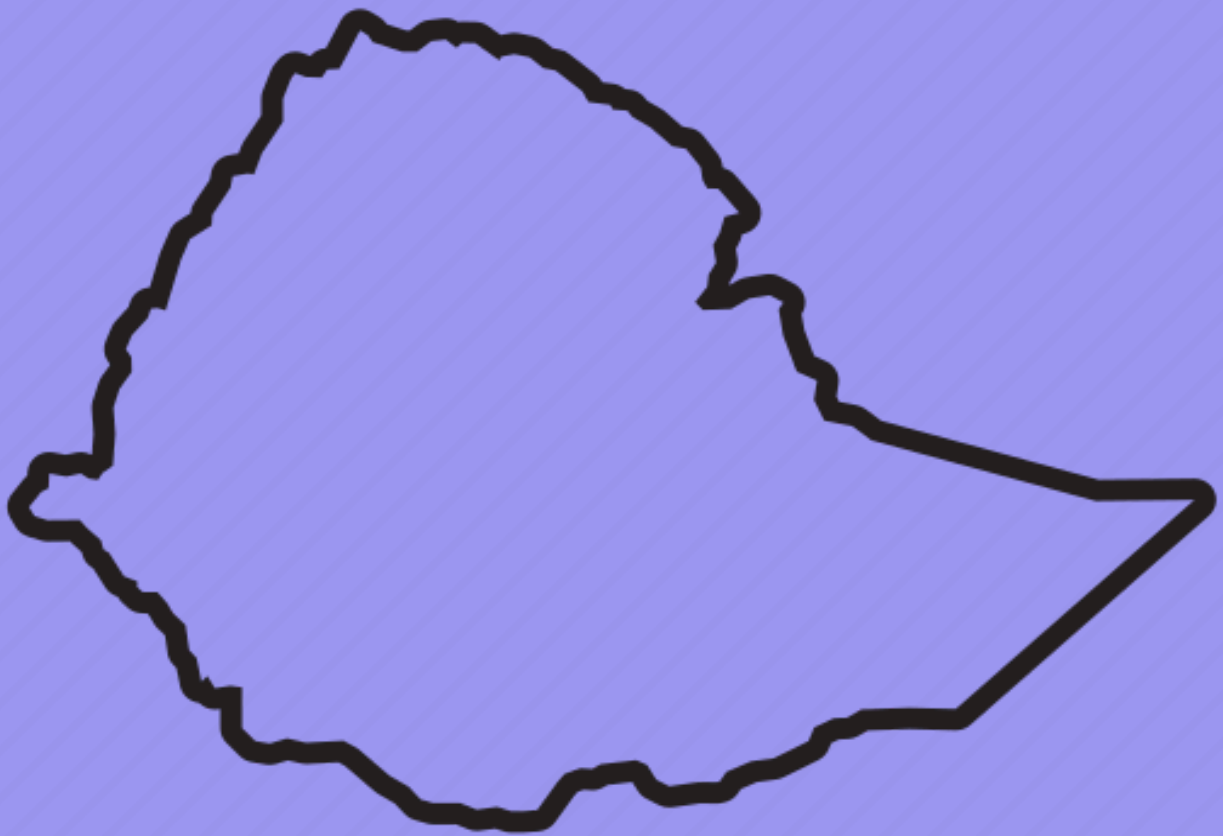# Capacity Building In-person (hybrid) Workshop Report on GACMO Tools in Applying the Indicator Sets for NDC Tracking to Ethiopia

Capacity Building In-person (hybrid) Workshop Report on GACMO Tools in Applying the Indicator Sets for NDC Tracking to Ethiopia

Deliverable #5 (Output E)

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AUTHORS

Mekonnen Maschal Tarekegn (PhD)
Global Environmental Solution, General Manager

Reviewers

Ivana Audia, Dr. Xianli Zhu, Dr. Aiymgul Kerimray

UNEP Copenhagen Climate Centre

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Background

Ethiopia submitted its Intended National Determined Contribution (INDC) in 2015 which become Ethiopia's NDC in 2017. The Nationally Determined Contribution (NDC) of Ethiopia focused on four pillars to mitigate GHG emissions: (1). improving crop and livestock production practices for higher food security and farmer income while reducing emissions, (2) Protecting and re-establishing forests for their economic and ecosystem services, including as carbon stocks, (3) Expanding electricity generation from renewable sources of energy for domestic and regional markets, (4) Leap frogging to modern and energy-efficient technologies in transport, industrial sectors, and buildings (FDRE, 2015). In addition to mitigation efforts Ethiopia's NDC identified adaptation efforts to reduce vulnerability of livelihoods and landscapes to climate impacts, focusing on three key areas: droughts, floods, and cross-cutting interventions. Many of the initiatives offer positive returns on investments, thus directly promoting economic growth and creating additional jobs with high value added (CRGE, 2011). The updated NDC is integrated in Ethiopia's Ten-Year Development Plan published in June 2020, and will form the basis of updating its core climate strategy, the 2011 "Climate Resilient Green Economy" (CRGE) strategy.

The ICAT's current Ethiopian emissions projections are higher in 2030 compared to the previous projections, due to revisions in the historical data and a smaller than expected impact of the pandemic on emissions. Ethiopia is set to overachieve its unconditional and conditional NDC targets in 2030 under current policies. Ethiopia's own climate plans are within the range of what is considered to be a fair share of global effort; however, the country need to have a tracking framework to see the exact contribution of each mitigation measures for reduction in its global share of carbon reduction.

Due to this reason, Ethiopia demands support of the Initiative for Climate Action Transparency (ICAT) to capacity building on Article 6 and GACMO methodology for the NDC Update mitigation measures implementation tracking. Hence, the ICAT Secretariat, the Environmental Protection Agency (EPA), and the UNEP Copenhagen Climate Centre (UNEP-CCC) have agreed to develop two support provisions such as (1) Application of the GACMO model and 2) Capacity building on the MRV related to Article 6 participation.

In the call for support provision that was developed through international cooperation, Global Environmental Solution has been selected as a national representative of the ICAT to facilitate the capacity building activities such as GACMO (Greenhouse gas Abatement Cost Model) model training for the NDC Update planning and implementations. Thus, with GES national facilitation, the ICAT secretariat has brought a resource person from UNEP-CCC and delivered an in - person capacity building training on application GACMO model contents and its applicability for NDC planning and implementation tracking for the FDRE Environmental Protection Authority and selected experts of line ministries such as Ministry of Water and Energy, Ethiopian Forestry Development, Ministry of Industry, Ministry of Mining, Ministry of Transport, Ministry of Agriculture, Ministry of Urban and Infrastructure, and selected regional states. The training was given for three days from 18 to 20 December 2024. All the processes, activities, training contents and outputs are reported as follows.

Objectives

The main objective of the in – person training was to provide a capacity GACMO Model Methodology and its applicability to selected experts from the line ministries of Ethiopia responsible for NDC Update implementation. The in – person training has achieved the following specific objectives.

- To give the theoretical concept of the GACMO methodology applicable for the NDC Update Planning & implementation in Ethiopia.

- To train the selected trainees on how to contextualize the GACMO model to analyze the Ethiopia's GHG mitigation options for achieving its updated NDC.

- To provide an in-depth practical exercise of GACMO models on the potential mitigation measures of the Ethiopian NDCs.

Training place and venue

The in-person training took place during 18-20 December 2023 in Debirezeit city, Ethiopia and streamed through Microsoft Team platform for regional state training participants. Fully furnished Training room with appropriate sitting, LCD projector, good sound system and refreshment were arranged in Pyramid Hotel & Resorts ([Pyramid Hotels & Resorts (pyramidresortet.com)](pyramidresortet.com)) in Debirezeit city (Figure 1). Resources were allocated for transportation and Hotel services to get all the trainees lodged. During the three days, all participants have lodged and successfully finished their trainings. They have attended the theoretical presentations, done practical exercises and entertained practical questions on contextualization of the GACMO Model in Ethiopian cases.

Figure 1 Sitting arrangement and Training Room organization in Ras-Amba Hotel for the Virtual training

List of participants

 A total of 25 trainees have participated in the in-person training of GACMO in Debirezeit. Among the participants, about (6/25) 24% of the in – person trainees were female (Figure 2). The female participants in this in-person training were 6% less than the virtual training that were held in the past (October 10 -12, 2023).
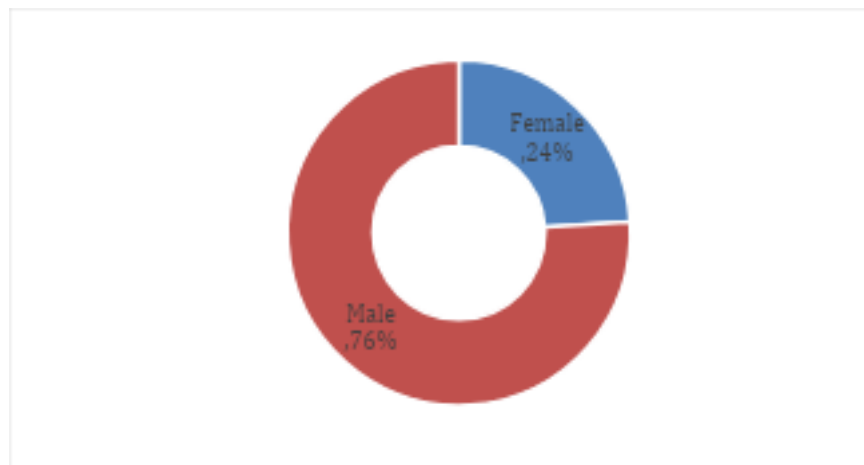
Figure 2 Gender distribution of participants of the GACMO Model in-person training

Four regional state percipients successfully attended the three days training. Due to in accessibility and fragility of the transportation system to Addis Ababa and Debirezeit training location, Diredawa and Harar participants attended the training online. Whereas participants from Oromia and Sidama Regional states attended the training in person. The other training participants came from the federal organizations and ministries that are responsible to NDC Update, implementation, and GHG emission reporting. Experts from the two senior national universities, Addis Ababa and Ethiopian Civil Service Universities, also attended the in - person training. Furthermore, private consulting firm employees joined the training as future trainers for GACMO. In general, the training was successfully given for experts from seven-line ministries, four federal offices, two coordinating bodies, two universities, and one private consulting firm. Table 1 below shows the participant list of the training workshop.

Table 1 Participant List of the GACMO Model in-person training

S N	Name	Organization	Gend er
1.	Mr. Benti Firdessa	Federal Democratic Republic of Ethiopia Environmental Protection Authority (FDRE EPA)	M
2.	Mr. Yizengaw Yitayih	Ministry of Trade and Labor (MoTL)	M
3.	Mrs. Behafta Hagos	Ministry of Trade and Labor (MoTL)	F
4.	Mr. Esmael Mohammed	Ministry of Industry (MoI)	M
5.	Mr. Birhanu Sisay	Ministry of Urban and Infrastructure (MoUI)	M
6.	Mrs. Eden Seyoum	Ministry of Industry (MoI)	F
7.	Mrs. Yayesh Mihiretie	Ministry of Mining (MoM)	F
8.	Mr. Sori Chalchisa	Ministry of Mining (MoM)	M

S N	Name	Organization	Gender
9.	Mr. Mekonnen Fufa	Ministry of Agriculture (MoA)	M
10.	Mr. Tolessa Benti	Ministry of Agriculture (MoA)	M
11.	Mr. Natan Cherinet	Federal Democratic Republic of Ethiopia Environmental Protection Authority (FDRE EPA)	M
12.	Mrs. Nebeyat Getachew	Federal Democratic Republic of Ethiopia Environmental Protection Authority (FDRE EPA)	F
13.	Hawi Girma	Federal Democratic Republic of Ethiopia Environmental Protection Authority (FDRE EPA)	F
14.	Dr. Mitiku Adisu	Ethiopian Civil Service University (ECSU)	M
15.	Mr. Heiru Sebrela	Ethiopian Forestry Development (EFD)	M
16.	Mr. Daniel Belay	Ethiopian Forestry Development (EFD)	M
17.	Mrs. Sofia Mohammed	Ministry of Water and Energy (MoWE)	F
18.	Mr. Dereje Ararsa	Ethiopian Civil Aviation Authority (ECAA)	M
19.	Mr. Gizachew Wendimu	Addis Ababa University (AAU)	M
20.	Mr. Alemayehu Agizew	Global Environmental Solution (GES)	M
21.	Dr. Mekonnen Amberber	Global Environmental Solution (GES)	M
22.	Mr. Shumi Negasi	Oromia Regional Sate Environmental Protection Authority (OEPA)	M
23.	Mr. Adisu Petrol	Sidama Regional State Environment, Forestry and Climate Change Commission (Sidama EFCCA)	M
24.	Mr. Samir Bekiri (online participation)	Harar regional state environmental Protection Authority (Harar EPA)	M

S N	Name	Organization	Gender
25.	Mr. Dereje Abiti (online participation)	Diredawa Regional State Environmental Protection Authority (Diredawa EPA)	M

Details of the training

Before starting the GACMO tool training, a brainstorming session of Ethiopian NDC Update was done. Mr. Benti introduced mitigation actions in Ethiopia's updated NDC so as to link them with the potential mitigation actions that were presented in GACMO tools. The participants identified the common mitigations that were presented both in GACMO tools and in the Ethiopian's updated NDC. The trainees became aware of the necessity to introduce some new mitigation actions in the updated NDC to the GACMO tool.

The GACMO Tools training during the three-day workshop represented a second training phase (in – person training) and was a continuation of the first virtual (online) GACMO training in October 2023. It contained both theoretical and practical training of GACMO Model in the context of mitigation actions in Ethiopia's updated NDC. The GACMO trainer (resource person) was Dr. Aiymgul Kerimray - UNEP-CCC (unepccc.org) from UNEP-CCC). She is a mitigation and energy specialist at UNEP CCC and contributes to the center's work related to GACMO model, net-zero pathways, enhanced transparency framework (ETF), etc. The training lasted three days. All the training sessions consisted of theoretical brief, assignment, activities, and homework with presentations.

In the previous training in October (1st phase), all the participants had learnt the basic definition and basic concepts of GACMO (Greenhouse gas Abatement Cost Model) which serves to calculate the current and future greenhouse gas emissions abatement costs. Again, in the second phase (this training), the focus was on training the participants on the details of GACMO model/tool. The trainer explained GACMO as a bottom-up greenhouse gas (GHG) emissions accounting tool developed over more than twenty years by UNEP-CCC. Also, she explained that GACMO tool allows countries to carry out rapid but accurate evaluation on the GHG mitigation impacts of a variety of mitigation options. The tool was developed to calculate the GHG emissions projections for the business-as-usual (BAU) scenario and for the mitigation scenario based on a set of selected mitigation options can be, for example, the mitigation options adopted or planned by a government and specified in national climate plans or a country´s NDC. The GACMO tool can be used to compare mitigation options in terms of their abatement costs and mitigation potential, to identify the set of mitigation options appropriate for a country. The GACMO tool can thus support technical experts and decision-makers to assess and understand the GHG emissions impacts of climate mitigation actions. The GACMO tool can also be used to assess the GHG emission reductions achieved through the effective implementation of mitigation options. Therefore, it can be used as a tool for tracking the progress in achieving emissions reductions from the implementation of climate change mitigation options and the progress in implementing and achieving the NDC. The trainer's theoretical part presentations included the following heading categories.

Applicability of GACMO Tool

The GACMO tool can be used at the national level (country level) but can also be adapted to be used at the sub-national level (region or city). It can be very useful for the preparation of national reports such as national communications, biennial update reports (BURs), biennial transparency reports (BTRs) including the common tabular format tables (CTF), or for the preparation and update of NDCs.

Details of the GACMO tool software

All the versions of the GACMO tool can be downloaded and used free of charge by any user and can be

installed on a personal computer. The tool is regularly updated. The last version of the GACMO tool is always made available on the webpage. The new version of the GACMO tool (version 2.01) has been developed with the support of the Initiative for Climate Action Transparency (ICAT). This new version follows the same methodological approach as the previous GACMO versions but proposes a step-by-step approach and includes an improved interface. The new version of the GACMO tool is supported by a detailed guidance and two introductory tutorials (https://youtu.be/ZlsaVCzI9aY & https://youtu.be/jVMwtSVeOPw).

The GACMO tool also includes some default values that are already pre-loaded in the tool and that the user does not have to update them unless he or she has better inputs and wants to make more precise estimates. These default values are all visible and accessible to the user. The first group of data with default values are those of key mitigation parameters, such as the IPCC database of emission factors (2006 IPCC Guidelines) and the global warming potential (GWP) of different GHGs. In the case of GWP, the GACMO tool uses by default the values of the fifth Assessment Report of the IPCC, as established in the Modalities, Procedures, and Guidelines (MPGs) adopted in the Katowice Climate Package through decision 18/CMA. However, previous GWP values are also available in the tool. The second group of data with default values are those for the mitigation potential parameters and economic-financial parameters of each mitigation option and their corresponding baseline situation. In this case, the GACMO tool uses by default, average values calculated from 6 relevant CDM projects available on the CDM website and summarized in the project pipeline developed at UNEP-CCC. Experience has shown that the use of default values for data related to baseline and mitigation options works well in the tool. However, it is recommended for a GACMO user to modify those default values for the data related to the mitigation and reference options, by replacing them with values specific to their case (e.g., country, city, region, industrial activity). This allows the user to adapt the GACMO tool to the specific national/local context.

Data requirements

The main data required to use the GACMO tool are those of the energy balance for a specific year (considered as the start year), that is, the data on the sectoral energy consumption of fossil fuels and electricity of a country, as well as the GHG emissions for the other non-energy sectors for the same year (taken, for example, from a national GHG inventory report). From these data, GACMO estimates CO_2 emissions from fuel combustion and summarizes the GHG emissions for the start year (generally the most recent year for which the necessary data is available). Then, applying growth factors for each sector (these factors are specific to the country and are estimated and entered in the tool by the user), the GACMO tool will project the GHG emissions to build a reference scenario (also called baseline scenario or business as usual - BAU), that includes projections for the years 2025, 2030, 2035, and/or 2050.

GHG mitigation options and scenarios

To build the GHG mitigation scenario, the GACMO tool includes a list of 119 mitigation options for different sectors. These mitigation options are organized into 24 categories of activities, such as agriculture, biomass energy, energy efficiency in homes, forestry, as well as geothermal, hydroelectric, solar, and wind energy, among others. It must be noted that some mitigation options included in the GACMO tool imply the use of fossil fuels (e.g., energy efficiency improvement, natural gas power plant). Those mitigation options may lead to emissions reductions, though may be insufficient to be in line with a 1.5°C degree climate goal which require the global net anthropogenic CO_2 emissions to reach net zero around 2050. Though the GACMO tool does not seek to promote such options, they are included in the list of mitigation options because some countries still consider using or are in the process of implementing them to reduce their emissions. In this context, the GACMO tool can also help to analyse whether the mitigation actions adopted and/or planned by a country are in line with certain climate goals (e.g., net-zero goal), and if not, help to assess which mitigation options could be implemented to meet those goals. Once the user has selected the mitigation options of interest, the tool calculates the emissions based on the defined growth factors and establishes a mitigation scenario towards the years

of 2025, 2030, 2035, and/or 2050.

The key data used as inputs and required for running the GACMO model are the (1) basic data about the country, such as population, GDP, and discount rate; (2) key assumptions (e.g., grid emission factor, energy prices, emission factors, calorific values of fuels, etc.); (3) Energy balance data in the start year, that is, the country's production/consumption of fossil fuels and electricity; (4) data on the GHG emissions for the key non-energy sectors in the start year: Agriculture, Forestry, Waste, Industrial processes and Fugitive emissions; (5) growth factors estimated over specific time periods for different sectors of activities; (6) the number of units of each mitigation option (selected by the user) penetrating toward the years 2025, 2030, 2035, and/or 2050; (7) technical and economical parameters of the technology/mitigation options (e.g., solar insolation, annual distance for transport, number of hours usage of lighting, etc.). It was also noted that the GACMO tool calculates GHG emissions reductions and approximate the investment costs as well as operation and maintenance costs that result from each selected mitigation action.

Structure of GACMO Model

During the introduction phase, all trainees received clear guidance on the model installation procedures and structure of the software. Accordingly, they understood the two visible spreadsheets when they open the GACMO model on their computer. In addition to the spreadsheets, the trainees also learned about the GACMO model/tool structure, including such as (1). The Introduction Sheet provides an overview of what the GACMO tool is and what its structure is; (2) the Guidance Sheet gives a quick step-by-step explanation for using the GACMO tool; (3)The Assumptions Sheet lists all the basic country data, fuel prices, and technical data that the GACMO tool needs as inputs for the calculations. This sheet must be filled in by the user; (4) The Energy Balance sheet covers the energy data disaggregated by sector of activity for the start year (5) The GHG Balance sheet shows the GHG emissions data disaggregated by sector of activity for the start year; (6) The Growth sheet includes the expected growth in energy consumption for the different sectors of activity for different periods of time; (7) The sheet of BAU projected Energy Balances includes the future energy balances for the years 2025, 2030, 2035, and 2050. The data in this sheet are automatically calculated by the GACMO tool; (8) The sheet of BAU projected GHG Balances indicates the future GHG emissions for the years 2025, 2030, 2035, and 2050; (9) The sheet of Mitigation Options lists all the mitigation options that the user may select depending on the national context, as well as the data relative to those mitigation options that the GACMO tool needs as inputs for the calculations; (10)The sheet of Results includes all the final results for the GHG emissions projections, reductions and costs calculations and (11) the Sheet of tracking progress can be used by the user to monitor the progress.

Practical Training

The trainees practiced on how to navigate the model. The trainer clearly explained to them the linkage between one sheet item to other parts of the GACMO tool to the other parts. And, before putting the Ethiopian contextualized mitigation actions, the participants were asked to analyse the interlinkage formula integrated in the model excel file.

The practical training lasted three days. The focus of Day 1 was setting up BAU scenario was exercised through navigating the Assumptions, Energy Balance, GHG Balance and Growth sheets of the model. About 120.3 million Population of Ethiopia and 107.66 billion USD GDP of Ethiopia (current prices) were inserted in Assumption sheets and participants were asked to see the changes. Then, based on the compound annual growth rate formula, the participants were asked to estimate the average historical % growth speed of GHG emissions in the AFOLU sector (calculating the average annual GHG emission growth rate for the period 2010-2018) and inserting it until 2050 in the "Growth" sheet. The participants were instructed to see the changes in emission reduction by changing the GWP data presented on the Ethiopian NDC Update documents ([Ethiopia's Third National Communication to the UNFCCC](#)) and then asked them to discuss how the resulting value of GWP can influence the mitigation potential from Agriculture and Landfills. Again, the trainees were asked to download the Third National Communication

of Ethiopia (TNC) using this link, find the latest data on GHG emissions from the waste sector in the TNC and fill in the data on GHG emissions from the solid waste and liquid waste in the corresponding cells of the "Start Year" Sheet, then asked to present the result. Finally, during the Day 1 of practical training, the trainees were asked to revise the growth rates in GACMO in accordance with Ethiopia's Climate-Resilient Green Economy (CRGE) strategy and also put the energy prices of crude oil price US$/bbl, electricity US$/kWh, kerosene US$/liter, gasoline US$/liter, diesel oil US$/liter in assumption sheet and price (US$/kg) of fuelwood in the "EE households" sheet and asked them to interpret the result.

On Day 2, the participant practiced the Mitigation scenario development through navigation of BAU projected Energy Balances and BAU projected GHG Balances sheets. The trainees used the 150,000 electric vehicles Ethiopian transport plan by 2030 and put in the mitigation option. Similarly, they opened the "Transport" technology table for electric cars and updated the cost of gasoline car to 17000 USD, electric car to 30000 USD and asked them about the emission reduction in ktCO$_2$e/year. Again, the land Use Change and Forestry (LUCF) sector has the largest mitigation potential because of highly ambitious reforestation and forest restoration in Ethiopia's updated NDC. At the same time, LUCF is the second most important driver of Ethiopia's GHG emissions under BAU assumptions. So, trainees have practiced the changes in emission reduction using this mitigation options. They put reforestation target of **3 million ha** in mitigation option in the Step 7 and discuss the emission reduction potential (ktCO$_2$e/year). The participants have also used a 100% penetration of CFL bulbs in the residential sector of Ethiopia by 2030. They have used Assumption of 5 light bulbs per household and population in Ethiopia 120.3 million households, and they determined the emission reduction in kt/year.

Day 3 of the training focused on the results and track progress exercises. The exercise was based on an assumption of 1 million efficient woodstoves was implemented in 2025, the trainer inserted this mitigation action in the tracking progress sheets and asked the participants to find out in the GACMO tool the accumulated GHG emission reduction and the percent (%) progress compared to 2030 target. The participants were asked to use Ethiopian targets of 2025, 2030, 2035 and 2050 on the penetration rate of efficient wood stove, LPG stoves, Reforestation and Electric cars mitigation options in GACMO tool. And, they were asked the percent (%) of reduction of the mitigation scenario compared to the BAU scenario in in 2025, 2035 and 2050. In the result sheet, all participants were asked to see the % increase in BAU scenario in 2030 compared to 2020, and % increase/decrease in the mitigation scenario in 2030 compared to 2020. And they compared the result with target of the NDC update. Finaly, the trainees were asked to produce a fully Ethiopian contextualized GACMO tools-based tracking tool for their NDC Update mitigation actions implementations. The training was completed by presentation from the participants on the way forward of applying GACMO tool version 2 to track the Ethiopia's progress in implementing its updated NDC and all sectors will be looking at the update of the tools to apply for their specific sector mitigations options. The details of the training were summarised in the Table 3 (Annex 1).

Appendix 1 - Training time table

Table 3 GACMO tool Training delivery schedules (18th – 20th, December 2023)

Time schedule	Specific Activities	Facilitator / others
	Day 1, December 18th 2023	
09.45-10.00	Welcoming remarks	
10.00-10.30	NDC Update & Climate Change Mitigation Actions	Benti Firdessa, FDRE EPA
10:30 – 10:45	*Health break*	
10:45-11:45	Introduction to the GACMO methodology: Review of GACMO spreadsheets.	UNEP-CCC Aiymgul Kerimray
11.45-12.30	Homework. Presentation of collected data for Ethiopia by participants. Discussion of the data availability and main data challenges.	All participants
12:30 – 13:30	**Lunch break**	
13:30 – 15:00	Start Year Data: Energy Balance, GHG Inventory	All participants
15:00 – 15:15	*Health break*	
15.15-16.30	Energy prices, emission factors, GWP, growth rates in the GACMO for Ethiopia. Presentation of obtained results by participants	All participants
16:30 – 17:00	Q&A session Conclusions for the Day 1	All participants Aiymgul Kerimray
	Day 2, December 19th 2023	
09.00-10.00	Presentation. Mitigation options and technology sheets. How to develop mitigation scenario in GACMO.	UNEP-CCC Aiymgul Kerimray
10.00-10.30	Applied exercises on adding mitigation options in GACMO	All participants
10.30-10.45	*Health break*	
10.45-12.30	Applied exercises on adjusting technology sheets in GACMO	All participants
12:30-13.30	*Lunch break*	
13.30-14.30	Formulating the list of mitigation options for Ethiopia: unconditional and conditional scenario	All participants
14.30-15.00	Presentation on the use of GACMO in other countries	Aiymgul Kerimray
15:00 – 15:15	*Health break*	
15.15-16.30	Applied exercises on analysis of GACMO results: creating MAR curve, interpreting GHG emissions projections	All participants
16:30 – 17:00	Q&A session Conclusions for the Day 2	All participants Aiymgul Kerimray
	Day 3, December 20th 2023	

Time schedule	Specific Activities	Facilitator / others
09.00-10.00	Use of GACMO for Biennial Transparency report (filling in CTF tables for NDC tracking with the results of GACMO).	UNEP-CCC Aiymgul Kerimray
10.00-10.30	Applied exercises on "Tracking progress" sheet	All participants
10.30-10.45	*Health break*	
10.45-11.30	Applied exercises on "Tracking progress" sheet	All participants
11.30-12.15	Next steps to develop GACMO model for Ethiopia	All participants
12.15-12.30	Evaluation of the Model training & instructing participants to complete the model filling to the context of Ethiopian NDC Update tracking	Aiymgul Kerimray All participants
12:30-13.30	*Lunch break*	
13.30-14.30	Completing the list of mitigation options in GACMO for Ethiopia: Review outputs, analyse the result and compare with the emission reduction that was set in the NDC Update	All participants
14.30-15.00	Presentation of the Ethiopian contextualized GACMO model as a tracking for the country NDC Update planning tool.	All participants
15.15-16.30	Closing remarks / taking the way forward & finishing administration works for the trainees, hotels and other	Federal Environmental Protection authority and Global Environmental Solution-Ethiopia