SNV	Complete
25	Ghana Gas Infrastructure Plant - recovery and utilisation of Gas from oil fields	Climate relevant	1000000000	Loan	Ghana	Ghana Gas Company	Active
26	Tweneboa-Enyenra-Ntomme (TEN) natural gas production field	Climate relevant	5900000000	Loan	Ghana	Tullow Ghana Limited	Active

Number	Name of Project	Scope	Amounts committed (USD)	Type of intrument	Donor	Reciepient	Status
27	ENI/Vitol (Sankofa) natural production fields	Climate relevant	7280000000	Loan	Ghana	ENI	Active
28	Technology Needs Assessment (TNA) update	Climate specific	70000	Grant	GEF	EPA	Complete
29	Third National Communication to UNFCCC	Climate specific	500000	Grant	GEF	EPA	Active
30	First Binnieal Update Report to UNFCCC	Climate specific	352000	Grant	GEF	EPA	Active
31	Ghana Climate Innovation Centre (GCIC)	Climate specific	17206500	Grant	DANIDA, Denmark	Ashesi Uni., SNV, EY, UNU-INRA	Active
32	Low Emission Capacity Building Project (LECBP)	Climate specific	1072558	Grant	EC, Germany, Australia	MESTI	Active
33	Africa Adaptation Programme	Climate specific	2760657	Grant	Japan	EPA	Active
34	Integrating Green Economy into Ghana's Medium-Term Development Plan	Climate specific	50000	Grant	Netherlands	MESTI	Active
35	Facilitating Implementation & Readiness For Mitigation	Climate specific	300000	Grant	Denmark	MESTI	Active
36	Green Climate Fund Readiness Programme	Climate specific	853345	Grant	Government of Germany	MESTI	Pipeline
37	Capacity Development for REDD Project	Climate specific	Unknown	Grant	Government of Germany	EPA & FC	Complete
38	Sustainable GHG Management Project in West Africa	Climate specific	Unknown	Grant	Australia, USA, Netherlands, UK, Belgium, New Zealand, UNFCCC, FAO, UNDP, UNDP	EPA	Active
39	Ghana Climate Change and Environmental Governance	Climate specific	274075	Grant	DFID,United Kingdom	MESTI	Complete
40	Green Facility	Climate specific	96000	Grant	Denmark	MESTI	Complete
41	Increased Resilience to Climate Change in Northern Ghana Through the Management Of Water Resources and Diversification of Livelihoods"	Climate specific	8293972	Grant	Adaptation Fund Board	MESTI	Pipeline

Number	Name of Project	Scope	Amounts committed (USD)	Type of intrument	Donor	Reciepient	Status
42	Information Matters Project	Climate specific	Unknown	Grant	BMZ, Germany	EPA	Active
43	Environmental Sustainability and Policy for Cocoa Production in Ghana	Climate relevant	1700000	Grant	Mondelēz Cocoa Life	Cocoa Board	Active
44	Support for Development and Operation of COCOBOD's Ghana Cocoa Platform	Climate relevant	1200000	Grant	UNDP/UN-REDD and Mondelēz Cocoa Life.	Cocoa Board	Active
45	Natural Resource and Environmental Governance Program Technical Assistance	Climate relevant	5000000	Grant	World Bank	MoF	Active
46	Forest Investment Program (FIP)	Climate specific	29500000	Grant	Stratregic Climate Fund	MLNR	Active
47	Forest Investment Program (FIP)	Climate specific	15000000	Grant	Stratregic Climate Fund and Africa Development Fund	MLNR	Active
48	Forest Investment Program (FIP)	Climate specific	10000000	Loan	Stratregic Climate Fund	MLNR	Active
49	REDD+ R-PP Implementation	Climate specific	3400000	Grant	Word Bank, FCPF	FC	Active
50	FCPF REDD+ Readiness Additional financning	Climate specific	5200000	Grant	Word Bank, FCPF	FC	Pipeline
51	Forest Preservation Programme	Climate relevant	8500000	Grant	Japan	FC	Complete
52	National Forestation Plantation Development Program (NFPDP)	Climate relevant	50000000	National budget	Ghana	FC	Active
53	Ghana Cocoa REDD+ Programme	Climate specific	5200000	Result Based Payment	World Bank	Ghana Cocoa Board and Forestry Commission	Pipeline
54	Coastal Sustainable Landscapes Project	Climate relevant	3500000	Grant	United States	USDA/USAID	Active
55	Advancing REDD+ in Ghana: Preparation of REDD Pilot schemes in Off-Reserve Forests and Agro-Forests	Climate specific	366954	Grant	ITTO	FORIG	Complete

Number	Name of Project	Scope	Amounts committed (USD)	Type of intrument	Donor	Reciepient	Status
56	Reducing Emissions from Deforestation and Forest Degradation through Collaborative Management with Local Communities	Climate specific	760408	Grant	ITTO	FORIG	Complete
57	Capacity building for CDM forestry in the framework of SFM emphasizing community forests and poverty alleviation in Ghana	Climate specific	644382	Grant	ITTO	FORIG	Complete
58	Does shifting Carbon Use Efficiency determine the growth rates of intact and disturbed tropical forests? Gathering new evidence from African forests	Climate relevant	134280	Grant	Natural Environment Research Council, United Kingdom	FORIG	Complete
59	REDD through stakeholder engagement	Climate specific	658716	Grant	ITTO	CSIR-FORIG	Active
60	Design and launch a Climate-smart Agricultural Finance Facility in Ghana	Climate specific	45100	Grant	Rockefeller Foundation	NCRC	Complete
61	Work with cocoa farmer organisations in Ghana to increase their member's capacity to access carbon finance.	Climate relevant	349900	Grant	Rockefeller Foundation	NCRC	Complete
62	Assessing and developing forest carbon and other PES projects in west africa and strengthening capacity for equitable local engagement with ecosystem services markets	Climate specific	126063	Grant	Moore Foundation	NCRC	Complete
63	Mapping forest landscape restoration in Ghana	Climate relevant	97701	Grant	Germany	IUCN-Ghana	Complete
64	Pro poor REDD+ initiative in Ghana	Climate relevant	504598	Grant	Denmark	IUCN-Ghana	Complete
65	Facilitating countries and communities in the design of pro-poor REDD+ Benefit Sharing Schemes	Climate specific	703448	Grant	Germany	IUCN-Ghana	Active
66	Towards Pro-Poor REDD+ Project (Phase II): Promoting Rights-based Approaches to Strengthen the Conservation, Governance and Sustainable Management of Landscapes in Cameroon, Ghana, Guatemala, Papua Province of Indonesia and Uganda	Climate specific	3961655	Grant	Denmark	IUCN-Ghana	Active
67	Advancing REDD+: mobilising private investment for community-based, carbon-intensive landscape restoration	Climate specific	658949	Grant	Norway	IUCN-Ghana	Active
68	Climate Change and Health Project	Climate relevant	1918182	Grant	GEF	MoH	Complete

Number	Name of Project	Scope	Amounts committed (USD)	Type of intrument	Donor	Reciepient	Status
69	Community Resilience through Early Warning	Climate relevant	5162667	Grant	Norway	NADMO	Complete
70	Ghana Urban Transport	Climate relevant	20000000	Grant	FDA	MoT	Active
71	Ghana Urban Transport	Climate relevant	7000000	Grant	GEF	MoT	Active
72	Ghana Urban Transport	Climate relevant	45000000	Loan	IDA	MoT	Active
73	Ghana Urban Transport	Climate relevant	18000000	National budget	Ghana	MoT	Active
74	Climate Change Adaptation in Northern Ghana	Climate specific	884000	Grant	Denmark	WRC	Complete
75	Assest Creation for Resilience	Climate specific	3527571	Grant	Government of Canada	MOFA	Phased-out
76	Advancing REDD+: Mobilising private investment for community - based , carbon-intensive landscape restoration NORAD PILAR)	Climate specific	464330	Grant		IUCN-Ghana	Complete
77	Support transition towards climate-smart agriculture food system	Climate specific	120000	Grant	Norway	MoFA	Complete
78	REDD+ Benefit sharing Project	Climate specific	772230	Grant		IUCN-Ghana	Complete
79	Towards Pro-Poor REDD+ Project	Climate specific	31594127	Grant		IUCN-Ghana	Complete
80	Forest Carbon Partnership Facility	Climate specific	5200000	Grant	Forest Carbon Partnership Facility	FC	Active
81	Ghana Forest Investment Programme	Climate specific	392000	Grant	Strategic Climate Fund (SCF)	COCOBOD, MLNR, FC	Active
82	Capacity Building for Transparency Initiative (CBIT)	Climate specific	1100000	Grant	GEF	EPA	Pipeline
83	Fourth National Communication/BUR2 to UNFCCC	Climate specific	826000	Grant	GEF	EPA	Active

Number	Name of Project	Scope	Amounts committed (USD)	Type of intrument	Donor	Reciepient	Status
84	Environmentally Sustainable Production Practices in Cocoa Landscapes (ESP II)	Climate relevant	1850004	Grant	Mondelēz Cocoa Life	Ghana Cocoa Board	Active
85	Advocacy and capacity building for disaster risk reduction and preparedness in Ghana	Climate specific	500000	Grant	World Bank's Global Facility for Disaster Reduction and Recovery	NADMO	Complete
86	Green Climate Fund (GCF) Readiness Programme	Climate specific	938679	Grant	(BMUB)	MESTI	Complete
87	Dedicated Grant Mechanism for Local Communities (DGM)	Climate specific	5500000	Grant	World Bank	Solidaridad	Active
88	Ghana Energy Sector Transformation Initiative Project	Climate relevant	20000000	Loan	World Bank	MOE	Active
89	Partnership for Productivity, Protection & Resilience in Cocoa Landscapes (PPPRCL)	Climate specific	Unknown	Unknown	DFID,United Kingdom	SNV_NCRC_FC_Touton	Active
90	Operationalising National Safeguards for Results-Based Payments from REDD+	Climate specific	496315	Grant	BMZ, Germany	SNV	Active
91	Full Sun to Shaded Cocoa Agro-forestry Systems (SCAFS)	Climate specific	1601697	Grant	BMZ, Germany	SNV	Active
92	Forest Governance, Markets and Climate	Climate specific	Unknown	Grant	UKAID, United Kingdom	Forestry Commission	Active
93	Climate Smart Cocoa Systems for Ghana (CLIMCOCOA)	Climate specific	Unknown	Grant	Denmark	Geography Department, University of Ghana	Active
94	Initiative on Climate Action Transparency	Climate specific	125000	Grant	Mutiple donors	EPA	Active
95	Nationally determined contribution-support programme (NDC-SP)	Climate specific	820000	Grant	Germany	MESTI	Active
96	UN CC: Learn Initiative	Climate specific	1072558	Grant	Switzerland	MESTI	Complete

Number	Name of Project	Scope	Amounts committed (USD)	Type of intrument	Donor	Reciepient	Status
97	Forest 2020	Climate specific	152000000 (6 countries)	Grant	UK Space Agency, United Kingdom	Forestry Commission, FRNR KNUST & FORIG	Active
98	Green Cooling Initiative I	Climate specific	Unknown	Grant	BMUB, IKI	EPA/MESTI	Complete
99	Green Cooling Initiative II	Climate specific	Unknown	Grant	BMUB,IKI	EPA/MESTI	Active
100	Management of Ozone depleting substances (ODS) banks project in Ghana	Climate relevant	Unknown	Grant	BMUB	EPA/MESTI	Active
101	Resilient livelihoods: improving access to Disaster Risk Reduction and Climate Change Adaptation good practices and financial services for risk reduction	Climate specific	249000	Grant	FAO	MoFA	Complete

7.3. Annex 3 - List of activity data used in the GHG

IPCC Codes	Sub-categories	Fuel Type (TJ)										
		RFO	Crude oil	HFO	Diesel	Gasoline	LPG	DFO	Petroluem coke	Charcoal	Woodfuel	Refinery gas
1.A1ai	Electricity generation		25635.16	14949.04				2356.44				
1.A1b	Petroluem Refining	1547.80							242.68			1896.44
1.A1ci	Manufacture of solid fuels_charcoal										51070.59	
1.A1cii	Other energy industries				469.04							
1.A2a	Iron and steel	2.50			58.48							
1.A2c	Chemicals	11.45			78.20						634.84	
1.A2d	Pulp, Paper & Print				22.57		41.82					
1.A2e	Food Processing, Beverage and Tobacco	320.34			814.83		129.99			175.59	6815.33	
1.A2i	Mining & Quarrying				9375.45	0.22						
1.A2j	Wood & Wood Prod				434.58							
1.A2k	Construction				2204.41							
1.A2l	Textiles & Leather	81.78			19.82							
1.A2m	Non-Specified	122.81			545.86		139.04				647.83	

IPCC Codes	Sub-categories	Fuel Types								
		Diesel	Gasoline	LPG	Kerosene	ATK	Liquid fuel (10^m3)	Charcoal	Woodfuel	Gaseous fuel oil (10^6 m3)
1.A3ai	International Aviation (International Bunkers)					4742.04				
1.A3aii	Domestic Aviation					793.35				
1.A3bi	Passeger cars	17225.96	18756.86	4248.90						
1.A3bii	Lightduty truck	871.87	7421.78							
1.A3biii	Heavy duty and buses	15656.08	4349.02							
1.A3biv	Motorcycle		13223.84							
1.A3c	Railways	12711.97								
1.A3di	International water-borne navigation	101.21								
1.A3dii	Domestic water-borne navigation	19.00								
1.A4a	Commercial/Institutional			544.70	35.73			4141.52	945.61	
1.A4b	Residential			6629.83	254.92			46510.63	54614.00	
1.A4ciii	Fishing	914.38	2461.48							
1.A4ci	Staionery	5.79								
1.A4cii	Off-road vehicle and other machines	970.24	1423.27							
1.B2a.ii	Flaring						169.89			
1.B2b.iii.3	Gas processing									0.59
1.B2a.iii.4	Refining						34536.25			
1.B2b.iii.5	Gas distribution									1.13

IPCC Codes	Sub-categories	Tonnes Lubricant	Clinker production	Mass of carbonate consumed	Amount of Steel or Iron production	Amount of Aluminium production	Imports of Refigerants
2.A.1	Cement Production		235929				
2.A.4b	Other Uses of Soda Ash			36.9			
2.A.4d	Other (Limestone use in Cement Production)			710056.91			
2.C.1	Iron and Steel Production (Electric Arc Furnace)				47383.88		
2.C.3	Aluminium production					37322.60	
2.D.1	Lubricant Use	141.63					
2.F1a	Reffrigeration and Stationery Air Conditioning						40.08
2.F1b	Mobile Air Conditioning						46.8

IPCC Codes	Sub-categories	No. of Animals	Amount of Urea Fertilisation	Amount of N applied	Amount of urine and dung N	Total nitrogen excretion for Manure Management System (Gg N /yr)				Rice Cultivation (Annaul area harvest - ha/yr)		
		(N)	(tonnes/yr)	(kg N/yr)	(kg N/yr)	Goats	Other cattle	sheep	Swine	Irrigated	Rainfed	Upland
3.A1aii	Other cattle	1815000										
3.A1c	Sheep	4744000										
3.A1d	Goats	6740000										
3.A1f	Horses	2932										
3.A1g	Mules & Asses	14820										
3.A1h	Swine	777000										
3.C2	Urea application		49592.87									
3.C4	Direct N2O Emissions from managed soils			86590210.65	140250994.50							
3.C5	Indirect N20 Emissions from managed soils			86590210.65	140250994.50							
3.C6	Indirect N20 Emissions from manure					30.3	43.3	22.7	6.3			
3.C7	Rice cultivation									37760	184080	14160

Pre-landuse	Post-landuse	Post-landuse (ha)			Contribution to total area
		1990-2000	2000-2010	2010-2015	% (2010-2015)
Closed forest	Closed forest	1665727.77	1281136.48	984426.97	4.127%
Closed forest	Open forest	545419.31	400468.28	182231.17	0.764%
Closed forest	Water	1190.20	465.29	903.90	0.004%
Closed forest	Grassland	79135.33	63587.45	25546.56	0.107%
Closed forest	Settlement	249.52	0.09	576.73	0.002%
Closed forest	Cropland	15908.41	31242.69	22622.05	0.095%
Closed forest	Wetland	1270.41	61.56	65.92	0.000%
Closed forest	Otherland	1114.12	3648.58	374.28	0.002%
Open forest	Closed forest	885091.36	741461.90	631729.04	2.648%
Open forest	Open forest	2460110.42	3844110.63	3775933.10	15.829%
Open forest	Water	1588.91	2454.17	45370.27	0.190%
Open forest	Grassland	1961381.63	1588833.13	2265476.87	9.497%
Open forest	Settlement	1757.14	3.50	38191.02	0.160%
Open forest	Cropland	367194.49	779408.94	1702355.06	7.137%
Open forest	oil palm	30000.00	207100.00	68500.00	0.287%
Open forest	cocoa	806751.00	100200.00	117240.00	0.491%
Open forest	rubber	780.00	12720.00	2300.00	0.010%
Open forest	citrus	32000.00	26000.00	1690.00	0.007%
Open forest	mango	81.00	6481.00	800.00	0.003%
Open forest	cashew	16066.00	59934.00	15600.00	0.065%
Open forest	Wetland	1300.41	1808.77	3171.99	0.013%
Open forest	Otherland	7889.22	17280.56	30266.72	0.127%

Pre-landuse	Post-landuse	Post-landuse (ha)			Contribution to total area
		1990-2000	2000-2010	2010-2015	% (2010-2015)
Cropland	Closed forest	106278.20	198363.90	91617.16	0.384%
Cropland	Open forest	445227.29	1030471.35	1218604.46	5.109%
Cropland	Water	1628.16	1240.36	78846.89	0.331%
Cropland	Grassland	1685045.37	2168437.52	1476597.90	6.190%
Cropland	Settlement	4125.51	0.45	82501.14	0.346%
Cropland	Cropland	1641755.89	1786748.52	1660833.29	6.962%
Cropland	Wetland	3486.26	2535.38	8891.96	0.037%
Cropland	Otherland	6220.10	18472.64	31644.68	0.133%
Grassland	Closed forest	106562.12	78857.33	59040.57	0.248%
Grassland	Open forest	819510.53	845675.44	1829247.01	7.669%
Grassland	Water	3861.62	2445.28	91157.51	0.382%
Grassland	Grassland	7863596.72	5891025.36	4141178.62	17.361%
Grassland	Settlement	4568.14	1.44	46261.39	0.194%
Grassland	Cropland	1096083.29	1205801.29	1650801.75	6.920%
Grassland	Wetland	7418.74	20485.12	5708.80	0.024%
Grassland	Otherland	28245.41	105351.87	32217.18	0.135%
Settlement	Closed forest	2518.45	2435.23	13243.06	0.056%
Settlement	Open forest	13740.25	18198.14	170164.79	0.713%
Settlement	Water	65.21	279.00	50921.12	0.213%
Settlement	Grassland	64284.37	72642.50	199091.47	0.835%
Settlement	Settlement	90462.31	203248.00	171816.80	0.720%
Settlement	Cropland	29351.09	44047.27	152638.98	0.640%

Pre-landuse	Post-landuse	Post-landuse (ha)			Contribution to total area
		1990-2000	2000-2010	2010-2015	% (2010-2015)
Settlement	Wetland	228.68	1883.34	3209.90	0.013%
Settlement	Otherland	2654.71	1311.80	10205.89	0.043%
Wetland	Closed forest	5499.03	203.53	515.85	0.002%
Wetland	Open forest	4954.27	1022.48	1482.61	0.006%
Wetland	Water	332.87	574.15	5003.93	0.021%
Wetland	Grassland	16599.75	12825.41	20430.87	0.086%
Wetland	Settlement	354.61	0.00	1048.80	0.004%
Wetland	Cropland	2241.90	3629.92	4758.88	0.020%
Wetland	Wetland	13381.51	5560.82	1811.86	0.008%
Wetland	Otherland	263.89	298.20	203.53	0.001%
Otherland	Closed forest	6912.97	4673.13	68.44	0.000%
Otherland	Open forest	18417.88	12435.76	45.66	0.000%
Otherland	Water	1032.39	498.86	0.00	0.000%
Otherland	Grassland	119291.81	68891.88	33.50	0.000%
Otherland	Settlement	141.38	0.00	147.33	0.001%
Otherland	Cropland	8470.62	18595.50	165.52	0.001%
Otherland	Wetland	1006.52	253.69	0.00	0.000%
Otherland	Otherland	1071.10	4056.35	3753.67	0.016%
Water	Closed forest	4158.38	3298.42	2105.08	0.009%
Water	Open forest	4027.51	7463.45	10699.31	0.045%
Water	Water	714256.54	738802.06	579979.04	2.431%
Water	Grassland	13609.92	61449.70	20489.05	0.086%
Water	Settlement	89.91	0.00	1107.79	0.005%

Pre-landuse	Post-landuse	Post-landuse (ha)			Contribution to total area
		1990-2000	2000-2010	2010-2015	% (2010-2015)
Water	Cropland	3256.32	24266.96	6642.61	0.028%
Water	Wetland	4747.51	11026.69	1188.03	0.005%
Water	Otherland	956.31	5807.51	504.68	0.002%
Total		23,854,000	23,854,000	23,854,000	100.0%

Variables	Value	Unit
Volume of fuelwood removal (whole trees)	331316.10	m3/yr
Volume of fuelwood removal (part trees - m3/yr)	220877.40	m3/yr
Areas affected by disturbance_fire	44949.51	ha/yr
Reference SOC	47.6	t C/ha
Forest Deadwood stocks	30.7	t C/ha
Forest Litter stocks	1.96	t C/ha
Cropland Deadwood stocks	11.36	t C/ha
Cropland Litter stocks	1.81	t C/ha
Grassland Deadwood stocks	4.2	t C/ha
Grassland Litter stocks	1.4	t C/ha
Average annual AGB growth (teak plantation)	8.1	(tonnes dm/ha/yr)

Variables	Value	Unit
Total Municipal solid waste generated	4,907.76	Gg
Total Solid waste disposed (SWD)	3,926.21	Gg
Share of SWD as food	47	%
Share of SWD as Paper	9	%
Share of SWD as Textile	8	%
Share of SWD as Plastics, other inert	36	%
Municipal solid waste incinerated	82.77	Gg
Industrial waste incinerated	0.09	Gg
Hazardous waste incinerated	0.39	Gg
Clinical waste incinerated	4.36	Gg
Municipal solid waste open-burned	419.33	Gg/yr
Organically degradable material in domestic wastewater	367.6	Gg/yr
Wastewater generated (Beer and Malt industry)	6.3	m3/product
Wastewater generated (Dairy Products industry)	7	m3/product
Wastewater generated (Fish Processing industry)	15	m3/product
Wastewater generated (Meat & Poultry industry)	13	m3/product
Wastewater generated (Organic Chemicals industry)	67	m3/product
Wastewater generated (Soap & Detergents industry)	3	m3/product
Wastewater generated (Vegetables, Fruits & Juices industry)	20	m3/product

7.4. Annex 4 - List of CSOs who participated in the BUR Reviews

NO	NAME	ORGANIZATION	PHONE NUMBER	EMAIL
1	Frank Kyei-Arthur	Sustainability Traits Consult	242355075	fkyeiarthur@yahoo.com
2	Gifty Gilly Akeseh	Global Strtegic Alliance	266647417	gillyakeseh@yahoo.com
3	Mary Jane Enchill	HATOF	246346698	mjane.enchill@gmail.com
4	Samuel Dotse	CAN-Ghana/HATOF	506679055	samuel.dotse@hotmail.com
5	Felix Best Agorvor	Abibiman Foundation	276145158	felixbestagorvor@yahoo.com
6	Grant Anim	Rehabilitation International Ghana	244275020	rehabghana@yahoo.com
7	James Kwabena Bonfeh	Youth for Action Ghana	244535472	jbonfeh@gmail.com
8	Isaac Ampomah	Concern Health Education	243044732	isaac.ampomah@gmail.com
9	Samuel Quaye	EPA	501301446	samuel.quaye@epa.gov.gh
10	J. S. Kwashie	Community and Family Foundation	274313220	bossbig24@gmail.com
11	Gloria Dzifa Aguze	Safe Water Network	244382208	gaguze@safrwaternetwork.org
12	Samuel Annan	FFCWI	208925441	ffcw@yahoo.cm,hk
13	Dr. E. V. Brown	Daaapu	277115125	daapu@yahoo.com
14	Kassim Gawusu-Toure	Greener Impact International	244967340	k-gawusu@gmail.com
15	Chibeze Ezekiel	Strtegic Youth Network for Development	244967931	chibeze@gmail.com
16	Abdulai Sanni	GGI	201415738	oyibo240@yahoo.co.uk
17	James K. Ahinisi-Blondy	VEST-AFRICA	242759878	james.ahinasiblondy@gmail.com
18	Mohammed Aminu Lukumanu	GHACCO	240276198	lukumasu74@yahoo.com
19	Samuel Obiri	CEIA	244708322	obirisamuel@gmail.com
20	Nicholas K. Duho	C.O.A	547661944	nicholasduho@yahoo.com
21	Peter Moadau	CEEP	242338380	current60@yahoo.com
23	Lovans Owusu Takyi	ISEES	244108268	lovanstakyi@gmail.com
24	Daryl Bosu	Arocha Ghana	202555727	daryl.bosu@arocha.org
25	sheilia Arhusah	HATOF/CAN Ghana	207366517	aten@hotmail.com

8 Additional Information

8.1 Ghana's Economic Diversification and Just Transition Efforts

8.1.1 Development policy context

Ghana's latest National Development Plan Titled Agenda for Jobs Creating Prosperity and Equal Opportunity for all- highlights key policy interventions to combat climate change in the medium term. In view of this and other frameworks, Ghana has developed its NDCs and has identified 20 mitigation and 11 adaptation programmes in 7 priority economic sectors. It has also developed The National Employment Policy. This is because the Government of Ghana recognises the threats that unemployment and under employment poses to national stability, economic growth and development, and has shown commitments to its obligation to promote decent work for all its citizens as its indicated in the development agenda and in the Medium-Term Development framework. However, the mitigation and adaption actions themselves present a host of negative impacts, particularly on work.

In order to address the issues, the International Labour Organization has developed non-binding Policy Guidelines The Just Transition Framework for countries aspiring to green their economies. Ghana is one of the first pilot countries for the implementation of the ILO Guidelines. The current Government flagship initiatives are relevant to the industrialisation and economic diversification drive to securing the future prosperity of the Ghanaian peoples. Therefore, the country has embarked on the most ambitious programme of social and economic transformation aimed at putting the country on the path of progress and prosperity. This programme, is hinged on restructuring the institutions of governance, modernising agriculture to enhance its productivity, a clear industrial policy, and rationalising the financial sector to support growth in agriculture, and growth in manufacturing and industry.

8.1.2 Ghana's Development Priority Programmes

The government's flagship programmes, "One District, One Factory", and "Planting for Food and Jobs" and Water for All Programme, have been launched, with the aim of making Ghana's economy the most business friendly on the continent of Africa, and in the world. This process of economic and industrial transformation is going along with ensuring that the most basic elements of social justice are met – making quality basic education (The Free Senior High School Education) and healthcare accessible to all – to promote a culture of incentives and opportunities. The One District, One Factory kicked off in 51 districts and Government has set aside a stimulus package of $100million to revive distressed but strategic and viable Ghanaian industries,". The 'One District One Factory' programme is a public-private partnership for ensuring nationwide spread of industrialisation in all 216 districts in Ghana as opposed to the hitherto situation where the vast majority of manufacturing facilities are located in the five largest urban areas, namely Accra, Tema, Kumasi, Takoradi and Tamale. The government launched the 'Planting for Food and Jobs Programme' with the aim of increasing food security and job creation for the youth while the 'One-Village-One-Dam' aims at ensuring all year-round farming in the three regions of the north, through the construction of irrigation dams in every village in that part of the country. "An additional benefit of this policy is to reduce the reliance on importation of food and improve the balance of trade. However, this programme is dependent on the successful implementation of the 'One-Village-One-Dam' initiative which is to reduce and ultimately end the practice of rain-fed agriculture in the country and the 'One-District-One-Warehouse' programme under which modern storage facilities will be developed.

In the 2017 budget, the government earmarked GH₵560 million for the initiative expected to create over 70, 000 jobs. On August 1, 2018 the government awarded 1,300 entrepreneurs under the National Entrepreneurial Innovative Plan (NEIP) in order to grow businesses in the country. The establishment of three development authorities to spearhead the development of the three ecological zones. The Savannah Development Authority, the Middle Belt Development Authority, and the according to the government is a vehicle to be used to fast-track the socio-economic transformation of the regions in these ecological zones. The authority in the addition is the primary agency for the implementation of the Infrastructure for Poverty Eradication Programme (IPEP). Despite its challenges, Ghana has fully integrated the SDGs into the overarching national development framework and has led the way in their implementation, The coordinated Programme of Economic and Social Policies-are helping to promote policy coherence and strengthening inter-sectoral coordination. Finally, the government is determined to build a new Ghanaian civilisation, a Ghana beyond Aid.

8.1.3 Methodology for obtaining Response Measures Information

Stakeholder Engagement, Desktop Reviews, National documents, online sources, consultations, questionnaire administration, Focus Group, Observation, Monitoring and site Verification Reports, Newspaper Reviews, Research, and Phone Conversations were used to gather evidence for the development of the BUR, however where factual statistics do not exist inferences were made based on relevant assumptions.

8.1.4 Concrete efforts on Responses Measures in Ghana

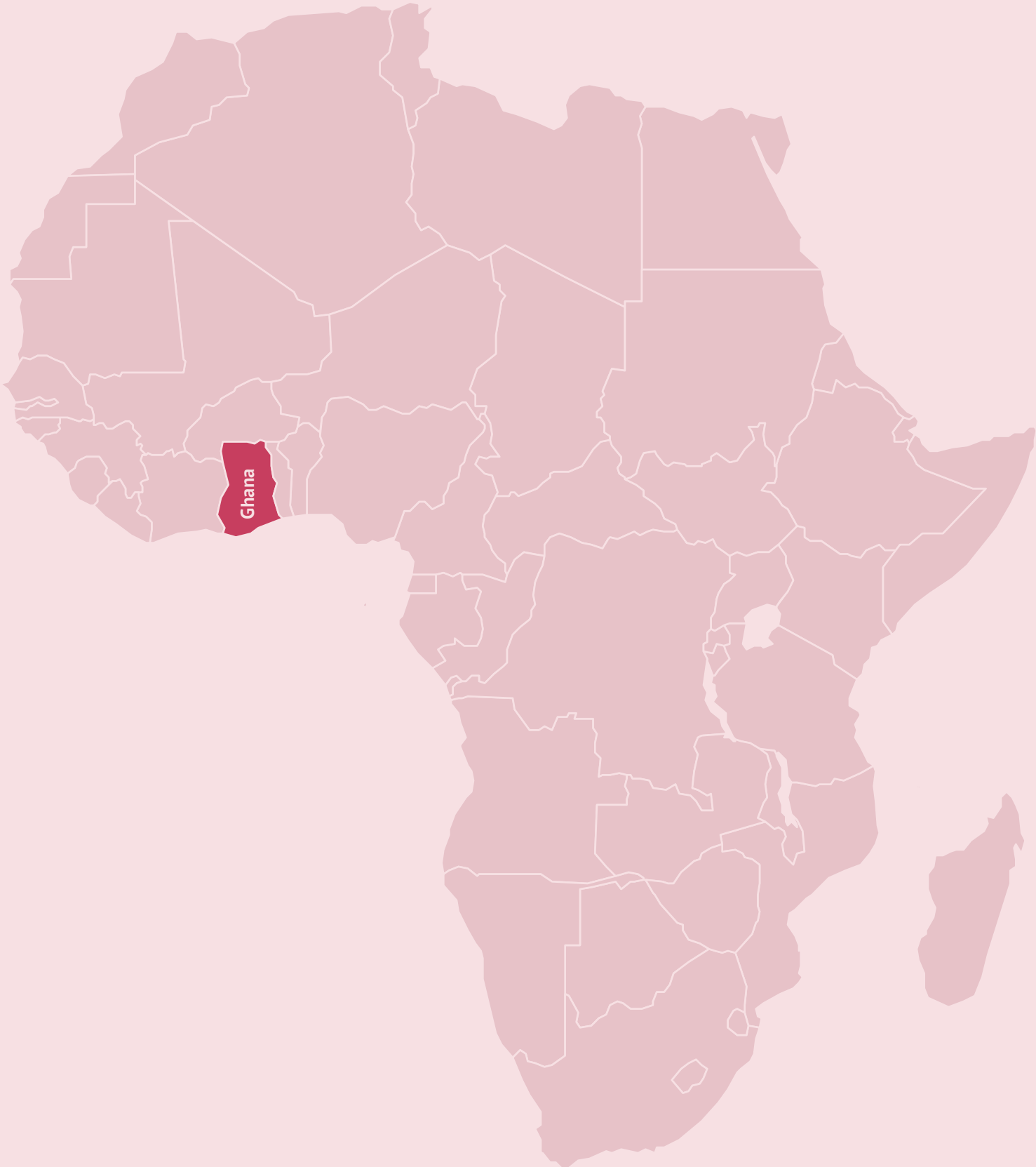
- Established 13-member Working Group on Response Measures.
- Public awareness on Response Measures in the print media
- Developed and adopted a new National Employment Policy in 2015
- Organised a National Dialogue on decent work and just transition in Accra in January 2018. The objectives of the dialogue are as follows: offer a platform for tripartite social dialogue on the implementation of climate change commitments and implications for employment in Ghana; identify sectors most likely to be affected positively or negatively, and define possible response measures from the perspective of promoting decent work and a just transition for all.

The dialogue recommended the following:

- Scoping and rigorous impact evaluation of the Nationally Determined Contributions on jobs and the market labour should be conducted.
- Retooling of the education system in particular the vocational and technical training schools and centres and to mainstream the "Just Transition concept" in their curriculum.
- Existing skills should be upgraded to reflect the needs of the transition to a green economy.
- Scoping Study on Decent Work and a Just Transition to an environmentally sustainable economy and society for all in Ghana to ensure a just transition is attained in the implementation of Ghana's NDCs.

GHANA

Environmental Protection Agency



GLOBAL SUPPORT PROGRAMME