



FEBRUARY, 2019

ENVIRONMENTAL PROTECTION AGENCY

[WWW.EPA.GOV.GH/EPA](http://WWW.EPA.GOV.GH/EPA)

# Ghana's ICAT Project Progress Report

Deliverable 2 Report - Renewable energy sector MRV

Submitted by : Antwi-Boasiako Amoah and Daniel Benefoh

# Table of content

Introduction	page 3
Progress made so far	pages 4 - 9
Utilisation of GACMO Tool in Ghana	page 10
GACMO Training for Data Champions	pages 11-13
Next steps	page 14

# 1. Introduction

Ghana's ICAT project officially commenced in 2017. The overall aim of the Ghana's ICAT is to contribute to the strengthening of the functionality of the Ghana's Climate Ambitious Report Programme (G-CARP) which is domestic MRV system. The project focused on the following areas:

- capacity development in MRV.
- develop transparency guidance for the renewable sector and further sharpen the data champions.

These strands of activities are relevant to improve the functionality of the G-CARP on the ground.



**The G-CARP is about sharpening the climate data management to meet the ambitious and lasting reporting.**

Source: Status of MRV in Ghana

---

Before implementation of the project started, Jorgen Villy Fenhann of UNEP-DTU paid a visit to Ghana to work with the team to finalise the work programme of the project. During his visit, the team completed the following deliverables:

## **(a) determining the scope of work of ICAT -**

The national MRV team, EPA and Jorgen worked together to identify possible areas in the domestic MRV system the ICAT project would focus on. This approach of the ICAT worked very well. It really allowed all the stakeholders to come up with joint needs the project can provide support to. Such tailor-made supports can meaningfully help to entrench the utility of the GCARP.

This feature the ICAT project adopted was innovative and was well received by the local team. Unlike ICAT, for project like this, the donor or the service provider, typically pre-determine the support package and format ahead of time before engaging with the recipient country. Through the bottom-up consultative approach, three main areas relating to the operationalisation of the GCARP were identified for the project

These included: (a) assessment of the status of the domestic MRV; (b) roles data champions and (c) training in the assessment of the full effects of climate actions. The team also discussed and agreed on the possible activities that would be implemented under each of the identified work area.

## **(b) finalisation of the work programme -**

When the identification of the work area was finalised, the team further worked on detailing out the specific activities under each of them.

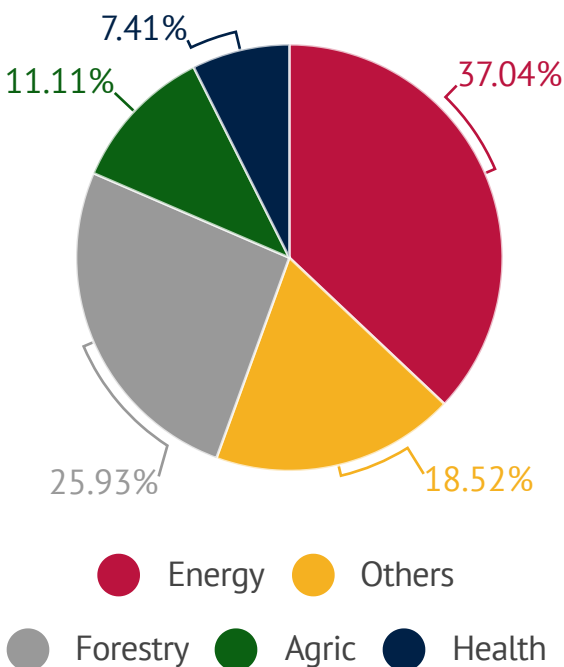
## 2. Progress made so far

### 2.1 Established MRV data champions

Ghana's NDCs are widely diverse. It spans across seven sectors of which 20 are mitigation actions and 11 adaptation. The scope and the level of implementation vary across sectors and geographic locations. This diverse nature of the NDC actions require an MRV system that can be responsive to the reporting needs.

With this wide range of NDCs, it makes sense to get the different line ministries to follow up on the implementation of their NDCs and report on them. In this regard, the MRV data champions were formed.

#### Breakdown of Ghana's NDCs



The data champions were identified and written to detailing their expected roles and invited them to join the community of practitioners on MRV. Upon receiving their official responses the team, was officially commissioned to form the data champion network. In all, 20 data champions from 9 different public sector organisations and CSOs constitute the data champion network. Ten of them have been appointed as the lead data champions supported by an alternative person as back up. Each data champion is responsible for a specific NDC.

The main role is to use the NDC MRV tool embedded in the GACMO tool to track. The team members have been trained on how to use the MRV sheet in the GACMO tool.

#### Some selected data champions

**Kwasi Sarpong**  
**Daniel Essel** **Salifu Addo**  
**Seth Mahu**  
**Hugh Brown** **Paula Edze**  
**Kennedy Amankwa** **Ben Sackey**  
**Fred Appiah** **Gifty Tetteh**

## Building GACMO Model for Ghana

Deliverable 2 of Ghana's ICAT project is on piloting renewable energy sector MRV. The consulting with the local MRV team and EPA, it was decided that instead of focusing only on the assessment of mitigation effects of the renewable energy action, the focus should be shifted to improving the analytical work behind Ghana's NDC target using the GACMO model.

The GACMO was originally developed by UNEP-DTU. It is an excel-based tool made up of series of multiple inter-linked sheets. The GACMO tool was selected because it is flexible enough to suit the unique national circumstance of Ghana. Another advantage GACMO has is that, it is not data intensive and can be adopted to fit different situations yet the results can be transparent and rigorous. For example, depending on the degree of available data, it is possible to develop both simple and complex models.

With GACMO, it was possible to assess the emission reduction and cost implication of the individual mitigation actions in the NDC, aggregate the effects of individual actions and come up the emission reduction targets and the MRV data.

The GACMO model has several sheet joined together to produced a meaningful results. The GACMO sheets are grouped into five main clusters: (a) individual technology assessment sheet, (b) balance sheets, (c) growth sheet, (d) marginal abatement revenue sheet and the (e) assumption sheet.

### Step 1: Technology mitigation options

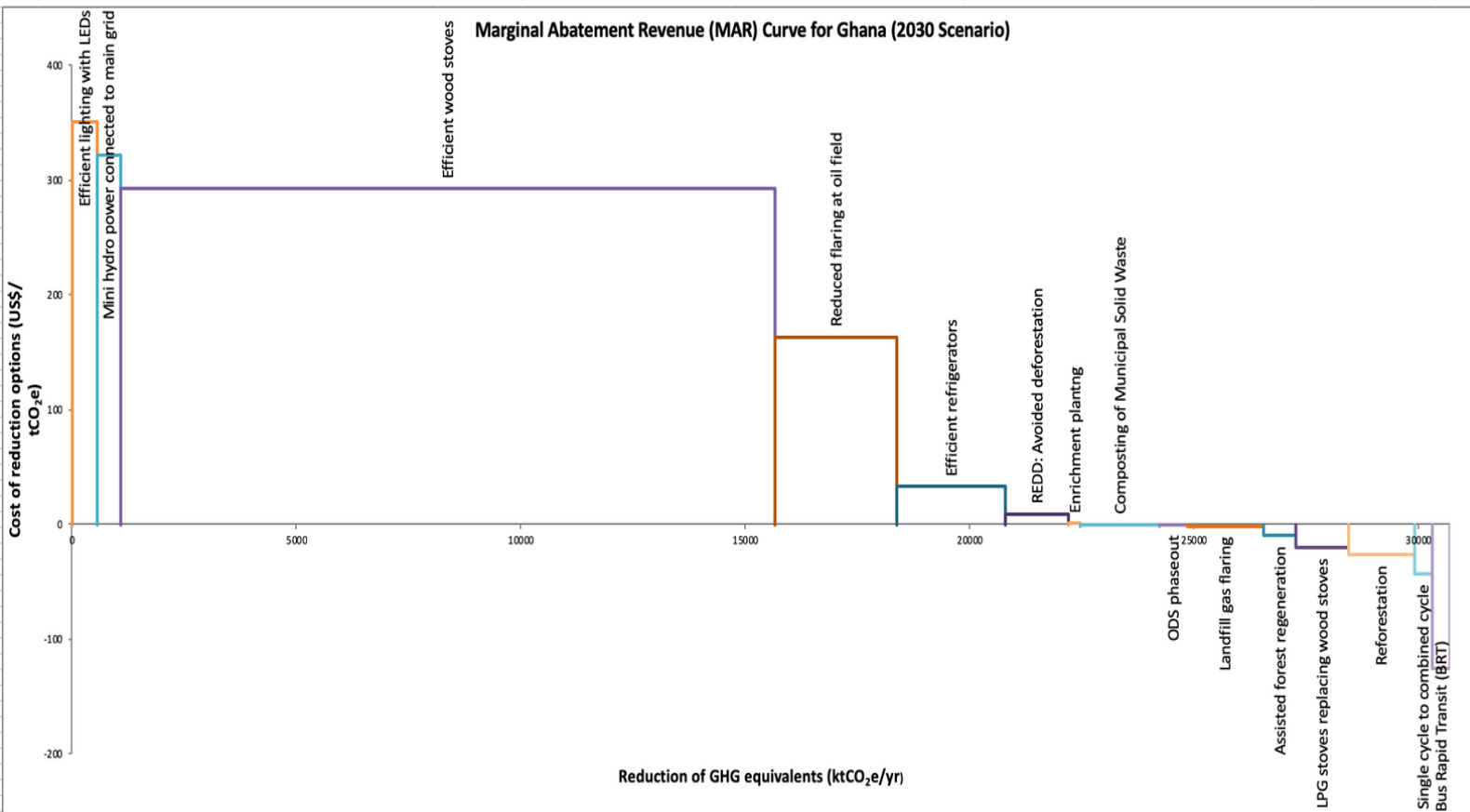
Ghana's GACMO model covers 28 mitigation technologies in Ghana NDCs. It spans from the energy, forest, transport and waste sectors. The emission reduction potential and the cost are evaluated first. Data on the reference and mitigation technology were collected from multiple sources including international literature. Data on technology cost were also obtained from literature. With these dataset it was possible to evaluate the emission reductions of each of the 28 technologies and their corresponding cost savings.

### Step 2: Marginal abatement revenue curve

Once emission reduction potentials and the associated cost are evaluated the results are automatically populate the in marginal abatement revenue curve sheet. The information from this curve is crucial in understanding the cost barriers for rolling out the mitigation technologies.

“

*With GACMO, it is possible to transparently evaluate the emission and cost savings of climate technologies. Aggregate their full effects relative to a set baseline, track progress all in one dashboard. Undoubtedly, a useful companion for the analytical behind Ghana's NDC.*



### **Step 3: Establish emission baselines**

The 2016 GHG inventory results were used as the base year emissions in GACMO. It allowed the easy transfer of the inventory figures from the IPCC format into the tool. Figures were disaggregated from the total national emissions to sector emissions and further to specific activities. All these values were captured in the "start balance" sheet in the tool.

The next step was to project emission up to 2030 based on the expected growth in population and gross domestic product. The projection calculation are set to every 5 year period from 2016-2020, 2020-2025 and 2025-2030. This projected emissions along Business-as-Usual (BAU trajectory depicted a policy situation where the status quo remain unchanged by 2030. The BAU emissions are expected to increased from 42 MtCO<sub>2</sub>e in 2016 to 47 MtCO<sub>2</sub>e in 2020, then to 57 MtCO<sub>2</sub>e in 2025 and finally at 71 MtCO<sub>2</sub>e in 2030. The emission associated with the absolute BAU scenario then form the basis for comparing the aggregate effects of the 28 mitigation technologies.

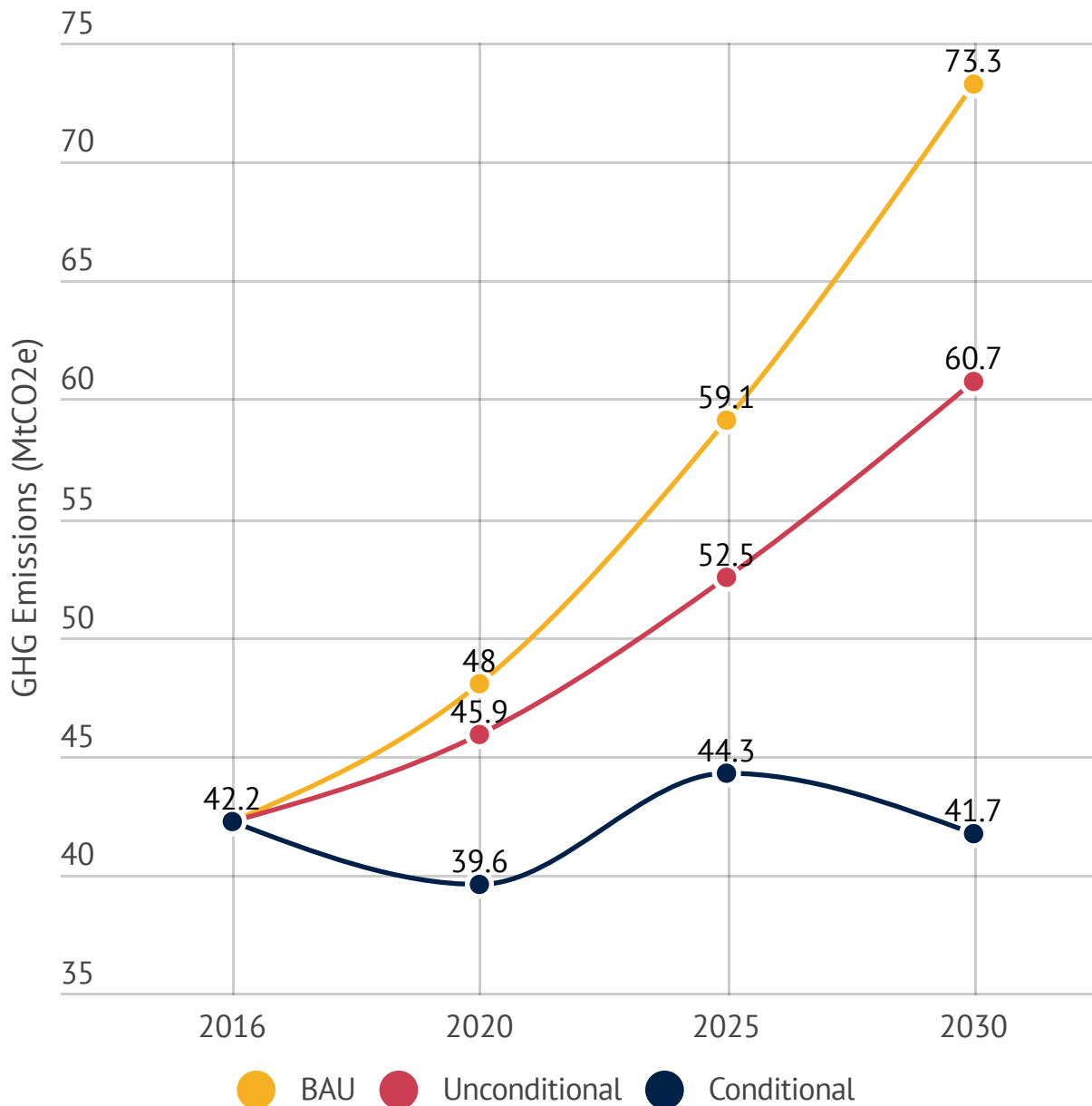
### **Step 4: Aggregate Mitigation potential**

In the "main" sheet, it is possible to append the emission reduction, the investment, annual cost and penetrating unit for each technology option in a given period. In addition, it is possible to indicate the co-benefits in terms of electricity, quantities of diesel and gasoline saved for a particular mitigation technology. The main sheets cover main2020, main2025 and main2030 and in each one of them similar information as indicated above have been provided.

### **Step 5: Overall emission reduction target**

Ghana has two-tier emission reduction target. The two targets were arrived at by aggregating the emission reduction of 5 mitigation options whose implementation would be country-led without international support. The five mitigation options and their emissions reduction effects are captured in the unconditional 17% target. The emission reduction effects of the additional 23 mitigation were expressed in percentage terms (43%) relative to the projected BAU emissions.

# Revision of Ghana's NDC target with GACMO



This very important graph was made possible by using the GACMO model. The model helped to improve the transparency of the analytical work behind Ghana's NDC and also increase the rigour of the calculation. This has increase the reliability of the decision-making process of the NDC. The GACMO analysis also made it possible to evaluate additional benefits of the 28 mitigation options as well as their cost implications. Another useful feature of the GACMO tool is it in-built user-friendly MRV sheet.



## Step 6: Define MRV System

The MRV is a critical part of Ghana's NDC. It allows a systematic tracking of implementation of the mitigation option and their corresponding emission reductions and co-benefits in a given year. Basically, the MRV sheet has seven columns with each having a specific MRV data variable. Columns 1 and 2 contain the list of the 28 mitigation options in Ghana's NDC and their units. The next set of columns have the penetration target for each mitigation technologies for 2020, 2025 and 2030 over which performance would be measured against on year-by-year basis.

The yearly penetration achievements of each mitigation option are to be recorded in the next set of columns one for each year (from 2016 to 2030). When the yearly achievements are inserted in GACMO the corresponding emission savings per year are automatically calculated as a cumulative figure. When all the individual yearly emission savings are put together it can give an indication of the extent to which emission reduction target are being met.

The last two columns are dedicated to record external and internal finance

MRV sheet in GACMO showing the mitigation options in the NDCs

In this sheet the country will follow the implementation of the GHG reduction options in the main sheets																				Total Accumulated GHG reduction kt/CO2e/yr	Total external finance Million US\$	Total internal finance
Type	Reduction option	Sub-type unit	2020 plan	2025 plan	2030 plan	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030		
Agriculture	Rice crop CH4 reduction	Rice crop CH4 red.(1000 ha)	0	0	0																0.0	
	Zero tillage	1000 ha	0	0	0																0.0	
	Tobacco curing	100 t tobacco/yr	0	0	0																0.0	
Biomass energy	Rice husk cogeneration plants	1 MW cogeneration	0	0	0																0.0	
	Biomass power from biomass residues	1 MW CHP plant	0	0	0																0.0	
	Bagasse power	100 kt sugar cane/year	0	0	0																0.0	
CCS	CCS plant	1 MW	0	0	0																0.0	
Cement	Clinker replacement	1000 tonnes cement/day	0	0	0																0.0	
Coal bed/mine methane	Coal mine methane	10 Mm3 CMM/year	0	0	0																0.0	
EE households	Efficient residential airconditioning	1000 Airconditioners	0	0	0																0.0	
	Efficient lighting with CFLs	1000 Bulbs	0	0	0																0.0	
	Efficient lighting with LEDs	1000 Bulbs	2,500	5,000	7,000	1,000															78.9	
	Efficient lighting with LEDs replacing CFL	1000 Bulbs	13,000	13,000	13,000					14,000											92.8	
	Efficient wood stoves	1000 stoves	100	500	2,000																8757.9	
	LPG stoves replacing wood stoves	1000 stoves	10	50	134																737.9	
	Efficient electric stoves	1000 stoves	0	0	0					85											0.0	
	Efficient refrigerators	1000 refrigerators	200	1,000	2,000																0.0	
EE industry	Efficient electric motors	1 kW	0	0	0																0.0	
	Energy efficiency in industry	10% red. of energy demand	1	1	2																0.0	
	Building materials	1 million bricks	0	0	0																0.0	
EE own generation	Waste heat recovery at cement plant	1 Cement plant	0	0	0																0.0	
	Waste heat recovery at steel plant	1 Steel plant	0	0	0																0.0	
EE service	Efficient electric motors	1 kW	0	0	0																0.0	
	Efficient office lighting with CFLs	1000 lights	0	0	0																0.0	
	Efficient street lights	1000 lights	0	0	0					18											7.2	
	Efficient water pumping	4 Million m3 water	0	0	0																0.0	
	HVAC	100,000 m2 floor area	0	0	0																0.0	
	Energy efficiency in service	10% red. of energy demand	1	1	2																0.0	
	New office buildings with central cooling	1000 m2	0	0	0																0.0	
EE supply side	New high efficiency coal power plant	1 MW	0	0	0																0.0	
	New natural gas power plant	1 MW	0	0	0																0.0	
	Switch from fuel oil to diesel	1 MW	0	0	0																0.0	
	Switch from fuel oil to natural gas	1 MW	0	100	0																0.0	
	Cogeneration in industry	1 MW	0	0	0																0.0	
	Single cycle to combined cycle	100 MW increase	3.3	3.3	3.3					3.3											386.5	
Energy distribution	Efficient electric grids	1 GWh loss reduction	0	0	0																0.0	
	Power factor increase	1000 commercial/industry buildings	0	1	1																0.0	
	Connection of isolated grid to central grid	1 GWh consumption	0	0	0																0.0	
Forestry	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 agroforestry	Reforestation of 1000 ha	0	0	0																0.0	
	Reforestation with Silvopasture	Reforestation of 1000 ha	50	100	70																0.0	
Fossil fuel switch	Switch from coal to natural gas in industry	100 TJ fuel use/year	0	0	0																0.0	
	Switch from fuel oil to natural gas in industry	100 TJ fuel use/year	0	0	0																0.0	
Fugitive	Reduced flaring at oil field	1 MMSCF/day	118	120	120																2.8	
																					64.3	

### 3. Utilisation of the GACMO tool in Ghana

After building the GACMO model specifically for Ghana based on the available country data, it has become necessary to revise the emission figures in the NDC implementation before it is finally published. Beside, the MRV sheet in the GACMO has been adopted as the template the data champions will use to capture information on the progress of implementation of the mitigation actions in their respective sectors. Certainly, any future changes in the NDC emission figures will rely on the GACMO tool.

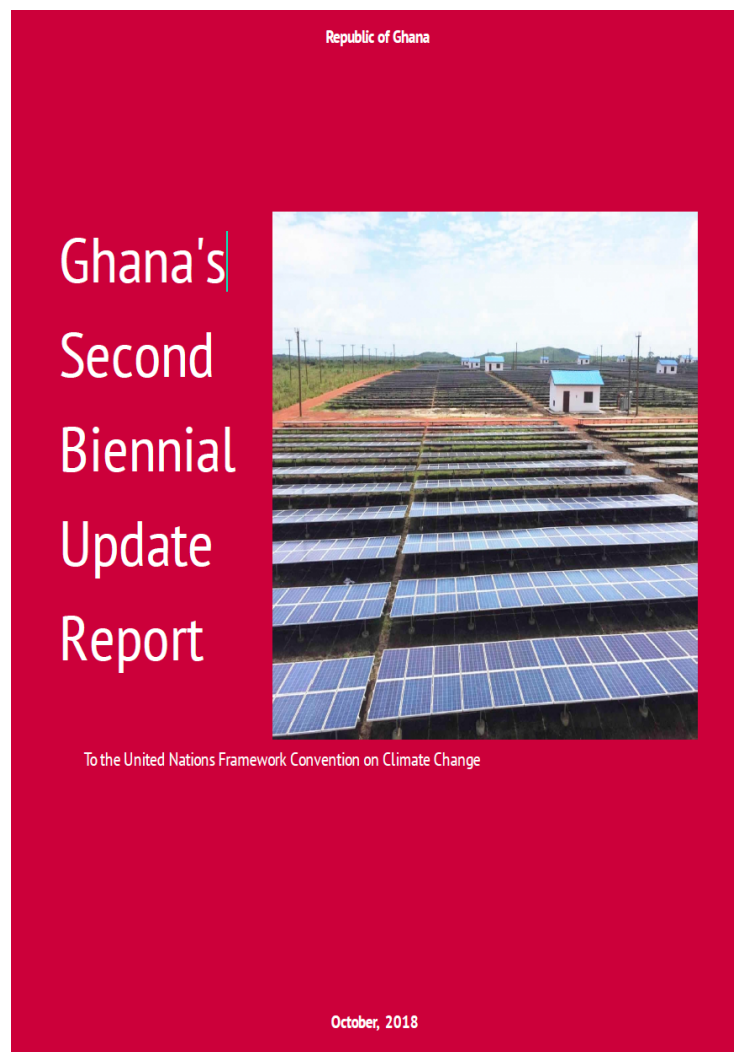


Multi-sectoral implementation plan for Ghana's Nationally Determined Contribution to the Paris Climate Agreement



REPUBLIC OF GHANA

Ministry of Environment, Science,



The GACMO tool was main tool Ghana used in the assessment of mitigation actions and their effect when compiling its second biennial update report to the UNFCCC in 2018. Once again the section of the GACMO that allowed the assessment of individual mitigation actions and the MRV sheet were very useful in the BUR work. The Ghanaian team found that very helpful, easy-to-learn, flexible and above all adaptable to suit the unique sectoral circumstances.

# 4. GACMO Training for Data Champions

## 4.1 Introduction

A workshop on the GACMO tool was organised at Mensvic Hotel in Accra on 23rd and 24th August, 2018. The purpose of the workshop was to introduce the GACMO to the data providers and collect feedback on the Ghana model. The workshop also afford the team to train the data champions on how to use the tool and what is expected from them in the future.

The workshop was organised by the Environmental Protection Agency (EPA) in close collaboration with the UNEP-DTU. In all, forty people participated in the workshop. They were drawn from both public institution, the academia and CSOs. Majority of the participated were either the data champions or their representatives. Additionally, people from data providing institutions also attended the workshop.

The workshop was timely because it was also afforded the opportunity to allow the participants to scrutinise the analysis behind the Ghana NDCs and provide comments.

## 4.2 Workshop Approach

The workshop was delivered using presentations, general discussions and hands-on exercises. After the opening the workshop, series of presentations were given to provide the context of the workshop including the objective. This was followed by the technical presentations on GACMO by Jorgen Villy Fenhann and Daniel Benefoh. The presentation by Daniel Benefoh largely focused on the utility of the GACMO tool within the context of NDC process.

The main technical presentation on the workings of the GACMO model was delivered Jorgen Villy Fenhann of UNEP-DTU. He took the participants through all the GACMO sheets and linkages among them. He also touched on the data requirements of the tool and the various data type. After the presentations, the participants had the opportunity to ask questions and provided comments on the model and the results. They also had the opportunity to try their hands on the GACMO tool. On the whole, the workshop turn out to be successful. The participants provided positive feedback on the usefulness of the workshop.

## 4.3 List of participants

	Institutions	Name of Participant
	Environmental Protection Agency	Juliana Bempah
	University of Ghana, Economics Department, Legon	Dr. D.K Twerefou
	University of Ghana, ISSER, Legon	Dr. Aba O. Crenstil
	Ministry of Environment, Science, Technology and Innovation	Gyimah Mohammed
	Energy Commission	Kennedy Amankwa
	Energy Commission	Salifu Addo
	Environmental Protection Agency	Joy Hesse Ankomah
	Environmental Protection Agency	Kwame B. Fredua
	Ministry of Food and Agriculture	Kingsley K. Amoako
	Environmental Protection Agency	Daniel Lamptey
	Energy Commission	Simpson Attieku
	Forestry Commission	Charles Sampong Duah
	Energy Commission	Micheal Abrokwa
	Environmental Protection Agency	Rosemary Boateng
	Forestry Commission	Thomas Gyambrah
	Ministry of Finance	Foster A. Gyamfi
	Ministry of Energy	Frank Kyei Arthur
	Volta River Authority	Charles Kofi Sam
	Forestry Commission	Jacob Amoako
	Environmental Protection Agency	K.Y. Oppong-Boadi
	Environmental Protection Agency	Antwi-Boasiako Amoah (PhD)
	Environmental Protection Agency	Daniel Tutu Benefoh
	Environmental Protection Agency	Richmond Aidoo
	Environmental Protection Agency	Patrick Addai
	Environmental Protection Agency	Ebenezer Appah-Sampong

	Institutions	Name of Participant
	National Development Planning Commission	Felix Addo- Yobo
	Ghana Statistical Service	Francise Dzah
	Environmental Protection Agency	John A. Pwamang
	Phebee Consults	Philip Acquah
	Ministry of Local Government and Rural Development	Akosua Agyarko
	Energy Commission	Paula Edze
	Civic Ghana	Kwame Agyei
		Mawufemer Gbeti
		Fiifi Boadi
		Josephine Gawu
	Ministry of Transport	Daniel Essel
		Rita Hewlett
		Victor Kotey
	KNUST	Kenneth Commey
	United Nations University	Kwabena Asubonteng

# 5. Next steps

The following are the next steps in the ICAT project:

- **Refine GACMO data inputs** - Fine tune the GACMO tool with newly published data from the various sector. The revision may as a results of updates of underlying data for the model with the view to improve its quality. This is important because it will be a major inputs into the 2020 submission of the Ghana's second NDC to the UNFCCC.
- **Populate GACMO MRV sheet** - work closely with the data champions to fill the 2017 and 2018 MRV template for their respective sectors. The completed templates will be used to evaluate aggregate effects of the implementation of the various mitigation actions.
- **Update the cost or investment data in the GACMO tool** - the current cost and investment information in the GACMO is quite generic. This make the estimation of the overall investment requirement for the mitigation actions NDC conservative. Ghana plans to work with UNEP-DTU to update the finance information in the model.
- **Sustainable development benefits** - Information on sustainable development benefits of the NDC mitigation measures are limited to the co-benefits related to avoided diesel or gasoline or electricity use. Information on jobs, incomes health benefits etc are missing in the model. This is one are areas the ICAT project will focus on exploring better ways to incorporate into the model.
- **Additional training on GACMO** - It is possible that as Ghana prepares to develop the second NDCs some improvements will be made to the existing data. Once that one has been done, it would be important to organise another training session for the wider stakeholders on GACMO.